Current Studies in Social Sciences 2024

EDITORS

S.Ahmet KIRAY
Osman ÇARDAK

ISRES Publishing

Current Studies in Social Sciences 2024

EDITORS

S.Ahmet KIRAY
Osman ÇARDAK

Current Studies in Social Sciences 2024

Editors

S.Ahmet KIRAY
Osman ÇARDAK

Cover Design and Layout

Fatih YAYLA

This book was typeset in 10/12 pt. Times New Roman, Italic, Bold and Bold Italic.

Current Studies in Social Sciences 2024

Published by ISRES Publishing, International Society for Research in Education and Science (ISRES)

Includes bibliographical references and index.

ISBN

978-625-6959-58-3

Date of Issue

October / 2024

Address

Askan Mah. Akinbey Sok. No:5/A Meram/Konya/Türkiye

E-mail

isrespublishing@gmail.com

www.isres.org

Current Studies in Social Sciences 2024

Foreword

Published in 2024, Current Studies in Social Sciences aims to shed light on contemporary approaches and interdisciplinary studies across various fields of social sciences, fostering new discussions in the academic world. The book covers a wide range of topics, including educational technologies, entrepreneurship education, sustainability, challenges faced by preservice teachers, educational theories, and applications in language and literature.

Each section offers significant contributions to its respective field. The first section, which explores the role of virtual reality and artificial intelligence in the transformation of educational practices, provides an in-depth discussion on the future of modern pedagogy. The second section highlights innovative teaching behaviors and pedagogical entrepreneurship approaches, emphasizing the creative roles of teachers in education.

The third section delves into the concept of sustainability in education, presenting detailed discussions on green school practices and environmental ethics. The fourth section focuses on the challenges and expectations of preservice teachers, offering valuable insights into their professional development. The fifth section draws a comprehensive framework for the theoretical foundations of education, discussing curriculum design and development. Finally, the sixth section offers diverse perspectives on literary and linguistic studies, including active learning methods in language teaching and archetypes in classical Turkish literature.

We extend our gratitude to the esteemed authors, editors, and all contributing academics who have made this publication possible. We believe this work will serve as a valuable resource for researchers in social sciences and as an essential reference for students, academics, and policymakers alike.

We hope that readers find this comprehensive collection both enjoyable and insightful.

Editors

Prof. Dr. S.Ahmet KIRAY

Necmettin Erbakan University, Türkiye

akiray@erbakan.edu.tr

Prof.Dr. Osman ÇARDAK

Necmettin Erbakan University, Türkiye

ocardak@erbakan.edu.tr

Table of Content

Section 6. Language and Literature

Section I:

Educational Technology

The Use of Virtual Reality in Biology Education

Sultan ÇIKRIK

Gazi University

Musa DİKMENLİ

Necmettin Erbakan University

Introduction

In the modern era, educational technology advancements have significantly transformed how knowledge is delivered and acquired. Digital learning tools, which utilize technology to create interactive and engaging experiences, have become increasingly prevalent across all levels of education. Among these tools, simulation-based learning has emerged as a powerful approach, enabling students to engage with realistic scenarios in controlled environments. Simulations allow exploring complex scientific processes, historical reconstructions, or intricate systems that might otherwise be inaccessible. One of the most promising emerging technologies in this context is virtual reality. Virtual reality combines the strengths of simulations with the interactivity of digital learning tools, offering learners an immersive and lifelike experience. In fields requiring deeper engagement, such as biology education, virtual reality stands out for its ability to facilitate understanding of abstract concepts and complex systems. By allowing students to explore microscopic worlds, interact with biological processes, and realistically visualize ecosystems, virtual reality can revolutionize traditional teaching methods and create more dynamic and impactful learning experiences.

Computer technology has become an integral part of nearly every aspect of life. Advances in science and technology have elevated the importance of information, paving the way for the emergence of the information society. In this context, humans have developed various methods for processing and presenting information via computers, introducing new concepts to the literature. One such concept is virtual reality, often described as a technology enabling the "reconstruction of reality" (Kayabaşı, 2005). Virtual reality is a computer-based technology that enables the creation of simulated environments. Unlike traditional user interfaces that provide only 1D or 2D experiences, virtual reality immerses individuals in a comprehensive 3D representation of the subject. Instead of merely viewing a screen, users can engage with and interact within 3D environments, making virtual reality a more engaging and intuitive technology for many applications (Bardi, 2019).

Virtual reality is a technology through which individuals can be immersed in an artificial environment, which may consist of either a completely imaginary universe or a reproduction of the real world. The experience is typically visual and auditory, with the possibility of incorporating haptic elements in certain applications (Elmqaddem, 2019). Virtual reality software represents one of the most advanced forms of computer-based animation and modeling technologies and is widely recognized as a system applicable for educational purposes. It provides a dynamic digital environment that enables the transfer of three-dimensional models to a computer platform, allowing users to interact with these environments. Typically, users integrate into the virtual environment through specialized equipment, such as electronic gloves, screen-equipped glasses, and wearable devices. These tools continuously relay information to the computer program, including the user's head orientation and hand movements, facilitating a seamless interaction between the user and the virtual space. Moreover, users can manipulate objects within the virtual environment using

devices like joysticks or mice, mimicking interactions found in physical reality. This technology offers diverse experiences, such as driving a race car, skiing, piloting a jet, exploring satellites, or sailing on the ocean, all within a virtual setting (Akpınar, 1999).

The Historical Development of Virtual Reality

Virtual reality has its roots in the mid-20th century, evolving from early attempts to create immersive and interactive experiences using technology. The journey of virtual reality development can be traced through several key milestones that have shaped its growth and applications. The initial ideas of creating simulated environments began with Morton Heilig's Sensorama in the 1950s, a machine designed to provide a multi-sensory cinematic experience. It combined visuals, sound, smell, and vibration, laying the groundwork for immersion in an artificial environment. In the 1960s, Ivan Sutherland introduced the "Sword of Damocles," the first head-mounted display (HMD) system. Although primitive by today's standards, it marked a significant step towards developing modern VR headsets. Daniel Vickers developed the first virtual reality headset in the 1970s at the University of Utah. This device featured two screens, enabling users to observe and interact with a virtual scene by simply turning their heads. A few years later, in 1982, the development of a new interface, the DataGlove, marked a significant advancement in VR technology. The DataGlove was designed to measure hand and finger movements, transmitting this information to the computer and enhancing user interaction within virtual environments. The 1980s and 1990s witnessed the commercialization of VR technologies. Jaron Lanier, often regarded as the pioneer of virtual reality, coined the term "virtual reality" in the 1980s and founded VPL Research, one of the first companies to produce VR equipment, including gloves and headsets. During this time, virtual reality was primarily used in specialized fields such as aviation, military training, and medical simulations, as these applications benefited from immersive training environments. With advancements in computing power and graphical processing in the 2000s, virtual reality technology began to reach broader audiences. Companies like Oculus (acquired by Facebook) and HTC introduced consumer-grade virtual reality headsets in the 2010s, such as the Oculus Rift and HTC Vive, making virtual reality more accessible for gaming, education, and other industries. Innovations in motion tracking, wireless connectivity, and high-resolution displays further supported these developments. In recent years, virtual reality has expanded beyond entertainment and training to include applications in education, healthcare, architecture, and scientific research. With the integration of artificial intelligence (AI) and augmented reality (AR), virtual reality continues to evolve, offering increasingly sophisticated and interactive experiences. The historical development of virtual reality demonstrates a trajectory of innovation driven by the desire to replicate and enhance real-world experiences in digital environments. As technology advances, its potential applications across diverse fields remain a promising area for exploration and growth (Fuchs, 2006; Bown, White, & Boopalan, 2017; VRS, 2020; Akinola, Agbonifo, & Sarumi, 2020).

Virtual Reality Devices and Tools

The effective use of virtual reality technology relies on a combination of advanced hardware and software components. These tools work together to create immersive and interactive experiences that enhance the user's engagement with the virtual environment. Hardware components, such as headsets, motion sensors, and haptic devices, provide the physical infrastructure necessary for virtual reality interaction, while software elements, including virtual reality platforms, simulations, and 3D modeling tools, ensure the functionality and adaptability of the virtual space. Understanding the roles of hardware and software is essential for comprehending the full potential of virtual reality in various fields, including education, healthcare, and entertainment.

The following sections provide an overview of the key hardware devices and software tools that enable the effective use of virtual reality technology (Onyesolu & Eze, 2011; Onyesolu, Ezeani & Okonkwo, 2012; Brown & Green, 2016; Ballo, 2018).

Hardware

- **VR Headsets:** These are the primary devices for virtual reality experiences, allowing users to see and interact with the virtual world (e.g., Oculus Rift, HTC Vive, PlayStation VR).
- **Control Devices:** Tools such as joysticks, gloves, controllers, or motion detection devices enable users to interact with the virtual environment.
- **Sensors and Cameras:** Devices that track and translate user movements into the VR environment.
- **Haptic Feedback Devices:** Equipment such as gloves, jackets, or other tools that provide tactile feedback to users.
- **Computers or Console Systems:** High-performance computers or gaming consoles are required to operate VR devices effectively.

Software

- **VR Platforms and Applications:** Software, games, or educational programs that manage the VR experience.
- **Simulation and Modeling Software:** Specialized VR applications for educational, scientific, or industrial purposes.
- **Virtual Environment Creation Tools:** 3D modeling software or tools to design virtual scenes and environments.

Engaging with virtual reality is made possible through specialized equipment, primarily a virtual reality headset. These headsets typically feature a stereoscopic 3D display system positioned in front of the user's eyes. Some advanced models are equipped with sensors capable of detecting head movements, enabling head tracking. This functionality allows users to look around within the virtual environment. The visuals are recalculated in real time to align with the direction of the user's head or gaze, ensuring a seamless and immersive experience (Elmqaddem, 2019).

The Role and Impact of Virtual Reality in Enhancing the Learning Process

Virtual reality technologies, increasingly utilized in education, provide novel learning experiences and continuously evolve through updated versions (Bülbül & Ersöz, 2022). Virtual reality has the potential to enhance, motivate, and stimulate students' understanding of specific concepts and phenomena. It is particularly beneficial for addressing topics and conducting challenging or impractical experiments to implement in traditional instructional settings. By enabling hands-on activities and fostering individualized learning experiences within a virtual environment, virtual reality offers a valuable tool for comprehending abstract scientific concepts that might otherwise remain difficult to grasp (Shim et al., 2003).

Virtual reality has been demonstrated to be an effective tool for teaching, particularly in disciplines such as Science, Technology, Engineering, and Mathematics (STEM). These fields often require higher levels of learner engagement, which VR facilitates through immersive, whole-body interactions integrated with environmental components for experiments. This approach can potentially enhance students' interactions with the subject matter and improve their conceptual understanding (Alrababah & Shorman, 2021).

The main features of virtual reality technology used in education can be defined as follows (Nikolou et al., 1997; Camp et al., 1998; Çavaş, Çavaş & Can, 2004):

- **Interactivity:** Virtual reality provides an interaction-oriented learning experience by allowing users to actively engage in the learning process.
- **Scale:** Virtual reality enables users to modify their physical dimensions, facilitating exploration and interaction within macro and micro worlds. This allows students to access learning opportunities that would otherwise be impossible, even with tools like a real microscope. For instance, virtual environments can simulate shrinking down to the size of a cell organelle, enabling detailed exploration within its structure. This feature aids in concretizing abstract biological concepts and deepening the learning experience.
- **Focusing Attention**: Virtual reality helps students fully concentrate on learning, enhancing their focus and increasing motivation.
- **Narrative Flexibility:** Virtual reality enables the flexible presentation of instructional content across different contexts and scenarios, adapting to diverse educational needs.
- **Experiential Learning:** Virtual reality allows students to experience abstract concepts tangibly, allowing them to learn by doing and experiencing.
- **Appealing to the Senses:** By engaging multiple senses, such as sight, hearing, and touch, virtual reality enriches the learning process, making it more multidimensional and immersive.

Strengths and Limitations of Virtual Reality Use in Education

Virtual reality offers several advantages over traditional learning techniques. With the increasing prevalence of computers in education, students' growing familiarity with technology has facilitated the development and adoption of more virtual reality-based learning tools. Research suggests that students often exhibit positive attitudes toward learning with virtual reality, particularly regarding enjoyment, realism, and the ease of understanding complex biological concepts. Through virtual reality, students can navigate and interact within virtual environments, manipulating learning objects to understand the subject matter better. Additionally, the immersive nature of virtual reality experiences can potentially enhance students' motivation and engagement in the learning process (Salis & Pantelidis, 1997).

Virtual reality enhances motivation, presents concepts more realistically, and provides opportunities for individuals with disabilities- who may not have previously had access to experimental and learning environments- to participate in these settings actively. It also allows students to learn at their own pace, facilitating a more effective learning process. Additionally, virtual reality offers students a broader time frame for learning than the constrained durations typically available in traditional classroom environments. By requiring mutual interaction, it engages students actively, fosters creativity, and supports the development of digital skills (Çavaş, Çavaş & Can, 2004).

While virtual reality systems offer significant advantages in learning environments, they also have limitations. One such limitation is the need to pre-program the desired knowledge into the system before it can be utilized effectively. Additionally, using VR may influence students' attitudes negatively, potentially leading to a lack of seriousness, responsibility, or attention to detail. Moreover, at the advanced stages of training, there remains a necessity for hands-on experience with actual equipment to ensure that learners gain practical skills and familiarity with real-world applications (Pearson & Kudzai, 2015; Potkonjak et al., 2016).

The Use of Virtual Reality in Biology Education

Most biological structures and phenomena are highly interrelated and inherently complex. Due to their abstract nature, many biological concepts present significant challenges for teaching and learning (Eidson & Simmons, 1998; Barack et al., 1999; Buclley, 2000). Humans perceive reality through their senses, which process diverse information from their surroundings (Amory et al., 1999). Consequently, visualization plays a crucial role in teaching and learning. Approximately fifty percent of the human nervous system is involved in vision, and visualization techniques aim to optimize this capacity (Pang, 1995). While the human senses are powerful tools for perceiving the environment, they are also inherently limited. For instance, the human eye has a restricted range of vision and cannot detect all sound waves. Similarly, the ability to perceive and comprehend scientific phenomena at the atomic or molecular level is constrained (Karr & Brady, 2000).

Although the implications of virtual reality in biology have been explored in a limited number of studies, a comprehensive understanding of its potential applications is yet to be fully developed. As a discipline, biology heavily relies on experimentation as a cornerstone of effective learning. However, understanding complex concepts and processes often presents challenges when relying solely on traditional educational methods. Integrating virtual reality into biology education offers a promising solution by simulating realistic environments, which enhance immersion and interaction, ultimately facilitating a deeper understanding of biological phenomena (Alrababah & Shorman, 2021). To further demonstrate the potential of virtual reality in biology education, the following examples illustrate how this technology can be effectively applied to enhance the teaching and learning of diverse biological concepts.

Virtual Cell: The cell is a complex, multidimensional environment where time and location are critical factors in determining when and where cellular events occur. Capturing this multidimensional environment on a two-dimensional printed page, a blackboard, or a web page is highly challenging. Virtual Cell is a project NDSU (North Dakota State University) developed. It provides a three-dimensional environment where students can learn about the functions and structures of a cell. The Virtual Cell includes subcellular components such as the nucleus, endoplasmic reticulum, Golgi apparatus, mitochondria, chloroplasts, and vacuoles (McClean, Slator & White, 1999).

Virtual Biology Laboratories: Virtual laboratories include a variety of objects such as microscopes, centrifuges, whole organisms, or single cells, along with pre-programmed specific actions. Students interact with these objects to achieve specific objectives, such as examining the properties of cells, separating cellular components, or measuring enzyme activities. Using creative representations of these objects and their behaviors allows students to engage in limitless experimentation within the virtual world (Subramanian & Marsic, 2001).

Virtual Molecular Biology Teaching: Teaching molecular biology, particularly at the secondary school level, faces significant challenges due to student disengagement and inadequate resources. This often results in confusion and frustration among students. Visualization plays a critical role in learning molecular biology; however, traditional classroom tools like diagrams and models fall short of representing the complexity of cellular and molecular dynamics as described in modern biology curricula. In this context, virtual reality technologies offer the ability to visualize DNA, proteins, and cellular structures in three-dimensional space, making it easier for students to grasp these concepts. An experimental study demonstrated that such virtual visualization activities significantly improved molecular biology achievement, particularly among male students. Focus group interviews revealed that these technologies reduced reliance on rote memorization, clarified complex concepts, and increased student interest and engagement. In conclusion, the findings of this study recommend integrating technology-supported learning environments into the teaching of molecular biology (Tan & Waugh, 2013).

Three-dimensional animated models based on virtual reality have various applications, including representations of the human eye and ear, cell membranes, peptide models, and actin-myosin structures (Amon & Valencic, 2000; Rourk, 2000). At the University of Chicago, Karr and Brady (2000) designed a fertilized Drosophila egg for university students and used virtual reality to present the behavior of a single sperm within a Drosophila egg. Shim et al. (2003) designed an environment based on three-dimensional virtual reality technology to teach the structure and functions of the eye. In the study, primary school students explored the structure and functions of the eye within the virtual environment. The results showed that students' interest in the subject increased, and they could better understand scientific concepts and phenomena.

In their study, Mikropoulos et al. (2003) designed a virtual environment based on plant cells and photosynthesis and made it available for experienced in-service teachers. In this virtual plant cell, users begin by navigating through the plant tissue outside the cell. Within the cell, intracellular structures are visible, and users can freely explore, observe, and study how the organelles are organized in the three-dimensional space of the cell and how they work together for the cell to function. The organelles' functions and adaptations to environmental changes can also be studied. In a study conducted with 37 teachers, the researchers examined teachers' attitudes toward the virtual environment and its impact on learning. According to the results of this study, 81% of the teachers believe that virtual reality is a valuable and effective learning tool in biology, and virtual reality provides an engaging, motivating, creative, and safe learning environment.

In a study, researchers investigated secondary school students' experiences using a mobile virtual reality application to explore the environmental impact of large-scale developments on nature reserves. The study involved 64 students from southeast England who participated in a geography field trip to their local nature reserve. During the trip, students used Google Expeditions (GEs), a smartphone-based VR application, to compare the physical field trip location with its virtual reality version. Google Expeditions provides over 700 guided virtual field trips, including locations such as the Queen Elizabeth Olympic Park, the Grand Canyon, and Antarctica, using 360-degree photospheres. Through VR and the GE app, students gained awareness of environmental issues caused by large-scale developments, acquired knowledge about their impact on ecosystems, and proposed actions for environmental protection. Following the field trip, students wrote letters to the Chiltern Society, a voluntary organization dedicated to preserving the Chilterns' landscape, discussing the implications of large-scale development plans near their local nature reserve (Tudor et al., 2018).

Bennett & Saunders (2019) assessed the educational impact of virtual reality on student learning and engagement in a sophomore-level cell biology course at Otterbein University. The study involved three stages: first, students explored the cell and its environment within the human body using virtual reality; second, they participated in a team-based activity to match images of cell components from the virtual reality application with their corresponding names; and finally, they completed a voluntary survey to provide feedback on the virtual reality experience and the related activity. Survey results showed that most students enjoyed the virtual reality experience and felt it positively influenced their education. The findings suggest that VR can be supportive in enhancing learning across various undergraduate courses.

In their research, Arslan, Kofoğlu, and Dargut (2020) examined techniques to improve learning performance in fields such as biology, anatomy, physiology, and experimental animals and analyzed the process of developing a specific mobile application using the Unity3D platform. The study focused on using virtual and augmented reality applications to enable students to practice in realistic conditions and gain knowledge and skills relevant to their professional fields. The study results suggest that disseminating virtual laboratories and augmented reality applications developed through needs analysis, lesson or course content design, and scenario writing can help overcome challenges in providing materials for students and address ethical debates surrounding

using experimental animals.

Conclusion

Today, societal development is often linked to advancements in science and technology, with education as the cornerstone of this progress. Innovations in educational technologies profoundly impact learning processes, reshaping traditional approaches to teaching and learning. While virtual reality technology has not yet been widely adopted within education systems, it allows individuals to engage in artificially created environments that simulate real experiences. This capability enables students to benefit significantly from immersive and interactive learning experiences. Research indicates that virtual reality technology enhances students' learning processes by fostering interaction with virtual environments, maximizing learning effectiveness. As a technology poised to become a fundamental component of educational environments in the future, virtual reality holds the potential to be effectively utilized across various fields of education and training. In these virtually constructed settings, students can actively engage in their learning processes through hands-on, experiential activities.

Integrating virtual reality into biology education can significantly enhance student engagement and understanding. While there are some logistical and financial challenges, the positive feedback from students indicates a bright future for virtual reality in education as long as these obstacles are managed effectively (Toman & Hubálovská, 2024).

Recommendations

For virtual reality to be more widely utilized in education, developing content that aligns with the biology curriculum and fulfills pedagogical objectives is essential. Collaboration between teachers and subject matter experts is crucial in this process. Encouraging the development of virtual reality applications tailored to biology topics is particularly important. For instance, applications that allow detailed exploration of cell structures, recreate natural ecosystems in digital environments, or provide an in-depth examination of human anatomy can aid students in concretizing abstract concepts. Additionally, virtual reality can enable students to interactively and visually study genetic processes, such as DNA replication or protein synthesis. It can also simulate the behavior of microscopic organisms, such as bacteria and viruses, under various conditions, providing insight into microbiology concepts. Students could virtually experience processes like photosynthesis, respiration, or nutrient cycles in plants, enhancing their understanding of these essential biological mechanisms. Furthermore, VR can facilitate the exploration of evolutionary processes by simulating the progression of species over time or illustrating how environmental changes affect biodiversity. Transferring laboratory experiments to virtual reality environments-especially simulations of costly or hazardous experiments-can provide students with valuable hands-on experiences in a safe and risk-free setting.

To ensure the effective use of virtual reality in education, in-service training programs should be implemented, incorporating practical, hands-on activities to enhance teacher competency. One significant barrier to the widespread adoption of this technology is the high cost of virtual reality tools and equipment. To address this issue, more accessible and cost-effective solutions need to be developed. Additionally, further scientific research is essential to evaluate the impact of virtual reality on teaching and learning processes. Such studies will provide valuable insights into the effectiveness and limitations of virtual reality, guiding its integration into educational practices.

References

Akinola, Y. M., Agbonifo, O. C., & Sarumi, O. A. (2020). Virtual reality as a tool for learning: The past, present and the prospect. *Journal of Applied Learning and Teaching*, *3*(2), 51-58.

Akpınar, Y. (1999). *Bilgisayar destekli öğretim ve uygulamalar*. Anı Yayıncılık.

Alrababah, Z., & Shorman, S. (2021). Review of effects of the virtual reality in education. In *The big data-driven digital economy: Artificial and computational intelligence* (pp. 445-459). Springer International Publishing.

Amon, T., & Valencic, V. (2000). VRML: Enhanced learning in biology and medicine. Future *Generation Computer Systems*, *17*:1-6.

Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of computer games as an educational tool: ıdentification of appropriate game types and game elements. *British Journal of Educational Technology*, *30*: 311-321.

Arslan, R., Kofoğlu, M., & Dargut, C. (2020). Development of augmented reality application for biology education. *Journal of Turkish Science Education*, *17*(1), 62-72.

Ballo, P. (2018). Hardware and software for ar/vr development. *Augmented and virtual reality in libraries*, 45-55.

Barack, J., Sheva, B., & Gorodetsky, M. (1999). As 'process' as ıt can get: students' understanding of biological processes. *International Journal of Science Education*, *21*: 1281-1292.

Bardi, J. (2019). Virtual reality defined & use cases | 3D Cloud by Marxent. 3D Cloud by Marxent. Retrieved May 17, 2023, from https://www.marxentlabs.com/what-is-virtual-reality/

Bennett, J. A., & Saunders, C. P. (2019). A virtual tour of the cell: Impact of virtual reality on student learning and engagement in the STEM classroom. *Journal of microbiology & biology education*, *20*(2), 10-1128.

Bown, J., White, E., & Boopalan, A. (2017). Looking for the ultimate display: A brief history of virtual reality. In *Boundaries of self and reality online (pp. 239-259). Academic Press.*

Brown, A., & Green, T. (2016). Virtual reality: Low-cost tools and resources for the classroom. *TechTrends*, *60*, 517-519.

Bucldey, B. C. (2000). Interactive multimedia and model-based learning in biology. *International Journal of Science Education*, *22*: 895-935.

Bülbül, H., & Ersöz, B. (2022). Eğitimde yapay zekâ sanal gerçeklik ve sanal evren (Metaverse). Yapay zekâ ve büyük veri kitap serisi (4. Baskı, s. 149-183) içinde. Nobel Akademik Yayıncılık.

Camp, J. J., Cameron, B. M., Blezek, D., & Robb, R. A. (1998). Virtual reality in medicine and biology. *Future Generation Computer Systems*, *14*(1-2), 91-108.

Çavaş, B., Çavaş, P. H., & Can, B. T. (2004). Egitimde sanal gerceklik. *TOJET: The Turkish Online Journal of Educational Technology*, *3*(4), 110-116.

Eidson, S., & Simmons, P. E. (1998). Microcomputer simulation graphic and alphanumeric modes: examining students' process skills and conceptual understanding. *The Journal of Computers in Mathematics and Science Teaching*, *17*: 21-61.

Elmqaddem, N. (2019). Augmented reality and virtual reality in education. Myth or reality?. *International journal of emerging technologies in learning*, *14*(3), 234-242.

Fuchs, P. (2006). *Le traité de la réalité virtuelle (Vol. 2). Presses des MINES.*

Kayabaşı, Y. (2005). Sanal gerceklik ve egitim amacli kullanilmasi. *TOJET: The Turkish Online Journal of Educational Technology*, *4*(3), 151-158.

Karr, T. L., & Brady, R. (2000). Virtual biology in the CAVE. *Trends in Genetics*, *16*(5), 231-232.

McClean, P. E., Slator, B. M., & White, A. R. (1999). The virtual cell: An interactive, virtual environment for cell biology. In *EdMedia+ Innovate Learning* (pp. 1442-1443). Association for the Advancement of Computing in Education (AACE).

Mikropoulos, T. A., Katsikis, A., Nikolou, E., & Tsakalis, P. (2003). Virtual environments in biology teaching. *Journal of Biological Education*, *37*(4), 176-181.

Nikolou, E., Mikropoulos, T. A., & Katsikis, A. (1997). Virtual realities in biology teaching. M. Bevan (éd.), *Proceedings VRET, 97*, 59-63.

Onyesolu, M. O., & Eze, F. U. (2011). Understanding virtual reality technology: advances and applications. *Adv. Comput. Sci. Eng*, *1*, 53-70.

Onyesolu, M. O., Ezeani, I., & Okonkwo, O. R. (2012). A survey of some virtual reality tools and resources. *Virtual reality and environments*, *21*, 22-42.

Pang, A. (1995). A Syllabus for Scientific Visualisation. *Scientific Visualisation in Mathematics and Science Teaching*, 261-283.

Pearson, C., & Kudzai, C. (2015). Virtual laboratories a solution for tertiary science education in Botswana. *European Journal of Logistics, Purchasing and Supply Chain Management*, *3*(3), 12-24.

Potkonjak, V., Gardner, M., Callaghan, V., Mattila, P., Guetl, C., Petrović, V. M., & Jovanović, K. (2016). Virtual laboratories for education in science, technology, and engineering: A review. *Computers & Education*, *95*, 309-327.

Rourk, W. (2000). Virtual biochemistry-a case study. *Future Generation Computer Systems*, *17*(1), 7-14.

Salis, C., & Pantelidis, V. S. (1997). Designing virtual environments for instruction: concepts and considerations. *VR in the Schools*, *2*(4), 1-8.

Shim, K. C., Park, J. S., Kim, H. S., Kim, J. H., Park, Y. C., & Ryu, H. I. (2003). Application of virtual reality technology in biology education. *Journal of Biological Education*, *37*(2), 71-74.

Subramanian, R., & Marsic, I. (2001). VIBE: Virtual biology experiments. In *Proceedings of the 10th International Conference on World Wide Web (pp. 316-325).*

Tan, S., & Waugh, R. (2013). Use of virtual-reality in teaching and learning molecular biology. *3D immersive and interactive learning*, 17-43.

Toman, M., & Hubálovská, M. (2024). Review Study "Virtual Reality in Biology Education". In *International Conference on Technology in Education* (pp. 235-245). Singapore: Springer Nature Singapore.

Tudor, A. D., Minocha, S., Collins, M., & Tilling, S. (2018). Mobile virtual reality for environmental

education. *Journal of Virtual Studies*, *9*(2), 25-36.

Virtual Reality Society (VRS). (2020). History of virtual reality. https://www.vrs.org.uk/virtual-reality/history.html.

About the Authors

Assist. Prof. Dr. Sultan ÇIKRIK completed her undergraduate education in 2005 at Selçuk University, Faculty of Education, in the Secondary Science and Mathematics Education program. She earned his master's degree in 2008 from the Institute of Science at Selçuk University and her doctorate in 2015 from the Institute of Education at Gazi University. She currently serves as an Assistant Professor in the Department of Biology Education under the Mathematics and Science Education Division at Gazi University, Gazi Faculty of Education. Her scientific work focuses on innovative approaches in biology education, education in natural sciences, and teacher training. She has participated in various projects, including "Erasmus+ 2023 School Education Accreditation Environmental Project: Biodiversity Awareness Education," "A Comparative Study on Biology Teacher Candidates' Views on Out-of-School Learning Environments," "TÜBİTAK 4004 Climate Change Awareness School."

E-mail: sultanaltunsoy@gazi.edu.tr, **ORCID:** 0000-0002-6821-7922.

Prof. Dr. Musa DİKMENLİ completed his undergraduate education in 1991 at Selçuk University, Faculty of Education, in the Secondary Science and Mathematics Education program. He earned his master's degree in 1996 from the Institute of Science at Selçuk University and his doctorate in 2000 from the same institute. He currently serves as a Professor in the Department of Biology Education under the Mathematics and Science Education Division at Necmettin Erbakan University, Ahmet Keleşoğlu Faculty of Education. His scientific work focuses on innovative approaches in biology education, education in natural sciences, and teacher training. Prof. Dr. Musa DİKMENLİ has numerous research articles, conference papers, and books on biology education. He has also worked in the fields of nature observation and nature photography.

E-mail: mdikmenli@erbakan.edu.tr, **ORCID:** 0000-0001-6501-9034.

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 8%.

To Cite This Chapter:

Çıkrık, S., & Dikmenli, M. (2024). The use of virtual reality in biology education. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp.1-10). ISRES Publishing.

Artificial Intelligence and Intelligent Software in Science Education

Buket GEVİŞ-FARHADZADA

Akdeniz University

Fatih Serdar YILDIRIM

Akdeniz University

What is Artificial Intelligence?

Artificial intelligence (AI) is a field of technology designed to enable computers or machines to think, learn, and solve problems like humans, and AI focuses on the development of systems that mimic cognitive processes and perform skills typical of human intelligence (e.g. decision making, learning, language comprehension, and visual perception) (Russell and Norvig, 2020). This discipline draws from many fields such as computer science, mathematics, psychology, linguistics and neuroscience (Nilsson, 1998).

Definition of Artificial Intelligence

Artificial intelligence is a science developed using software and algorithms to enable machines to exhibit "intelligence" like humans, and the main goal of AI is to create systems that mimic the problem-solving and learning capabilities of the human mind (McCarthy, 2007). For example, an AI system can learn from data and apply what it has learned to new situations (Goodfellow et al., 2016).

With the rapidly developing technology, individuals' orientation towards the tools and equipment supported by the technology encountered in their daily lives is progressing rapidly, and individuals have started to affect their communication with each other, behavior and access to information thanks to this rapidly advancing technology (Chiu, 2021). The concept of artificial intelligence, introduced by John McCarthy, was first mentioned at the Dartmouth Conference in 1956 (Alpaydın, 2013). Artificial intelligence (AI), an interdisciplinary field, aims to develop algorithms and computer systems that can fulfill cognitive capacities such as perception, problem solving, language understanding, human intelligence, learning and decision making (Russell & Norvig, 2021). In simpler terms, artificial intelligence, in which machines are the tools, is defined as an artificial computer system that consists of systems and mechanisms that consist of systems and mechanisms that consistently renew and improve the ways of thinking, decision-making competencies, working principles produced by individuals with the problems they face, and consist of cognitive functions such as "communication, idea and reasoning, comprehension, learning, problem solving, decision making, reconciling plural expressions with each other" or self-managing behaviors (UIB, 2017). Artificial intelligence is defined as the operation of machines as the product of human mind and the commands given to these systems (Zeide, 2019). If we talk about concepts related to artificial intelligence; algorithms, neural networks, language processing, data mining and machine learning (Baker & Smith, 2019). With the advancement of processes, artificial intelligence has a great share in the development of health systems, computer programming, control systems, voice and image recognition systems, decision making or robots (Hwang,, Xie, , Wah, & Gasevic, 2020). Artificial intelligence is intelligent programs that can produce answers not only to predetermined problems but also to an existing situation, helping to solve complex problems (Nabiyev, 2012). According to Nils Nilsson (1990), another leading figure in artificial intelligence, he defined artificial intelligence as a theory that aims to create imitations of natural intelligence.

Types of Artificial Intelligence

AI is generally categorized into three basic types. These are Narrow Artificial Intelligence (ANI), General Artificial Intelligence (AGI) and Super Artificial Intelligence (ASI).

- **Artificial Narrow Intelligence (ANI):** Refers to systems that specialize in a particular task. For example, voice assistants (Siri, Alexa) are in the narrow artificial intelligence category (Searle, 1980).
- **Artificial General Intelligence (AGI):** These are systems with a general intelligence at a similar level to humans, and research in this field is ongoing (Bostrom, 2014).
- **Artificial Super Intelligence (ASI):** Refers to systems that exceed human intelligence and this concept is more of a theoretical discussion area (Tegmark, 2017).

Key Areas of Artificial Intelligence Technologies

AI is enriched with different technologies, and these technologies can be divided into the following key areas:

- **Machine Learning (ML):** A subfield of AI that enables algorithms to learn using data. ML, combined with big data analytics, has been effective in solving complex problems (Mitchell, 1997).
- **Deep Learning (DL):** A subfield of machine learning, deep learning can work with neural networks to identify more complex data patterns (LeCun et al., 2015).
- **Natural Language Processing (NLP):** The development of AI systems that process text and speech data. For example, translation systems and chatbots use this technology (Jurafsky and Martin, 2021).
- **Computer Vision (CV):** It is a field for analyzing and recognizing visual information. Autonomous vehicles are an example of computer vision (Goodfellow et al., 2016).

How Artificial Intelligence Works?

AI systems work by processing data through algorithms and models. This process usually consists of the following stages:

1. **Data Collection:** Large data sets are needed for AI to learn. For example, the data used in the training of autonomous vehicles includes millions of hours of driving videos (Russell and Norvig, 2020).
2. **Model Training:** Algorithms are optimized for specific tasks by working on data. For example, a face recognition system learns from thousands of facial images (Goodfellow et al., 2016).
3. **Prediction and Decision Making:** Trained models make predictions on new data and use them to make decisions (Mitchell, 1997).

Usage Areas of Artificial Intelligence

AI is used in many sectors such as health, education, finance, transportation and agriculture.

- **Health:** AI is used to assist doctors in diagnosis and treatment recommendations (Esteva et al., 2017).

- **Education:** Adaptive learning systems offer personalized content based on students' individual learning pace (Woolf, 2010).
- **Finance:** AI-based algorithms are used in risk analysis and financial forecasting (Ng and Koller, 2015).
- **Transportation:** Autonomous vehicle technologies are one of the most remarkable applications of AI in the transportation sector (Levinson et al., 2011).

The Future of Artificial Intelligence

The future of AI needs to be considered alongside ethical issues and possible risks. For example, the replacement of labor by automation can lead to social and economic problems (Brynjolfsson & McAfee, 2014). However, the debate about the potential of AI to develop consciousness continues among scientists (Tegmark, 2017).

What are the Development Processes of Artificial Intelligence?

Artificial intelligence (AI) development processes have historically gone through several different phases. These processes have been shaped by technological advances, theoretical innovations and the expansion of application areas.

Initial Period: (1950s - 1960s)

The foundations of AI were laid in the mid-1950s with Alan Turing's proposal of the "Turing Test", which provided a theoretical framework on the ability of machines to think like humans and established the first theoretical foundation of AI (Turing, 1950). In the same period, the Dartmouth Conference held by John McCarthy in 1956 symbolized the birth of artificial intelligence and led to the official recognition of AI as a research field (McCarthy, 1956). Initially, AI research was based on logic and symbolic computation methods, which gave rise to the so-called "symbolic artificial intelligence" (Newell and Simon, 1972).

Early Practices and Progress: (1960s - 1970s)

The 1960s and 1970s were the years when the first applications of AI were developed. During this period, the first chatbots such as "ELIZA" were created and early steps were taken in the field of natural language processing (Weizenbaum, 1966). Also, the concept of expert systems emerged in this period and expert systems are computer programs that aim to mimic the decision-making processes of human experts in a given domain (Feigenbaum, 1983). However, the AI systems of this period lacked the ability to generalize and had limited success.

The Rise of Expert Systems: (1980s)

The 1980s marked a period in which AI found a greater place in commercial applications and expert systems became widely used in areas such as medicine, engineering and finance, with data-driven logic and rule-based systems playing an important role (Jackson, 1986). Also during this period, theoretical work on connected neural networks increased, but due to limited computational power, these technologies could not yet be applied efficiently (Rumelhart et al., 1986).

Machine Learning and Deep Learning: (1990s - 2000s)

In the late 1990s, AI research shifted to machine learning (ML) and deep learning (DL) approaches. During this period, AI systems became capable of learning from data. In particular, LeCun's work on deep neural networks made a big leap in this field (LeCun, 1998). Deep learning has played an important role in accomplishing previously difficult tasks (e.g. image recognition)

(Hinton et al., 2006). During this period, the use of large data sets and more powerful computational infrastructures accelerated the pace of development of AI (Bengio et al., 2007).

Big Data and High Performance Computing: (2010s)

The 2010s marked a period of massive development of AI integrated with big data and high-performance computing, and the advancement of deep learning techniques revolutionized areas such as image processing, voice recognition and natural language processing (Silver et al., 2016). During this period, systems such as Google's AlphaGo demonstrated that AI has reached a level that can surpass human intelligence (Silver et al., 2016). In these years, the ethical and societal implications of AI have also become more debated (Brynjolfsson & McAfee, 2014).

Autonomous Systems and Societal Impacts of AI: (2020s and Beyond)

Today, AI has a wide range of applications in autonomous vehicles, smart cities, healthcare, finance and manufacturing sectors, and AI accelerates and optimizes autonomous decision-making processes (Brynjolfsson & McAfee, 2014). However, with the proliferation of AI, societal issues such as ethics, security, and loss of labor force have also come to the fore, and issues such as ethical use of AI, transparency, fairness, and security have been intensively studied by researchers (Binns, 2018).

What is Artificial Intelligence in Education?

Artificial intelligence (AI) in education refers to the application of AI technologies to improve students' learning processes, increase teachers' productivity, and optimize overall education systems. AI in education covers a wide range of application areas such as personalizing learning processes, monitoring student performance with data analytics, automating teaching materials, and making education more accessible (Holmes et al., 2019).

Definition of Artificial Intelligence in Education

Artificial intelligence in education is an interdisciplinary field of study in which computer-based algorithms are used to support educational processes and these systems offer individual learning pathways by analyzing student behaviors and needs (Luckin et al., 2016). For example, adaptive learning systems personalize education by providing content according to each student's learning speed and level (VanLehn, 2011).

Adaptive learning systems and automated skills feedback are concrete reflections of the concept of individualization and continuous improvement in education, and these approaches ensure that students demonstrate knowledge at regular intervals, actively participate in the learning process and are supported until they reach mastery, and these innovative systems, with the opportunities offered by technology in education, provide students with a personalized and continuous feedback-oriented learning experience, both improving the quality of learning and strengthening equal opportunities in education (Beck, Stern & Haugsjaa, 1996).

While constructivist learning theory provides a framework for understanding the essence of human learning processes, modern artificial intelligence technologies reveal the potential to digitize and automate these processes, and these developments show how knowledge construction processes between human and machine can work together and bring new perspectives to education, knowledge management and innovation, but the human ability to create deep meaning based on experience, emotion and creative thinking remains distinct from artificial intelligence (Coiera, 2003).

Looking at the early periods of artificial intelligence (AI) applications in education, the contributions of Sidney L. Pressey, a psychologist and educator working at Ohio University in

the 1920s, mark an important turning point, and Pressey, in particular, worked on developing the concept of "automatic teaching", and although the concept of artificial intelligence was not considered in its current sense due to the lack of computer technologies in this period, the devices developed by Pressey were among the first attempts to promote individualized learning in education (Thorndike, 1927). Sidney L. Pressey's (1950) views on multiple-choice tests indicate that assessment and evaluation processes in education can be used not only to measure achievement but also as a tool to reinforce the learning process, and Pressey argued that tests functioning as a kind of "feedback" mechanism can increase the effectiveness of the learning process, and in this context, Pressey's ideas emphasize the use of tests not only to determine how much knowledge students have acquired, but also to help students correct their mistakes and reinforce correct knowledge (Thorndike, 1927). Today, these ideas led to the development of reinforcement and feedback systems that form the basis of modern educational technologies and artificial intelligence applications. Today's artificial intelligence-based educational software is a system that identifies students' correct answers and provides them with immediate feedback, and supports their learning by personalizing it, which is very similar to Pressey's "machine" concept. Pressey's ideas sowed the first seeds of modern adaptive learning platforms and intelligent instructional technologies (Holmes et al., 2019).

According to Sidney L. Pressey (1950), it was a vision that reshaped the role of technology in education and aimed to make educational processes more efficient, but today, the development of artificial intelligence and learning management systems allows teachers to be freed from time-consuming tasks such as test assessment and interact more with students, which improves the quality of the teaching process, relieves the burden of teachers and provides students with more personalized learning experiences. Pressey's early insights laid the foundation for modern applications of educational technologies and contributed to the development of an innovative governance approach in education (Pressey, 1950). Skinner was particularly noted for his "Pigeon Project" during World War II, which proved that pigeons could be trained to perform certain tasks and demonstrate high levels of accuracy in these tasks. Skinner shaped desired behaviors by rewarding pigeons with positive reinforcement (e.g., food rewards) when they performed certain behaviors, and the basis of this work was operant conditioning, meaning that the behaviors of organisms can be shaped by the consequences of those behaviors (Pressey, 1950). Skinner's teaching machines are the forerunners of modern educational technologies and artificial intelligence applications, and systems such as personalized learning and intelligent tutoring systems are based on an ever-evolving scientific foundation that aims to increase student achievement by supporting individual learning. Skinner's vision demonstrated to Skinner (1958) the importance of both behavioral learning theory and technological innovation in education.

Artificial Intelligence Technologies in Education

Artificial intelligence technologies used in education can be divided into the following main areas:

Adaptive Learning Systems

These systems are AI-based tools that dynamically adjust learning processes by analyzing students' individual needs. For example, ALEKS (Assessment and Learning in Knowledge Spaces) software measures students' knowledge level and provides them with customized math exercises (Falmagne et al., 2013).

Automated Evaluation Systems

AI-based automated assessment tools can quickly and consistently evaluate students' exams and written assignments. For example, a system called "Gradescope" can analyze exams of large groups of students in a short time and provide feedback (Shute, 2008).

Natural Language Processing (NLP) Applications

NLP technologies have been used to improve language learning and writing skills. For example, software such as Grammarly provides feedback on grammar and word choice in students' writing processes (Burstein et al., 2003).

Educational Chatbots

Chatbots are digital assistants that support the learning process by providing instant guidance to students. For example, Jill Watson is an artificial intelligence assistant used to answer students' questions at Georgia Tech University (Goel & Polepeddi, 2016).

Simulation and Virtual Reality

AI-enabled simulation systems support experiential learning, especially in science and engineering. For example, virtual laboratory software such as Labster allows students to conduct experiments without risk (De Jong et al., 2013).

Advantages of Artificial Intelligence in Education

- **Personalized Learning:** Artificial intelligence offers a more effective educational experience by tailoring each student's learning process to individual needs (Luckin et al., 2016).
- **Equity and Accessibility:** AI technologies enable more students to access quality education by reducing geographical or economic constraints (Holmes et al., 2019).
- **Increased Productivity:** It automates teachers' repetitive tasks, allowing them to focus on more creative and pedagogical activities (Shute, 2008).
- **Challenges and Ethical Issues of Artificial Intelligence in Education**
- **Data Privacy:** Collecting and analyzing student data raises privacy and data security issues (Holmes et al., 2019).
- **Inequality Risk:** The high cost of developing and implementing AI systems can lead to inequalities in low-income regions (Luckin et al., 2016).
- **Reduction of the Human Factor:** The overuse of AI can reduce the social and emotional interaction between students and teachers (Selwyn, 2019).

Future of Artificial Intelligence in Education

In the future, AI will be able to take on more complex teaching tasks and more accurately predict students' needs through learning analytics, and with this, the integration of AI into education requires the establishment of ethical guidelines and regulatory frameworks (Luckin et al., 2016).

What Are Artificial Intelligence Applications in Education?

Artificial intelligence (AI) technologies are increasingly taking place in education and transforming educational processes. The applications of AI in education serve a number of purposes such as increasing student achievement, making teaching processes more efficient and personalizing learning experiences.

Personalized Learning

AI can deliver customized educational content based on students' individual learning needs. Based on students' learning pace and preferred learning methods, AI-supported systems propose personalized lesson plans and materials. This approach contributes to the development of a student-centered learning model (VanLehn, 2011; Luckin et al., 2016). Moreover, AI-based applications can monitor student performance and provide additional support in weak areas (Siemens, 2013)

Automated Assessment and Feedback

AI can make student assessments faster and more accurate. Written exams, assignments and even open-ended questions can be automatically analyzed and evaluated by AI systems, saving teachers time. Moreover, such systems provide instant feedback to students, allowing them to correct their mistakes instantly (Baker & Inventado, 2014). This practice reduces the burden on teachers and accelerates the learning process of students.

Language Learning and Comprehension

AI plays an important role in language learning applications. By using natural language processing (NLP) techniques, learners can be provided with language corrections, pronunciation assistance, and the interpretation of written texts in real time. For example, apps can notify learners of language errors, enabling them to speak more accurately and fluently (Godwin-Jones, 2018). Moreover, language learning apps offer students personalized speaking and writing practice (Kukulska-Hulme, 2012).

Intelligence-Based Learning Aids

AI can be used in education in the form of virtual tutors or digital assistants. These tools fulfill the function of answering questions, providing learning materials and general guidance to students. Chatbots allow students to ask questions and get quick answers 24/7. This practice increases student interaction, especially in distance education (Woolf, 2010). Through virtual tutors, students can receive fast and effective feedback whenever they need it (García-Serrano et al., 2019).

Artificial Intelligence Supported Educational Materials

AI is also used in the production of educational content. Educational materials can be automatically shaped according to student needs. For example, teachers can create interactive and entertaining content for students with AI-enabled systems. AI also enables the creation of more engaging and interactive course materials, taking into account students' individual learning styles (Liu et al., 2017). Such materials increase student engagement and make the learning process more efficient.

Student Performance Monitoring and Early Warning Systems

By analyzing students' performance, AI can predict potential difficulties in their educational process. Early warning systems track students' academic achievement and allow for early intervention for underperforming students. Such systems help teachers and schools to provide timely support to students (Siemens, 2013). Moreover, by predicting students' achievement, these applications contribute to shaping educational policies more effectively (Baker & Inventado, 2014).

Gamification and Interactive Education

AI is also used in game-based learning (gamification) applications. While students learn interactively in game environments, AI-supported systems analyze their in-game performance and

suggest personalized learning paths. This increases students' motivation and makes the learning process more enjoyable (Anderson et al., 2016). Moreover, gamification helps students to be more engaged in lessons and achieve their learning goals (Gee, 2003).

What is Smart Software in Education?

Smart software used in education transforms teaching processes by utilizing artificial intelligence (AI), data analytics and adaptive learning technologies. These software are designed to meet the individual learning needs of students, personalize the learning process and improve the teaching effectiveness of teachers.

Adaptive Learning Systems

Adaptive learning systems are intelligent software that dynamically organizes educational content according to students' individual learning pace and needs, and these systems offer a more effective learning experience by adapting content based on students' prior performance and learning needs (VanLehn, 2011). For example, Khan Academy's AI-based platform analyzes students' progress in mathematics and science and suggests personalized exercises (Kerr, 2014).

Artificial Intelligence Assisted Learning Assistants

AI-based teaching assistants support learning processes by providing individualized feedback and guidance to students, help students solve problems they encounter during learning, and provide teachers with information about students' strengths and weaknesses (Graesser et al., 2012). For example, Carnegie Learning's "MATHia" software addresses misconceptions by providing instant feedback to students in mathematics teaching (Woolf, 2010).

Automated Test and Evaluation Software

Automated testing and assessment software are tools that analyze students' exam performance and provide feedback. They evaluate not only correct or incorrect answers, but also students' problem-solving processes. For example, the platform called "Gradescope" provides a quick assessment by automatically scanning exam papers and saves teachers time (Shute, 2008). These software offer an effective solution for assessing large groups of students (VanLehn, 2011).

Simulation and Virtual Reality (VR) Based Educational Software

Simulation and virtual reality-based software provide students with experiential learning opportunities, and these software, which are especially common in science and medical education, allow students to perform real-life experiments in a virtual environment (Savin-Baden & Howell, 2013). For example, the software called "Labster" contributes to the development of students' laboratory skills by providing the opportunity to perform chemistry and biology experiments in a virtual environment (Liu et al., 2011).

Educational Games and Gamification Software

Gamification in education is an approach that uses game elements to increase students' motivation and make the learning process more fun. Educational games help students develop scientific thinking and problem solving skills. For example, "Minecraft: Education Edition" is a software that aims to develop students' collaboration and creativity skills in science and mathematics courses (Gee, 2003). These software programs attract students' attention and make the learning process more effective (Caponetto et al., 2017).

Learning Analytics Based Software

Learning analytics is an approach that uses big data technologies to analyze and understand students' learning processes. This software monitors students' performance and provides teachers

with detailed reports on learning processes (Siemens, 2013). For example, platforms such as "Edmodo" offer teachers the opportunity to better understand the learning needs of each student by tracking student activities (Sherman & McKenna, 2016).

Artificial Intelligence Supported Chatbots

AI-based chatbots in education are digital tools that guide students during learning and answer their questions. These chatbots provide 24/7 support to students, accelerating their learning process and directing them to resources. For example, "Differ" is a chatbot designed to help students understand course materials (Graesser et al., 2012). Chatbots are seen as an effective tool that supports students' individual learning processes (Woolf, 2010).

Artificial Intelligence Based Language Learning Software

AI-based software in language learning helps students improve their language skills by providing instant feedback. For example, "Duolingo" allows students to improve their speaking, listening and writing skills and tracks individual progress (Loewen et al., 2019). Such software offers a more effective language learning experience by personalizing the learning process (VanLehn, 2011).

What are Artificial Intelligence Applications in Science Education?

Artificial intelligence (AI) applications in science education help students better understand scientific concepts, accelerate their learning processes and increase their interest in science. AI increases the effectiveness of science education by offering various benefits to both teachers and students in education.

Intelligent Teaching Assistants

Artificial intelligence is used as intelligent educational assistants to provide individualized feedback and guidance to students. These assistants identify student-specific learning paths, identify gaps and provide personalized content. Especially in science, these assistants constantly monitor student performance and provide teachers with more detailed reports, making the teaching process more efficient (Woolf, 2010). Intelligent teaching assistants identify the subjects in which students struggle and make suggestions to strengthen them in these areas (Graesser et al., 2012).

Adaptive Learning Systems

Adaptive learning systems in science education are AI-based tools that personalize educational content according to students' learning pace and needs. These systems assess students' prior knowledge and provide materials of appropriate difficulty for each student. In science, adaptive learning systems address students' deficiencies by reworking concepts that students do not understand or have difficulty with (VanLehn, 2011). In addition, these systems provide instant feedback to students, allowing them to quickly correct their mistakes (Kerr, 2014).

Simulation and Virtual Laboratory Software

Artificial intelligence supported simulation software has an important place in science education. They enable students to reinforce their theoretical knowledge with hands-on experiments. For example, in sciences such as chemistry or biology, virtual laboratories offer students the opportunity to simulate real-world experiments. These AI-supported applications provide students with the opportunity to manipulate various variables and enhance their understanding of scientific processes (Savin-Baden & Howell, 2013; Liu et al., 2011). Such software enables students to conduct experimental research and learn scientific methods (Tseng et al., 2013).

Games for Artificial Intelligence Supported Science Education

AI is used together with gamification strategies in science education. In science education, educational games help students to solve scientific problems, while at the same time providing students with scientific thinking skills. AI-based games offer dynamically challenging tasks based on students' success in the game, thus increasing students' motivation and encouraging them to learn (Gee, 2003). These games enable students to reinforce their science knowledge and create a learning environment for scientific discovery (Caponetto et al., 2017).

Data Analysis and Modeling Software

AI-based data analysis software in science offers students the opportunity to analyze large data sets. These software provide students with scientific research skills such as data collection, analysis and drawing conclusions. Students can make sense of data and reach scientific conclusions by using data visualization tools in fields such as biology, chemistry or physics (Sherman & McKenna, 2016). AI-supported data analysis software also enables students to formulate their own hypotheses and encourages them to conduct research (Tseng et al., 2013).

Automated Test and Evaluation Systems

In science education, AI-supported automated testing and assessment systems provide students with instant feedback on their individual performance. These systems analyze students' answers on exams, identify errors, and report on the subjects in which students are deficient. Furthermore, AI tracks students' progress in their understanding of scientific concepts and provides teachers with reports specific to each student (Shute, 2008). Such systems save time for teachers and provide continuous feedback to students (VanLehn, 2011).

Intelligent Science Teaching Assistants and Chatbots

Chatbots and intelligent assistants also play an important role in AI-supported science education. This software guides students through science-related topics by providing answers to their questions. Chatbots not only answer students' questions on specific science topics, but also guide them to different resources, enabling them to learn more deeply (Woolf, 2010). These tools especially help students' individual learning processes and enable them to take an active role in the learning process (Graesser et al., 2012).

What is Intelligent Software in Science Education?

Science education plays a critical role in helping students understand the natural sciences and make connections to everyday life. Smart software can improve the effectiveness of science education, especially by using artificial intelligence (AI) and learning analytics. This software supports the learning process by providing customized educational experiences based on students' individual learning needs.

Simulation and Virtual Laboratory Software

Among smart software, the most widely used tools for science education are simulation and virtual laboratory software, which allow students to relate theoretical knowledge to real-world applications. Especially in physics, chemistry and biology courses, students can conduct experiments in a virtual environment and better understand scientific principles by controlling various variables (Savin-Baden & Howell, 2013). Simulation software makes learning environments more interactive, encourages students' active participation and facilitates teachers' classroom management (Liu et al., 2011).

Adaptive Learning Systems

Another type of smart software used in science education is adaptive learning systems, which deliver content based on students' individual learning pace, interests and prior knowledge. Using AI and learning analytics, these software continuously monitor student performance and personalize the teaching process by adapting the course content according to the student's needs (VanLehn, 2011). Such systems enable in-depth learning of concepts, especially in science, and offer additional support in areas where students have difficulties (Kerr, 2014).

Artificial Intelligence Assisted Learning Assistants

AI-supported teaching assistants are an important part of science education, providing instant feedback and guidance to students. They provide question-solving strategies that can help students find the right answer, analyze questions and identify missing concepts, as well as stimulate students' curiosity by asking them engaging questions about science (Woolf, 2010). TAs monitor students' progress over time based on their individual learning process and improve the quality of teaching by providing reports to teachers (Graesser et al., 2012).

Smart Assessment Tools for Science Education

Smart software in science education also plays an important role in assessing students' performance. Smart assessment tools analyze students' thinking processes beyond their performance in exams. They provide instant feedback to students while at the same time monitoring their thinking styles and how they process concepts. This provides teachers with valuable information to more accurately assess what students do and do not understand (Shute, 2008). Based on the teacher's feedback, students can improve their learning strategies and recognize their own shortcomings (VanLehn, 2011).

Gamification and Smart Game Based Software

Smart software that uses gamification elements in science education is effective in increasing students' motivation. These software integrate game elements into learning processes and keep students' interest in science alive. For example, educational games designed for learning science provide students with opportunities to solve, explore and experiment with scientific problems. This type of software makes the learning process more fun and engaging, while at the same time developing students' scientific thinking skills (Gee, 2003). As students progress through the games, they can track their achievements and learning with visual and numerical data (Caponetto et al., 2017).

Data-Based Science Education Software

Data-based software used in science provides students with the opportunity to conduct scientific research by working on large data sets. These software tools provide students with the skills to collect and analyze data, form hypotheses and draw conclusions. Using data visualization tools, students can make sense of scientific data and use data to solve real-world problems (Tseng et al., 2013). Moreover, data-based software provides students with the opportunity to practice analyzing data in different areas of science (e.g., environmental science or astrophysics) (Sherman & McKenna, 2016).

What are the Advantages of Artificial Intelligence?

The development of artificial intelligence (AI) technologies is leading to revolutionary changes in many sectors. The advantages offered by AI can provide a variety of benefits for both individuals and communities.

Efficiency and Speed

AI increases productivity by automating and accelerating tasks. Time-consuming and repetitive tasks that can be performed by humans can be performed much faster and more efficiently by AI systems. This results in significant time savings, especially in areas such as manufacturing, data analysis and customer service (Brynjolfsson & McAfee, 2014). Since AI has the capacity to analyze large data sets, it becomes faster to draw meaningful conclusions from this data (Mayer-Schönberger & Cukier, 2013).

Reducing Human Error

AI systems have the capacity to reduce human error. Especially in critical areas such as medical diagnostics, financial analysis, and production lines, the accuracy and predictability provided by AI minimizes error rates, which both increases safety and improves the quality of results (Rajpurkar et al., 2017; LeCun et al., 2015). The success of AI in these areas stems from its ability to exhibit higher accuracy rates than humans in certain tasks.

Personalized Experiences

AI can provide personalized services by understanding the specific needs of individuals. In the education, health and retail sectors, AI analyzes user behavior and provides content, recommendations and solutions tailored to each individual. For example, in education, AI-based applications provide customized content based on students' learning speed (VanLehn, 2011). Moreover, in the medical field, AI can provide personalized treatment recommendations based on patients' genetic and medical history (Topol, 2019).

Accessibility and Inclusion

AI has the potential to create a more accessible world for people with disabilities. For example, speech recognition and visual recognition technologies can help visually impaired individuals better understand their environment. Furthermore, automatic translation and language processing applications can facilitate communication between individuals of different languages. This contributes to building a more inclusive society on a global scale (Bertelsmann Stiftung, 2017).

Creating New Jobs

AI is creating new jobs and opportunities. With the development of AI, new professions such as data scientists, AI engineers and ethics experts have emerged. This increases the demand for qualified employees in the labor market and brings new educational requirements (Chui et al., 2016). At the same time, new business models are emerging through the application of AI, supporting economic growth.

Autonomy and Robotics

The use of AI in robotic systems reduces the dependence on human intervention and enables the development of autonomous systems. Autonomous vehicles can improve traffic safety by reducing driver errors, while industrial robots enable more efficient and safer production processes. These technologies improve quality of life by removing people from repetitive and dangerous work (Goodall, 2014; Shi et al., 2017).

Finding Solutions to Difficult Problems

AI is a particularly effective tool for solving complex and large-scale problems. For example, in areas such as combating climate change or treating genetic diseases, AI can make more accurate predictions and develop solutions through data analysis and modeling. This allows for accelerated scientific research and more effective solutions (Silver et al., 2016; Esteva et al., 2019).

Advanced Data Analytics and Forecasting

One of the most important advantages of AI is its ability to analyze large data sets and make predictions based on this data. This capability is used in the finance, healthcare, retail and energy sectors. For example, AI-powered analytical tools can predict customers' shopping behavior, enabling companies to develop more efficient marketing strategies. Again, in healthcare, AI can be used for early diagnosis of diseases (Chollet, 2019; Rajpurkar et al., 2017).

What are the Disadvantages of Artificial Intelligence?

Although artificial intelligence (AI) has made significant progress, especially in recent years, it also brings with it various disadvantages and potential risks. These disadvantages can have significant impacts at both technological and societal levels.

Employment Loss and Labor Force Change

One of the biggest disadvantages of AI is the loss of labor. Especially in sectors where automation is increasing, the use of AI can pose serious threats to the working class. Robots and automated systems can replace humans in production, customer service and even in some white-collar jobs, leading to high unemployment and significant changes in the labor market (Brynjolfsson & McAfee, 2014). Moreover, this process can require a major transformation in skills and labor requirements, which can lead to social inequalities (Chui et al., 2016).

Data Privacy and Security Issues

Since AI systems operate using large data sets, data privacy and security is an important risk factor. Such systems collect and process users' personal information, which can be a violation of individuals' privacy. Furthermore, the security of AI-enabled systems can be vulnerable to attacks by malicious actors. Especially in critical areas such as autonomous vehicles or healthcare, such vulnerabilities can have serious consequences (Zeng et al., 2017; Taddeo & Floridi, 2018).

Lack of Transparency in Decision Making Processes

The lack of transparency of AI's decision-making processes is a major drawback. AI is often based on "black box" models, meaning that it is often unclear how and why algorithms make certain decisions. This can lead to trust issues, especially in sensitive areas such as health, finance and law. Moreover, lack of transparency can lead AI to make erroneous or unfair decisions, which can undermine societal trust (Burrell, 2016; Angwin et al., 2016).

Moral and Ethical Issues

The ethical use of AI is also a controversial issue. AI systems need to make ethical decisions, especially in applications such as autonomous vehicles and combat robots. However, AI's decisions are often based on parameters set by humans, which may not fully reflect human values and ethical norms. For example, there is uncertainty about what ethical principles an autonomous vehicle should consider when deciding which people to save in the event of an accident (Lin, 2016). Such decisions can be incompatible with societal norms and lead to ethical problems.

Algorithmic Biases

AI systems may have algorithmic biases depending on the data sets they are developed for. If an AI system learns from historical data, the social biases in that data can also influence its decisions. For example, AI systems used in recruitment processes may reflect past discrimination based on gender or race, which can lead to unfair outcomes, and such algorithmic biases can undermine the social justice principle of AI (O'Neil, 2016; Noble, 2018).

Dependency and Diminishing Human Capabilities

The overuse of AI can make people lazy to develop their own skills and abilities. For example, AI-supported software can prevent students from improving their written language skills because language processing systems provide correct spelling and grammar suggestions. Similarly, overuse of AI can undermine people's own ability to analyze, problem solve and make decisions (Carr, 2014).

Loss of Control and Unpredictable Behavior of AI

With the evolution of AI, it is becoming increasingly difficult to predict the behavior of machines. AI systems are able to evolve by working on big and complex data, but this evolution process cannot be fully controlled by humans. This can have potentially unpredictable and unintended consequences. Especially in areas such as autonomous weapons and military systems powered by artificial intelligence, loss of control can create great dangers (Binns, 2018; Lin, 2016).

References

Akpınar, Y., (1999). "Computer Aided Instruction and Applications", Anı Publishing 1st Edition, Ankara, 127-155.

Allahverdi, N., (2002). "Expert Systems: An Artificial Intelligence Application", Atlas Yayın Dağıtım 1st Edition, Istanbul, 15-16.

Alpaydın, E. (2013). Artificial learning. Istanbul: Boğaziçi University Publishing House.

Anderson, C. A., et al. (2016). *The Influence of Video Games on Youth: A Developmental Perspective.* In Handbook of Children and the Media, 211-234.

Angwin, J., Larson, J., Mattu, S., & Kirchner, L. (2016). *Machine Bias.* ProPublica.

Aşiroğlu, S. C., (2016). Preservice Preschool Teachers' Views on Their Self-Efficacy in Differentiated Instruction. Mersin University Journal of Faculty of Education, 12(3).

Baker, R. S., & Inventado, P. S. (2014). *Educational Data Mining and Learning Analytics.* In Learning Analytics, 61-75.

Baker, T., & Smith, L. (2019). Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges. Nesta. Retrieved from https://media.nesta.org.uk/documents/Future_of_AI_and_education_v 5_WEB.pdf.

Beck, J., Stern, M., & Haugsjaa, E. (1996). Applications of AI in Education. Crossroads, 3(1), 11-15.

Bengio, Y., et al. (2007). *Learning Deep Architectures for AI.* Foundations and Trends in Machine Learning, 2(1), 1-127.

Bertelsmann Stiftung. (2017). *Artificial Intelligence for Europe: A Strategy for Artificial Intelligence in Europe.* Brussels.

Binns, A. (2018). *On the Importance of Transparency in Artificial Intelligence.* Journal of Information, Communication and Ethics in Society, 16(2), 192-213.

Bostrom, N. (2014). *Superintelligence: Paths, Dangers, Strategies.* Oxford University Press.

Brynjolfsson, E., & McAfee, A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies.* W.W. Norton & Company.

Burstein, J., Chodorow, M., & Leacock, C. (2003). *Criterion: Online Essay Evaluation.* Machine Learning, 60(1-3), 263-280.

Burrell, J. (2016). *How the Machine 'Thinks': Understanding Opacity in Machine Learning Algorithms.* Big Data & Society, 3(1), 1-12.

Caponetto, I., et al. (2017). *Gamification in Education: A Study on the Influence of Gamified Learning Environment on Students' Engagement and Learning Performance.* Computers & Education, 104, 26-40.

Carr, N. (2014). *The Glass Cage: Automation and Us.* W.W. Norton & Company.

Coiera, E. (2003). Clinical decision support systems. Guide to health informatics, 2(1).

Chiu, T. K. F. (2021). A holistic approach to Artificial Intelligence (AI) curriculum for K-12 schools. TechTrends, 65, 796–807. https://doi.org/10.1007/s11528-021-00637-1.

Chollet, F. (2019). *Deep Learning with Python.* Manning Publications.

Chui, M., Manyika, J., & Miremadi, M. (2016). *Where machines could replace humans—and where they can't (yet).* McKinsey Quarterly.

Chui, M., Manyika, J., & Miremadi, M. (2018). *Artificial Intelligence: The Next Digital Frontier?* McKinsey & Company.

Dastin, J. (2018). *Amazon Scraps AI Recruiting Tool That Showed Bias Against Women.* Reuters.

Davenport, T. H., & Ronanki, R. (2018). *Artificial Intelligence for the Real World.* Harvard Business Review.

De Jong, T., Linn, M. C., & Zacharia, Z. C. (2013). *Physical and Virtual Laboratories in Science and Engineering Education.* Science, 340(6130), 305-308.

Esteva, A., et al. (2017). *Dermatologist-level classification of skin cancer with deep neural networks.* Nature, 542(7639), 115-118.

Esteva, A., et al. (2019). *A Guide to Deep Learning in Healthcare.* Nature Medicine, 25(1), 24-29.

Falmagne, J.-C., et al. (2013). *Knowledge Spaces: Theories, Empirical Research, and Applications.* Psychology Press.

Feigenbaum, E. A. (1983). *The Handbook of Artificial Intelligence.* Volume 1. Addison-Wesley.

Gee, J. P. (2003). *What Video Games Have to Teach Us About Learning and Literacy.* Computers in the Schools, 19(3-4), 1-10.

Gee, J. P. (2003). *What Video Games Have to Teach Us About Learning and Literacy.* Computers in Entertainment, 1(1), 20-20.

García-Serrano, A., et al. (2019). *Chatbots in Education: A Review of the Literature.* Educational Technology & Society, 22(4), 71-85.

Goel, A., & Polepeddi, L. (2016). *Jill Watson: A Virtual Teaching Assistant for Online Education.*

Georgia Institute of Technology.

Goodall, N. J. (2014). *Machine Ethics and Automated Vehicles.* In Road Vehicle Automation (pp. 93-102). Springer Vieweg, Berlin, Heidelberg.

Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning.* MIT Press.

Godwin-Jones, R. (2018). *Using Mobile Technology to Enhance Language Learning.* Language Learning & Technology, 22(2), 1-17.

Graesser, A. C., et al. (2012). *Cognitive Tutoring Systems and the Next Generation of Educational Technology.* Journal of Educational Psychology, 104(2), 447-457.

Güler Arı, T., (2016). Study into the Views of the Students Learning Turkish as a Foreign Language over Collaborative Learning in Language Courses. Education Research Journal, Vol. 6(10) (188-192).

Hinton, G. E., et al. (2006). *Reducing the Dimensionality of Data with Neural Networks.* Science, 313(5786), 504-507.

Holmes, W., Bialik, M. ve Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Boston, MA: Center for Curriculum Redesign.

Hwang, G. J., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of artificial intelligence in education. Computers and Education: Artificial Intelligence, 1. https://doi.org/10.1016/j.caeai.2020.100001.

Jackson, P. (1986). *Expert Systems: An Introduction.* Addison-Wesley.

Jurafsky, D., & Martin, J. H. (2021). *Speech and Language Processing.* Pearson.

Kaplan, J. (2016). *Artificial Intelligence: What Everyone Needs to Know.* Oxford University Press.

Kerr, B. (2014). *Adaptive Learning in Education: Integrating Theory and Practice.* Cambridge University Press.

Kukulska-Hulme, A. (2012). *Language Learning in Mobile Devices: An Investigation of the Use of Mobile Technologies in Language Learning.* ReCALL, 24(3), 219-242.

LeCun, Y. (1998). *Theoretical Framework for Backpropagation.* IEEE Transactions on Neural Networks, 9(5), 849-868.

LeCun, Y., et al. (2015). *Deep Learning.* Nature, 521(7553), 436-444.

LeCun, Y., Bengio, Y., & Hinton, G. (2015). *Deep Learning.* Nature, 521(7553), 436-444.

Levinson, J., et al. (2011). *Towards Fully Autonomous Driving: Systems and Algorithms.* IEEE Intelligent Vehicles Symposium.

Lin, P. (2016). *Why Ethics Matters for Autonomous Cars.* In Autonomes Fahren (pp. 69-85). Springer Vieweg, Berlin, Heidelberg.

Liu, M., et al. (2011). *Simulations and the Development of Students' Inquiry Skills: A Research-Based Approach.* Educational Technology Research and Development, 59(1), 91-108.

Liu, M., et al. (2017). *The Impact of Interactive Educational Games on Learning Outcomes in*

Science. Educational Technology Research and Development, 65(5), 1151-1168.

Loewen, S., et al. (2019). *The Effectiveness of App-Based Language Learning.* Language Learning & Technology, 23(2), 114-127.

Luckin, R., et al. (2016). *Intelligence Unleashed: An Argument for AI in Education.* Pearson Education.

Luckin, R., et al. (2016). *Intelligence Unbound: The Future of Uploaded and Machine Minds.* Springer.

Mayer-Schönberger, V., & Cukier, K. (2013). *Big Data: A Revolution That Will Transform How We Live, Work, and Think.* John Murray.

McCarthy, J. (1956). *Logic and Artificial Intelligence.* Journal of Symbolic Logic.

McCarthy, J. (2007). *What is Artificial Intelligence?* Stanford University.

Mitchell, T. (1997). *Machine Learning.* McGraw-Hill.

Newell, A., & Simon, H. A. (1972). *Human Problem Solving.* Prentice-Hall.

Ng, A., & Koller, D. (2015). *Machine Learning Applications in Finance.* Stanford University Press.

Nilsson, N. (1990). The mathematical foundations of learning machines. San Mateo: Morgan Kaufmann.

Nilsson, N. J. (1998). *Artificial Intelligence: A New Synthesis.* Morgan Kaufmann.

Noble, S. U. (2018). *Algorithms of Oppression: How Search Engines Reinforce Racism.* NYU Press.

O'Neil, C. (2016). *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy.* Crown Publishing Group.

Pressey, S. L. (1950). Development and appraisal of devices providing immediate automatic scoring of objective tests and concomitant self-instruction. The Journal of Psychology, 29(2), 417-447.

Rajpurkar, P., et al. (2017). *Deep Learning for Chest Radiograph Diagnosis: A Retrospective Comparison of the CheXNeXt Algorithm to Radiologists.* PLOS Medicine, 14(11), e1002686.

Rumelhart, D. E., Hinton, G. E., & Williams, R. J. (1986). *Learning Representations by Back-Propagating Errors.* Nature, 323(6088), 533-536.

Russell, S., & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.

Russell, S. J. & Norvig, P. (2021). Artificial intelligence: A modern approach (4th ed.). Pearson Education.

Savin-Baden, M., & Howell, S. (2013). *Interactive Learning Environments in Science Education.* Routledge.

Selwyn, N. (2019). *Should Robots Replace Teachers? AI and the Future of Education.* Polity

Press.

Silver, D., et al. (2016). *Mastering the Game of Go with Deep Neural Networks and Tree Search.* Nature, 529, 484-489.

Siemens, G. (2013). *Learning Analytics: The Emergence of a Discipline.* American Behavioral Scientist, 57(10), 1380-1400.

Silver, D., et al. (2016). *Mastering the Game of Go with Deep Neural Networks and Tree Search.* Nature, 529(7587), 484-489.

Sherman, M., & McKenna, T. (2016). *Big Data and Education: The Promise and Perils of Data-Driven Learning.* Routledge.

Shi, Y., et al. (2017). *Application of Robotics in Manufacturing and Industry 4.0.* Robotics and Computer-Integrated Manufacturing, 43, 7-13.

Shute, V. J. (2008). *Focus on Formative Feedback.* Review of Educational Research, 78(1), 153-189.

Skinner, B.F. (1958). Teaching machines. The Review of Economics and Statistics 42 (3): 189–191.

Taddeo, M., & Floridi, L. (2018). *How AI can be a force for good.* Science, 361(6404), 751-752.

Tegmark, M. (2017). *Life 3.0: Being Human in the Age of Artificial Intelligence.* Knopf.

Thorndike. E.L. (1927). The law of effect. The American Journal of Psychology 39 (1/4): 212–22. https://doi.org/10.2307/1415413.

Topol, E. (2019). *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again.* Basic Books.

Tseng, H., et al. (2013). *Using Data and Virtual Labs to Teach Science Concepts.* Journal of Science Education and Technology, 22(3), 329-338.

Turing, A. M. (1950). *Computing Machinery and Intelligence.* Mind, 59(236), 433-460.

Uludağ Exporters' Associations / UIB (2017). Artificial intelligence and new technologies. Uludağ Exporters' Associations General Secretariat R&D Branch Report. http://www.uib.org.tr/tr/kbfile/artificial-intelligence-and-new-technologies.

VanLehn, K. (2011). *The Relative Effectiveness of Human Tutoring, Intelligent Tutoring Systems, and Other Tutoring Systems.* Educational Psychologist, 46(4), 197-221.

Zeide, E. (2019). Artificial intelligence in higher education: Applications, promise and perils, and ethical questions. EDUCAUSE Review, 54(3), 31– 39. Retrieved from https://er.educause.edu/- /media/files/articles/2019/8/er193104.pdf.

Zeng, D., Lu, X., & Chen, J. (2017). *Artificial Intelligence and Data Privacy: Protecting Personal Information in the Age of AI.* IEEE Internet Computing, 21(5), 8-13.

Woolf, B. P. (2010). *Building Intelligent Interactive Tutors: Student-centered Strategies for Revolutionizing E-learning.* Elsevier.

Weizenbaum, J. (1966). *ELIZA – A Computer Program for the Study of Natural Language*

Communication between Man and Machine. Communications of the ACM, 9(1), 36-45.

About The Authors

Buket GEVIS FARHADZADA is currently working as a Research Assistant at Akdeniz University, Faculty of Education, Department of Mathematics and Science Education, Department of Science Education. She holds a master's degree in Science Education from Akdeniz University. Her main areas of interest are education, science education, artificial intelligence, augmented reality and STEM applications.

E-mail: buketgevis@akdeniz.edu.tr, **ORCID:** 0000-0003-2871-5377.

Fatih Serdar YILDIRIM is an Associate Professor at Akdeniz University, Faculty of Education, Department of Mathematics and Science Education, Department of Science Education. She holds a PhD degree in Biology Education from Gazi University. His main areas of interest are artificial intelligence, social sciences and humanities, education, science education, life sciences, environmental biology, environmental pollution, basic sciences and augmented reality applications.

E-mail: fsyildirim@akdeniz.edu.tr, **ORCID:** 0000-0003-4080-8488.

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 3%.

To Cite This Chapter:

Gevis-Farhadzada, B., Yıldırım, F. S. (2024). Artificial intelligence and intelligent software in science education. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp. 11-29). ISRES Publishing.

Translation Technology Course Design: From Practice to Theory

Evanthia SARIDAKI

University of Thessaly

Introduction

Translation technology has rapidly developed over the past decades and therefore technological skills are considered to be one of the major skills that translators must possess in order to practise their profession. As Bowker (2020) observes, people nowadays have been convinced that translators have to embrace translation technology in order to survive in translation market rather than resist it. The digital revolution is bringing about changes in translation pedagogy and a need currently exists for the introduction of theoretical matters in the translation technology classroom. Indeed, in light of the continuous changes in the market of translation and its implications for the teaching process, it should be questioned whether and to what extent current curricula meet not only with the technological needs of the translation industry but also with theoretical issues related to the use of technology such as the ethical dilemmas that arise, the constraints of using translation technology tools apart from the benefits and pedagogical limitations in teaching translation theory.

Theoretical Background

The Concept of Translation Competence

One of the main subjects widely addressed in the fields of Translation Studies regards the kind of competences required for the professional translator in order to promote a successful career in the industry. Within this framework, the concept of competence needs to be further analysed as a notion that encompasses a series of elements and procedures involved in the process of translation.

In Europe, a competence-based approach to translator training has been established in higher education translation programmes. Many theorists have endeavored to identify the different components of the notion of competence and set specific criteria indicating its multifaceted nature which is continually evolving. Hence, several multidimensional models have been proposed and validated by different empirical evidence. One of the most frequently cited models has been developed by the PACTE Group (2005) which suggests that translation competence consists of "bilingual, extra-linguistic, knowledge of translation, instrumental, strategic subcompetences and also psycho-physiological components".

Another suggested model is the EMT (European Master's in Translation) Competence Framework named initially "competence wheel" which was developed by an expert group in 2009 and updated in 2017 by the EMT Board presented as a mechanism composed of cogs representing the movement and smooth functioning of all competences as a whole. The updated version includes the following components: language and culture, service provision, translation, technology, personal and interpersonal and service provision training students to possess the necessary skills and expertise in order to perform effectively in their future workplace.

Kiraly (2000) develops a constructivist approach based on the distinction between translation competence and translator competence with the former focusing on the linguistic aspects of the translation process and the latter focusing on the development of various skills, knowledge acquisition and attitude forming regarding the practical matters of the translator's profession.

Finally, Krajcso (2018) relates translation competence to the market demands of the professional world of translation by emphasizing the strong relationship between the activity of translation and the development of technological competence and stressing the need for further research on "operational competence" which is related to the translator's ability to handle issues such as marketing, risk management, legal aspects and ethical issues in the translator's profession.

Translation Technology Competence

Over the last decades, the progress in information technology has led to the development of advanced technological tools that have proven to be very powerful instruments for the translator's profession. O' Hagan (2013) talks about "the technological turn" that the translation sector has embraced with certain consequences in Translation Studies and the pedagogical approaches to be adopted in the teaching process. This transition has had an important effect on translator training since translation technology subcompetence has become one of the key elements of translation competence development allowing for more effective and efficient results in the practice of translation.

The PACTE Group considers "technological competence" also known as "instrumental knowledge" as a key-element of translation competence defining it as "procedural knowledge related to the use of documentation resources and information and communication technologies applied to translation". Another approach of what technological competence entails is described by the EMT (European Master's in Translation) as "all the knowledge and skills used to implement present and future translation technologies within the translation process".

Li et al (2023) propose a translation technology competence model that is composed of six basic elements: machine translation, post-editing, information literacy, terminology management, translation memory and computer-aided translation. Translators use machine translation as an assistant tool in order to increase their production in a variety of thematic areas within the translation industry and improve the quality of translations. Post-editing makes up another main component which involves reviewing and improving the output of machine translation in order to check qualities such as its accuracy and appropriateness for purpose. Information literacy that concerns the translator's ability to detect and utilize information constitutes an essential part of his technological competence. The introduction of the Internet has enormously expanded the information sources available to translators by transforming dramatically the detection of information in the translation process. Terminology management involves the process of identifying, extracting, storing, utilizing and keeping term records up to date. Since terminological analysis makes up the foundation for translating specific thematic fields, one of the aims of translator training programmes is to instruct students in constructing terminological databases and develop terminology management skills. Translation memory makes up another useful technological tool for professionals by referencing and reusing existing translation texts when producing new translations. It provides users with the opportunity to work and ensure compare their work to previous consistency especially in thematic areas which are characterized by a high rate of specialised vocabulary and syntactic structures. Computer-aided translation involves the translator's capacity to utilize computer-assisted translation software and other computer programmes in order to meet the demands of their tasks and produce quality translations.

It is essential to train students on the above-mentioned subsectors so that they gain knowledge of the most advanced technological developments and high level of proficiency since technology is becoming nowadays an integral part and common practice in the professional world of translation.

Method: Toward a Theoretical Approach to Translation Technology

Although attitudes toward new technologies range from acknowledging their usefulness to considering them "inconvenient" (Corpas Pastor et al., 2015), they now make up a necessary component of the act of ranslation, and more widely on the act of human communication. Such an attention to translation technology in the academic world is definitely a positive step forward, however, we recognize the need for the introduction of a theoretical approach of translation technology in the translation curriculum in general, and, more specifically, in the translation technology classroom. The current study aims at offering a framework of reflection on the implications of technological developments for the theorization of translation by proposing a theoretical approach to translation technology. The main issues tackled in this chapter are the aims and content of a theoretical approach toward translation, pedagogical difficulties in translation theory teaching and basic criteria for content selection.

Aims and Content

Critical Thinking and Translation Technology Competence

One of the subcomponents of the notion of translation competence is related to critical skills development that helps translation students to further improve their performance on translation tasks and tests. The ability to think critically is the key to improving translation competence by providing translators with the necessary intellectual tools to assess the target audience expectations of their work, to make appropriate selections of translation methods and strategies and be able to examine critically the available resources. Translation technology competence is highly impacted by critical skills since many of the tasks in the translation task such as machine translation work or post-editing are affected by the translator's critical ability through self-regulation (Yang & Wang, 2020). Thus, one of the primary goals of the theoretical component in translation technology courses should be critical skill development that should have a strong impact on the translator's technological competence.

Cultural Awareness and Translation Technology Competence

Bennett (2003) defines cultural intelligence as "a set of cognitive, affective, and behavioral skills and characteristics that support effective and appropriate interaction in a variety of cultural contexts" with four basic components: cognitive, metacognitive, motivational and behavioral. Cultural intelligence is related to the concept of cultural competence which is connected to the individual's ability to recognize and respect cultural differences as well as to his ability to interact effectively with people from other cultures.

In the field of translation, modern approaches view translation not as a mere transcoding process, but as a form of action across cultures, as a cross-cultural event (Arrojo, 2005; Venuti, 1995; Bassnett-McGuire, 1980). According to the EMT Competence Framework programmes, the intercultural stage of translator training should aim at developing student sensitization to the cultural differences among societies and their implications for translating, since the acquisition of cultural and transcultural knowledge makes up the basis for the acquisition of ranslation competence. One of the main goals set at translator training programmes is the study of the role culture plays in translation, focusing mainly on the linguistic and cultural resources employed by translators in their attempt to serve as mediators of cultural messages. Thus, cultural competence is strongly linked to translation technology competence since translators need to be equipped with adequate information technology literacy in order to access sources of information so that they can bridge cultural gaps between texts that are due to cultural differences.

The Ethical Dimension of Translation Technology Competence

Many of the discussions in Translation Studies tackle the question of ethics in translation focusing investigating matters such as the obligation of the translator to be accurate and faithful, that is, "how to translate" (Pym, 2001). Chesterman (2001) describes four different models of ethics in translation: ethics of representation that stresses issues such as fidelity, faithfulness, accuracy, alterity and true representation of the other; ethics of service which aligns with theories of functionalism and compliance with the translation brief; ethics of communication stressing the importance of communicating with others and the role of the translator as mediator working to achieve cross-cultural understanding" and norm-based ethics which involves behavior in accordance with the norms of a certain time and culture regarding the criteria of an acceptable translation product. In the case of PACTE, ethics makes up part of the concept of psychophysiological competence, defined as "a critically reflective morality aimed at identifying, examining and addressing practice problems" (Borstner & Smiljana, 2014). For Göpferich (2009), ethics forms part of the "translator's self-concept/professional ethos", where issues of social behaviour are raised. The ethical subcompetences is considered to be an essential component of the translator's professional behaviour.

While ethical issues of the translation process are by no means new in the field of translation studies, technology has not been addressed adequately in its theoretical dimension. Although there had been some attempts back in the 1990s to ethical matters related to machine translation (MT), in the late 2000s theoreticians raised ethical matters that translation technology created which are closely related to wider sociocultural matters coming out of the translation process. Bowker (2020) provides a comprehensive model of the concept of ethics in translation that entails the following six elements: the sharing and commoditization of translation resources; privacy and confidentiality of data; fidelity and collaboration; professional identity, autonomy and job satisfaction; productivity, time and money; and cultural hegemony versus the linguistic diversity paradox.

Integrating ethical issues in translation technology classes is essential especially at the beginning of the translation process since the social, legal and ethical considerations of technology should not be underestimated. Drugan (2017) makes an interesting proposal of "an integrated, inter-disciplinary approach to bringing ethics into translator training" involving the introduction of ethics into translation technology classes with the main pedagogical approach the use of case-studies that would provide students with the opportunity to examine real-life problems and consider a variety of parametres in taking translation decisions and solutions. The current study was inspired by Bloom's taxonomy (Drugan and Megone, 2011) that consists of four main levels: a. understand, b. apply, c. evaluate, d. create. The overall aim of the specific approach is to help students to understand general ethical issues related to translation technology, then to identify them in specific contexts, afterwards to justify their response and, finally, to create new approaches that would help them to handle ethical issues.

The Ideology of Translation and Translation Technology Competence

The translator's ideological role is closely connected to the notion of ethics in the act of translating. The integration of the ideological dimension of the translator in translation technology classes could be one of the essential components of a comprehensive theoretical approach to translation technology so that students realize their moral responsibilities to society in transferring sociocultural messages. Althusser (2021) acknowledges that ideology dominates in the act of translating by stressing that "there is no practice except by and in ideology". While every type of text entails an ideological nuance, specific types of texts are representative of the ideological load they bear such as political texts, religious texts and media discourse.

Since the major aim of translation programmes is to train future professionals employed in the translation industry, teachers of the corresponding major must be well aware of the above-mentioned aspect of translation and take the necessary actions in adjusting the curriculum so as to align the teaching concept in accordance with the ideological aspect of translation and the development of translators as ideological mediators. Hence, students who finish new translation technology classes will show greater sensitivity toward the ideological aspect of translation compared with students who have been trained under the traditional curriculum system.

What is proposed in the current research is the integration of a systematic theoretical tool in translation technology classes that would aim at making students understand the notion of ideology in translation and how it is linked to translation technology competence development. The role played by ideology in translation and that of the translator as ideological mediator should make up another main component of translation technology classes in academic translator training programmes.

History of Technology

Knowledge of the history of translation is of vital importance to students that would help them to eliminate their misunderstanding on the benefits and limitations of translation technology and develop a rational and objective expectation of translation technological tools. Mossop (Gambier, 2012) suggests that we should avoid being charmed by technologies themselves and "not to teach the instrument but the principle". The most important of all is that translator training maintains its humanistic character which is often depreciated by technoscience.

One of the questions translation students often ask in translation technology courses is why professionals who are mostly concerned with practical problems of translation to approach translation technology in a historical context. Woodsworth (1995) who has discussed the significance of studying the past of translation provides the following answer: "Or, for those whose primary goal is professional practice, because one ought to be familiar with the history of one's discipline in order to practice efficiently".

Therefore, teachers of translation should design a translation technology course that would focus on the relation between technology and translation through centuries and the role of technology as a means of communication. It is essential that students acquire consciousness of the philosophy of technology so that he continually tests it and evolve with it.

Furthermore, their reflection on past of technology would help them to develop their critical ability as one of the most significant subcompetences for the translator's profession. Benmouhoub (2019) stresses the significance of critical thinking in helping them "question the things around them and act critically in their academic and professional career".

Another practically-oriented benefit of studying technology in its historical context is to make students reflect on the process of translation in its sociological and cultural context and as Alenezi (2021) says, "recognizing the differences between the source text and target text cultures at different levels is important for learners who seek to become translators". Within this framework, the study of the history of translation technology would have practical value toward the understanding of the sociocultural aspect of translation and the translator's role as that of ideological "transformer and mediator".

Content

Within this framework, the current research proposes a comprehensive and reinforced theoretical approach to translation technology as integrated part of a translation technology course that would comprise the following components:

- Knowledge of the history of Computer Aided Translation as well as the philosophy of technology throughout centuries in order to acquire consciousness of the philosophy of technology, so that translator training can maintain its humanistic character.

- Examination of the ways in which electronic communication has been used to enhance communication between translators, especially through Internet forums for professional translators. The communicative aspect of the translation procedure must be an element which should be stressed through this academic-oriented technology course which could contribute to the improvement of the translators' communicative competence.

- The effect of information technology on the translator's role as ideological and cultural mediator. The integration of the social dimension of the translator could be one of the basic elements in the particular theoretical approach so that students realize their moral responsibilities to society as transferring social and political messages.

- The concept of professionalization of translation since technology has really changed the translation profession. The notion of professional competence could be integrated in such an approach with 'professional competence' including these subcompetences:

- Organizational: the ability to design and manage a translation task assigned to the translator in order to acquire career management skills.

- Interpersonal: the ability to work collaboratively and develop interpersonal relations with the people involved in the translation task.

- Instrumental: knowledge of the available resources and ability to apply them to the translation process.

- Psychological competence: acquisition of self-awareness and self-confidence which is closely related to the translators' performance and helps them handle the psychological stress during the translation procedure.

Difficulties in the Teaching Process

Another matter to be explored concerns the difficulties that teachers of the particular major might encounter in integrating the theorical aspect of translation technology competence related to students' knowledge and background in the use of technologies, their attitudes and opinions toward technology and technology teachers' academic background.

- Students' background in the use of new technologies

Students' background in the use of technology may present a diversified picture. At first, it is of great importance for teachers to investigate students' level of technological knowledge before they decide on the teaching methods and content of a translation technology course. Next, they should adopt varied teaching techniques in accordance with students' profile and specific needs. This implies that teachers should form a general picture of the make-up of each student group in order to decide on their teaching methods and course content design.

Furthermore, the increasing heterogenous composition of students' groups in translation programmes has possibly made teachers more aware of various learning styles, although, as Kelly (2005) supports "learning styles exist and have always existed in the most apparently homogeneous groups". However, an important premise is that students' individual features and their prior educational background affect their learning styles which according to researchers are so deeply rooted that they may be very difficult to change.

• Students' attitudes toward the use of technology

For the majority of students who come to university have relatively little experience in using computers for translation purposes so the first steps toward mastering computer skills might be a painful experience. In this type of course, it is essential to explore right from the start through questionnaires and other research instruments their attitudes and opinions regarding the contribution of translation technology to their future career as professionals. Furthermore, it is essential for translation teachers to investigate in the design stage of their course students' opinions on the contribution of a theoretical approach to translation technology to the translator's profession as one of the main difficulties involved in the teaching of translation results from students' prejudiced attitude toward the theoretical component of their training (Mossop, 2005). Gentile (1995) calls the particular attitude "atheoretical", a term that he uses in order to stress the belief among a considerable part of student community that one does not need a theoretical background in order to be able to translate. It is certainly important for students to realise that theoretical knowledge is closely connected to the practice of translation and that some theoretical background in translation background will certainly help students to produce better results and it makes up necessary prerequisite for professionals in the translation industry.

• Translation technology instructors with knowledge of pedagogic and didactic principles

One of the most serious problems in teaching translation technology is that quite often teaching is assigned to experts who are entirely cut off from humanistic sciences or ignore basic pedagogic and didactic principles. This certainly influences translation students who become demotivated and lose their interest in a comprehensive approach toward translation technology. We might also encounter difficulties in the implementation of a theoretical approach toward translation technology due to academics' negative attitude toward technology. More particularly, theoreticians, by fear of "dehumanization" of the translating process, may adopt a negative attitude regarding the use of technology as lacking any academic "prestige".

Features of Theoretical Components in Translation Technology Courses

Another issue that is raised is related to the specific traits that theoretical components should have in order to integrated into a practical translation technology class. The following are some useful criteria adopted by Mossop's model (2005) that are proposed to translation teachers in formulating the theoretical component of their class in order to provide an aspect of academic prestige to translation technology classes.

• Components should be directly relevant to the students' needs. It is important that they provide practical answers to questions and problems actually faced or likely to be encountered by students and graduates.

• Components should be easy to understand by being simple in structure so that students are not discouraged in abstracting theoretical notions resulting in adopting a negative attitude toward the theorization of technology.

• Components should be recalled throughout the course and the practical implications of theoretical components should be stressed repeatedly during the correction of practical translation

technology exercises.

• Theoretical elements must ensure that motivation is maintained.

This could be achieved by making students realize the contribution of a theoretical approach of translation technology to their future career as professional translators.

Conclusion

The advancement of technological tools has brough about a new insight into the traditional translation theories and practices. Considering the increasing demands of the translator's profession in the twenty first century, it is time for an integrated pedagogic approach to translation technology teaching that could combine theoretical and practical components, by careful adaptation to each training context, student population and other important parametres.

Acquiring the know-how is not sufficient for ensuring that students will possess the necessary technological competences that they will need as future translators. The effectiveness of computerized instruction will depend to a great extent on an approach, combining theory and practice, education and training, so that we can avoid both a technological approach which is cut off from its sociopolitical environment and a certain technophobia which keeps individuals away from technological development.

The main goal of the proposed approach is to help students develop awareness of both the benefits and, mostly, the dangers of using technology so that they can make their own conscious choices regarding the use of technology. Knowing how to use it, how for and for what purpose and to what effects, is difficult to achieve but it should be the main objective of a translation technology course.

Above all, it should encourage students to move beyond directed instruction and acquire autonomy as lifelong learners and users of new technology. Translation technology teaching must aim at cultivating students' ability to adapt dynamically to the tools of the profession as they evolve in their career as translators. As Biggs (2003) points out, simply teaching students how to use new technologies does not make learning more effective or innovative. Instead, he introduces the term "education technology" in an attempt to remind teachers that the overall aim should be to enhance learning and motivate students to be lifelong learners.

References

Alenezi, A. M. (2021). Intercultural competence in a translator training program: Exploring students' self-assessment and perceptions. *Revue Traduction et Langues, 20*(2), 8-22.

Althusser, L. (2021). *Essays and Ideology*. Verso.

Arrojo, R. (2005). The ethics of translation in contemporary approaches to translator training. In M. Tennent (Ed.), *Training for the New Millennium* (pp. 225-245). Benjamins.

Bassnett McGuire, S. (1980). *Translation Studies*. Methuen.

Benmouhoub, L., & Boukhedimi, Y. (2019). Towards a dynamic approach to assessing students' critical thinking skills in higher education. *Revue Traduction et Langues, 18*(2), 115-128. https://doi.org/10.52919/translang.v18i1.511

Bennett, J. (2011). Developing intercultural competence. In *2011 Association of International Education Administrators Conference Workshop*.

Biggs, J. (2003). *Teaching for Quality Learning at University: What the Student Does*. Open University Press.

Borstner, B., & Smiljana, G. (2014). Teaching ethics and critical thinking in contemporary schools. *Problems of Education in the 21st Century, 6*, 1–17. https://doi.org/10.33225/pec/14.61.09

Bowker, L. (2020). Translation technology and ethics. In K. Koskinen & N. K. Pokorn (Eds.), *The Routledge Handbook of Translation and Ethics* (pp. 262–278). Routledge.

Chesterman, A. (2001). Proposal for a Hieronymic oath. *The Translator, 7*, 139–154.

Corpas Pastor, G., Seghiri, M., & Zaretskaya, A. (2015). Integration of machine translation in CAT tools: State of the art, evaluation and user attitudes. *SKASE Journal of Translation and Interpretation, 8*, 76–88. http://www.skase.sk/Volumes/JTI0/pdf_doc/04.pdf

Drugan, J. (2017). Ethics and social responsibility in practice: Interpreters and translators engaging with and beyond the professions. *The Translator, 23*, 126–142. https://doi.org/10.1080/13556509.2017.1281204

Drugan, J., & Megone, C. (2011). Bringing ethics into translator training: An integrated, interdisciplinary approach. *The Interpreter and Translator Trainer, 5*, 183–211. https://doi.org/10.1080/13556509.2011.10798817

Gambier, Y. (2012). Teaching translation/training translators. In Y. Gambier & L. V. Doorslaer (Eds.), *Handbook of Translation Studies* (Vol. 3, pp. 163-172). Benjamins. https://doi.org/10.1075/hts.3

Gentile, A. (1995). Translation theory teaching: Connecting theory and practice. In C. Dollerup & A. Linddegaard (Eds.), *Teaching Translation and Interpreting 3: New Horizons* (pp. 55-62). Benjamins.

Göpferich, S. (2009). Towards a model of translation competence and its acquisition: The longitudinal study TransComp. In S. Göpferich, A. Jakobsen & I. M. Mees (Eds.), *Behind the Mind: Methods, Models and Results in Translation Process Research* (pp. 12–37). Samfundsliteratur.

European Master's in Translation. (2017). EMT Competence Framework. https://commission.europa.eu/resources

Kelly, D. (2005). Un modelo de competencia traductora: Bases para el diseño curricular. *Puentes, 1*, 9–20.

Kiraly, D. (2000). *A Social Constructivist Approach to Translator Education: Empowerment from Theory to Practice*. Routledge.

Krajcso, Z. (2018). Translators' competence profiles versus market demand. *Babel, 64*, 692–709. https://doi.org/10.1075/babel.00059.kra

Li, X., Gao, Z., & Liao, H. (2023). The effect of critical thinking on translation technology competence among college students: The chain mediating role of academic self-efficacy and cultural intelligence. *Psychology Research and Behavior Management, 16*, 1233-1256. https://doi.org/10.2147/PRBM.S408477

Mossop, B. (2005). What practitioners can bring to theory – The good and the bad. *Target, 10*,

231-240.

O'Hagan, M. (2013). The impact of new technologies on translation studies: A technological turn? In B. Francesca & C. Millán (Eds.), *The Routledge Handbook of Translation Studies* (pp. 503–518). Routledge.

PACTE Group. (2005). Investigating translation competence: Conceptual and methodological issues. *Meta, 50*, 609–619. https://doi.org/10.7202/011004ar

Pym, A. (2001). Introduction: The return to ethics in translation studies. *The Translator, 7*, 129–138.

Venuti, L. (1995). *The Translator's Invisibility*. Routledge.

Woodsworth, J. (1995). Teaching the history of translation. In C. Dollerup & A. Linddegaard (Eds.), *Teaching Translation and Interpreting 3: New Horizons* (pp. 128-138). Benjamins.

Yang, Y., & Wang, X. (2020). Predicting student translators' performance in machine translation post-editing: Interplay of self-regulation, critical thinking, and motivation. *Interactive Learning Environments*, 1–15. https://doi.org/10.1080/10494820.2020.1786407

About the Author

Dr. Evanthia SARIDAKI is a Lecturer in Translation Studies at the Department of Language and Intercultural Studies (University of Thessaly, Greece). Her expertise is in translation theory, its applications to translation practice and translation theory course design. She holds a B.A. in English Language and Literature, a second B.A. in French Language and Literature (Aristotle University) and an M.A. in Translation (U.W.E, Bristol, U.K.). Her Ph.D. (Aristotle University, School of French, Department of Translation) is in the field of Translation Studies, and, more specifically, on translator training. Her academic interests are centered on translation theory, the sociocultural dimension of translation, the psychological aspect of the translation process and English for Academic and Specific Purposes. She has authored various research papers and book chapters in her area of academic interests.

E-mail: evsaridaki@uth.gr, **ORCID:** 0000-0002-2783-0798

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is %1.

To Cite This Chapter:

Saridaki , E. (2024). Translation technology course design: From practice to theory. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp 31-40). ISRES Publishing.

Section 2.

Entrepreneurship and Education

From Entrepreneurship to Pedagogical Entrepreneurship: An Educational Framework *

Kadriye BAYRAM

Nevsehir Haci Bektas Veli University

Oktay ASLAN

Necmettin Erbakan University

Introduction

With the developments in the world, changing sectoral needs, social demands, new professions and business conditions bring innovation in education to the forefront. The reflections of innovation in the education sector bring innovations in new-generation schools and teacher qualifications. Today, entrepreneurship is among these innovations. Because economic development and inter-country development are associated with the existence of entrepreneurial societies. In entrepreneurship, it is essential to mobilize science, technology, and innovation to answer daily life problems and improve welfare (OECD, 2011). When different definitions of entrepreneurship are examined, common characteristics include problem-solving, innovation, productivity, product design and presentation (Yaman, 2023). Entrepreneurship, which requires turning new ideas into action in education, encompasses many skills such as risk-taking, creativity, innovative thinking, independent work, action planning, project management, goal setting, analyzing, value creation, designing, initiative and responsibility-taking, and collaborative work (Bikse & Riemere, 2013; European Commission, 2016, 2017; Morris & Kuratko, 2002). Therefore, today, entrepreneurship studies in various fields such as technology, health, agriculture, tourism, environment and education are coming to the forefront with their multidimensional competence area and interdisciplinary structure.

The trend towards entrepreneurship studies in the education field has increased significantly in recent years. It has been concluded that applied entrepreneurship trainings promote entrepreneurial learning, attitude, entrepreneurial skills and culture, and entrepreneurship intervention programs develop entrepreneurial intention and self-efficacy (Martínez-Gregorio, Badenes-Ribera, & Oliver, 2021). Therefore, entrepreneurial thinking skills should be developed at an early age. (Anderson et al., 2014). In this context, the Turkish Entrepreneurship Strategy and Action Plan (2015-2018) aims to "promote entrepreneurship in education, provide entrepreneurship education at all levels, and carry out entrepreneurship projects in schools". Similarly, to raise productive individuals equipped with entrepreneurship skills, entrepreneurship outcomes were included in the curricula of science, social sciences and science applications courses (MoNE, 2018, 2024), and an undergraduate course called "Economics and Entrepreneurship" was added to teacher training undergraduate programs (CoHE, 2018).

When examining entrepreneurship pedagogy, competencies that require skills to be used at the time of action come to the fore, unlike subject matter knowledge. The pedagogical content competencies models developed to date have identified the knowledge areas that teachers need for teaching content knowledge (Mthethwa-Kunene, Onwu, & de Villiers 2015; Rollnick et al., 2008). General pedagogical content knowledge (PCK) has been extensively examined in research focused on PCK (e.g., Gehrtz, Brantner, & Andrews 2022; Major & Palmer, 2002, 2006; Smith & Kanuka, 2018). In recent years, there has been growing interest in developing "subject-, concept-, method-, and skill-specific PCK" (Aydın Günbatar, 2019).

*This book section is conducted with the support of TÜBİTAK BİDEB-2218 Domestic Postdoctoral Research Fellowship Program (2022/2).

The changing roles and needs of the new generation of individuals and society require innovation in the learning and teaching process and teacher competencies. In raising individuals who will adapt to changing learning environments and meet the needs of 21st-century individuals, teachers' professional and personal competencies must align with entrepreneurial knowledge and skills. As a complementary element of entrepreneurial teacher success and entrepreneurship ecosystem, entrepreneurial school climate is important from pedagogical environments (Uçar, 2020). Teachers, who are the pedagogical practitioners of entrepreneurship, and schools, where entrepreneurship culture is created, play a key role in the integration of entrepreneurship into education from an early age and the acquisition of entrepreneurial competencies. In this context, the pedagogy of entrepreneurship has recently come to the forefront as a new field of study. Therefore, in this chapter, we first examine the nature of entrepreneurship in different fields, then explain the importance of entrepreneurship education and models of entrepreneurship education, and then introduce entrepreneurial teacher competencies as active practitioners of education. Finally, we presented the structure, characteristics and types of skills covered by the concept of "pedagogical entrepreneurship (PE)", which emerged as a new product of the evolution of entrepreneurship in the pedagogical dimension. We also explored the challenges faced in applying pedagogical entrepreneurship in education and discussed what needs to be done to overcome these difficulties.

Entrepreneurship and Entrepreneurship Education

When the historical process relating to sustainable development is examined, entrepreneurship competence comes to the forefront with the definition of "entrepreneurship and initiative" terms among the competencies that the information society should have (EC, 2006). Similarly, the work of the Organization for Economic Cooperation and Development (OECD, 2018) has brought to the agenda the need to develop entrepreneurial competencies for economic development and social cohesion. In the 21st-century economy and business environment, new competencies such as digital literacy, business management, planning, and entrepreneurship need to be developed to cope with the current problems caused by globalization and the pandemic (Slišāne, 2021; Turulja et al., 2020). Current development plans, institutional strategic plans, action plans, and educational reforms developed to train manpower with these competencies required by the business world have contributed to the development of the pedagogical aspect of entrepreneurship.

The relationship between entrepreneurship and pedagogy is often described using terms such as "entrepreneurial learning, entrepreneurship education and entrepreneurship pedagogy" (Skolverket, 2015 as cited in Dal et al., 2016). The term entrepreneurship, which has its origin in the field of finance, is defined as "establishing new organizations" from the economic dimension (Gartner, 1989). In the educational dimension, entrepreneurship is the ability to put ideas into action (EC, 2016). According to the World Economic Forum, entrepreneurship is a process that encompasses innovation, creativity and sustainable development (WEF, 2009), while according to the European Commission, it is the ability to transform ideas involving innovation and creativity into practice and to initiate, plan and sustain a project (EC, 2008, 2012). The goal of providing individuals with these competencies has been the starting point for entrepreneurship education research.

Entrepreneurship education is the development of personal characteristics, attitudes and skills that underpin entrepreneurial thinking and behavior (EC, 2008, 2012). The entrepreneurial skills targeted by entrepreneurship education include "analytical, creative and innovative thinking, idea generation, research, planning, problem-solving, decision making, risk-taking, collaboration, communication, persuasion, tolerance of ambiguity, opportunity and value creation, financial and digital knowledge, proactivity, responsibility, leadership, and success motive" (Haara et al., 2016; Huber, Sloof, & Van Praag, 2012; OECD, 2018). The expectation from entrepreneurship education is to equip individuals with both economic value for their future lives and cognitive and

social skills within the framework of lifelong learning. (EC, 2008, 2012). In gaining these skills and competencies, the need to address the pedagogical structure of entrepreneurship comes to the fore. In this context, it is crucial to implement commercial, pedagogical, and social activities within the field of education that provide societal and individual benefits from economic, cultural, and social perspectives (Uçar, 2020). As a matter of fact, in the Entrepreneurship Strategy and Action Plan (2019), it is stated that entrepreneurial characteristics and competencies should be considered in teacher education and that it is important to invest in lifelong entrepreneurship education (p. 27, 48).

Entrepreneurship education aims to enable individuals to take action by using the necessary knowledge and skills to cope with problem situations (OECD, 2018). Moreover, it seeks to promote the adoption of entrepreneurship as a lifestyle (Uçar, 2020) and fosters the emergence of characteristics related to entrepreneurial potential (Heinonen & Poikkijoki, 2006). The dimensions of "creating a business idea, product design and production, financing, promotion and marketing, investment and sustainability" are emphasized as entrepreneurship-related elements of entrepreneurship education. The entrepreneurship skills and pedagogical competencies targeted to be developed in each dimension are combined in Table 1 (adapted from Deveci & Beşoluk, 2022; Tarhan, 2020).

Table 1. *Entrepreneurship and pedagogical skills targeted to be developed according to the dimensions of entrepreneurship education*

Entrepreneurship Dimensions	**Target Entrepreneurship Skills**	**Target Pedagogical Skills**
Creating a business idea	Expressing a business idea, forecasting, understanding the difference, designing a workplace, business planning	Creative thinking, innovative thinking, seeing opportunity, collaboration, problem solving
Financing	Awareness of financing support, cost calculation, needs, market and resource analysis	Resource management, risk-taking, locus of control
Product design and production	Product (brochure, logo, advert) design, determination of product quality, product production	Teamwork
Promotion and marketing	Creating a marketing plan, defining the market and product, product promotion, advertising design	Effective communication, self-confidence and self-efficacy
Investment and sustainability	Governance, networking	Problem-solving, futuristic thinking, determination, leadership

It is recommended to use various teaching methods and techniques such as mind intelligence games, modelling, interdisciplinary STEAM applications, digital story, project development, case studies, field trips, observation, drama, interviews with experts, experimentation, and argumentation to gain entrepreneurship competencies with the elements of entrepreneurship education (Selanik Ay & Acar, 2016; Tarhan, 2021). Furthermore, it is recommended to design activities based on real-world issues related to the topic, that is, to implement life-based learning (Uçar, 2020). The suggestions indicate that experiential and active pedagogical methods are widely used in entrepreneurship education (Hägg & Gabrielsson, 2020). Entrepreneurship education for the acquisition of entrepreneurial skills is based on three approaches (Haara & Jenssen, 2019; Kirby, 2003; Lackéus 2015):

i) Teaching about entrepreneurship: It aims to provide students with a general conceptual knowledge and understanding of entrepreneurs and entrepreneurship. This approach is suitable for secondary and university levels and is based on theoretical subject and content-based teaching.

ii) Teaching for entrepreneurship: Focuses on students' acquisition of basic skills and competencies (business plan, project preparation, etc.) related to entrepreneurship practices to train entrepreneurs. This approach, suitable for secondary and university levels, aims to provide vocational knowledge and skills.

iii) Teaching through/through entrepreneurship: It aims for students to create new ventures, such as starting a company, and to experience the entrepreneurial process behaviorally. This approach, which can be adapted for all levels of education, is a high-level, applied approach that encompasses both mentioned strategies. With this teaching approach, both the discipline-specific subject area is learned, and entrepreneurial skills are developed with the practical dimension. Entrepreneurship skills are acquired through on-the-job practices, that is, by doing and experiencing.

In terms of level, teaching about entrepreneurship is at the cognitive level, teaching for entrepreneurship is at the skill level, and teaching through entrepreneurship is at the behavioral level. When entrepreneurship education models are examined in the literature, the purpose and dimensions emphasized by each model (Bal İncebacak, 2022, p. 46, 54) are given in Table 2.

Table 2. *Entrepreneurship education models*

Model Name	**Dimensions of the Model**	**Purpose of Entrepreneurship Education in the Model**
Progression Model (Rasmussen & Nybye, 2013)	1-Action (start-up, communication, value creation, collaboration) 2-Creativity (idea-opportunity, applied knowledge, solution) 3-Attitude (self-confidence, dealing with uncertainty, accepting failure, ethical principles) 4-Environment (culture, conditions, market, economy)	Finding new solutions by applying knowledge as a team, experimenting with ideas and transforming them into applications that create value in society, developing creativity, creating initiatives
Entrepreneurship and Education Integration Model (Paloniemi & Belt, 2017)	1-Entrepreneurship Skills (opportunity creation, business design, modelling, planning) 2-Entrepreneurship Training (creating opportunities, learning and teaching) 3-Training Process (structuring learning and teaching: social constructivism)	Making practical applications, creating ideas, opportunities and value

Based on different definitions and approaches of entrepreneurship, it is understood that the dimensions focused on "idea creation, opportunity creation, value creation and venture creation" come to the fore in educational models (Lackeus, 2020). It is important to provide entrepreneurship education in all its dimensions in the early stage. According to Erikson's Psychosocial Development Theory (1968), he stated the "guilt phase against entrepreneurship" (3-6 years) is the third period. In this stage, he explains that entrepreneurial characteristics emerge in individuals at an early age before reaching school age. Therefore, it is necessary to create active, flexible, interactive,

democratic, social, motivating, collaborative, inspiring and multidimensional entrepreneurial learning environments to foster the development of these entrepreneurial characteristics (Gibb, 2005; Löbler, 2006). It is important to organize these environments in a way that encourages entrepreneurial behaviors, entrepreneurial ideas, collaborative work, student success, and students to take authority and responsibility (Yaman, 2023). Learning environments with these qualities will encourage entrepreneurial learning.

The term entrepreneurial learning is associated with the learning process and learning styles in an entrepreneurial context. It is based on knowledge (know-what), skills (know-how) and connections/networks (know-who). In other words, entrepreneurial learning focuses on knowledge accumulation, experience, developing new knowledge, and formal and informal networking. In this framework, entrepreneurial learning occurs during the process of understanding and changing the environment, starting and managing new ventures through social interaction, discovering and evaluating opportunities, taking action, and transforming experiences into action. Due to its social and individual nature, entrepreneurial learning involves "individual and collective learning, exploratory and utilitarian learning, intuitive and perceptual learning", and it requires the integration and interaction of these three types of learning. This is because these types of learning help in the entrepreneurial process of generating and implementing new ideas and understanding how entrepreneurs discover and develop opportunities (Wang & Chugh, 2014). The characteristics of entrepreneurship education for entrepreneurial learning include facilitating learning, learning by doing, teamwork and problem-solving (Garnett, 2013).

Entrepreneurial thinking skills are as important as entrepreneurial learning. Raising entrepreneurial thinkers with entrepreneurial intentions, attitudes, cognitive structures and deep belief systems about a subject requires special expertise (Kruger, 2007). From this point of view, **entrepreneurial teachers** play a key role in the implementation of entrepreneurship education models, the design of entrepreneurial learning environments and the dissemination of entrepreneurial learning, entrepreneurial thinking skills, entrepreneurial mindset and culture (Deveci, 2016; EC, 2014; Slišāne, 2021).

Entrepreneurial Teacher Competencies

The terms "entrepreneurial teachers" and "teacher entrepreneurs" are used in the educational context to understand the implications of entrepreneurial behavior in teaching methods. These terms refer to teachers who exhibit entrepreneurial characteristics in the teaching process (Slišāne, 2021). There are three perspectives in literature on teacher entrepreneurship. The first one is entrepreneurship education and pedagogy, which aims to develop entrepreneurial skills in students. The second perspective, entrepreneurship, business development and establishment, focuses on commercial and economic activities, such as teachers starting an enterprise and a business. Finally, the entrepreneurial competencies and behaviors perspective reflects teachers who transform their entrepreneurial competencies into behaviors and actions (Keyhani & Kim, 2021). In this framework, entrepreneurial teachers have characteristics such as "knowledgeable, dedicated, innovative, collaborative, responsible, opportunity-oriented, risk-tolerant, proactive, social, self-developing, motivated, committed, decisive, leader, visionary" (Keyhani & Kim, 2021; Slišāne & Hyytenen, 2023).

The literature emphasizes that entrepreneurial teacher competencies and entrepreneurship education should differ from traditional approaches and understanding. Entrepreneurial teachers are defined as both people who develop entrepreneurial skills in their students (Peltonen, 2015) and entrepreneurs who bring an entrepreneurial mindset to their students (Heinonen & Poikkijoki, 2006). Whether they start a business or not, teachers with entrepreneurial knowledge and characteristics become role models in the process of developing entrepreneurial behavior in their students. The characteristics of an entrepreneurial teacher for students include *encouraging student*

participation, communicating well with them, motivating them, using different methodologies, and being flexible (San-Martín et al., 2021). In addition, entrepreneurial teachers demonstrate entrepreneurial behaviors that enhance their professional performance and improve students' learning. These entrepreneurial behaviors of teachers include *seeing opportunities, following innovative practices, researching new developments and studies in the field of education, motivating students to think critically and creatively, developing technology-based projects inside and outside the classroom, adapting teaching materials to changing situations, and seeking the necessary resources for this* (Khorrami, Farhadian, & Abbasi, 2018, Neto, Rodrigues, & Panzer, 2017 as cited in Slišāne, 2021). Therefore, entrepreneurial teachers encourage their students to set goals, take responsibility, plan, search for different solutions and find answers, self-regulate, self-evaluate, act independently, etc., allow them to take risks, learn from their mistakes, develop and apply different perspectives, facilitate learning through individual and collaborative experiences, and enrich learning with developing new teaching methods and original activities (Garnett, 2013; Seikkula et al., 2015; Slišāne, 2021). At the same time, the entrepreneurial teacher, who has characteristics such as leadership, open-mindedness and high persuasiveness, establishes effective communication networks with students, teachers, parents and other educational stakeholders, and looks for ways to involve different sectors in entrepreneurship education (EC, 2011, 2014).

With entrepreneurial characteristics such as cognitive (*presenting a business idea, defining concepts related to entrepreneurship, etc.*) and non-cognitive (*creativity, innovation, risk-taking, seeing opportunities, teamwork, determination, etc*.) (Deveci, 2021; Deveci & Beşoluk, 2022), the teacher needs to effectively implement entrepreneurship education by integrating it into the lesson and subject to develop entrepreneurial knowledge and skills in their students. For this, an entrepreneurial teacher needs to possess pedagogical field competence specific to entrepreneurship skills across the dimensions of "goal, student, program, strategy and evaluation". In this context, the "**pedagogical entrepreneurship**" approach comes to the fore as a way of conceptualizing entrepreneurship pedagogy in the gaining and evaluating entrepreneurship skills in educational institutions.

Pedagogical Entrepreneurship

Changing educational reforms bring changes in the teacher education system to train qualified and competent teachers who can adapt to technological development and labour market demands. School reforms require teachers to design an effective learning process that enables students to acquire entrepreneurial skills. The process related to these learning practices is still unclear and brings up the new concept of pedagogical entrepreneurship (Dal et al., 2016; Slišāne, 2021). The concept of "pedagogical entrepreneurship" is used to describe the integration of entrepreneurship into the educational process (Haara et al., 2016). Pedagogical entrepreneurship combines the field of pedagogy and the discipline of entrepreneurship. Pedagogical entrepreneurship is a necessary tool for student development with action-oriented, authentic learning and self-regulation abilities that are not only related to economics or business (Haara & Jenssen, 2016).

Pedagogical entrepreneurship is an approach to teaching and learning that focuses on opportunities and possibilities in the classroom, with a focus on discovery and innovation, based on a lifelong learning perspective (Haara & Jenssen, 2019). The concept of pedagogical entrepreneurship is defined narrowly and broadly in different countries. From a narrow perspective, pedagogical entrepreneurship is applied more business-oriented in secondary education, while in a broad sense, the concept is used to promote creativity in primary school education. In these perspectives, the focus is on fostering innovation and creativity in the early years of school, whereas the implementation of creative entrepreneurial ideas through educational activities related to economics and business at upper secondary level (Dal et al., 2016).

From an educational perspective, pedagogical entrepreneurship is the realization of entrepreneurship education from a teacher or pedagogue perspective (Leffler, 2009; Riese, 2011; Svedberg, 2010). At the same time, pedagogical entrepreneurship is an incentive tool that helps the successful implementation of individual and organizational goals in the teaching profession (Slišāne, 2023). Namely, pedagogical entrepreneurship is about how teachers can use their entrepreneurial competencies in managing classroom and out-of-school practices. Therefore, teacher and pedagogical approaches play a key role in developing students' entrepreneurial competencies. Pedagogical entrepreneurship is carried out by entrepreneurial teachers who are innovative and flexible thinkers, recognize problems, set strategic goals, collaborate with school and community, work in teams, take initiative, identify and evaluate opportunities, use resources efficiently, take financial responsibility, are socially motivated, risk-takers, persistent and determined, creative and leaders. Moreover, to develop entrepreneurial competencies, it is important that students actively participate in the learning process (Toutain & Fayolle, 2017; Slišāne, 2021, 2023; Slišāne & Rubene, 2021). Therefore, pedagogical entrepreneurship aims to help students develop an entrepreneurial mindset capable of making independent decisions through a more innovative and creative learning process rather than starting a business (Dal et al., 2016; Riese, 2010). In this context, pedagogical entrepreneurship is often associated with 'creativity and innovation' terms. In this perception, the pedagogical entrepreneurship concept is a definition that includes competencies related to creativity, innovation, planning research/work, problem-solving, and working in a team (Sjøvoll, 2011, Skolverket 2015 as cited in Dal et al., 2016). The components that determine the conceptual framework of pedagogical entrepreneurship are as in Table 3 (Slišāne, 2023, p. 2858)

Table 3. *Conceptual framework of pedagogical entrepreneurship (PE)*

Conceptual Components	**Personal skills**	**Social skills**
Leadership	Flexibility	Effective communication Using resources
Professional autonomy	Pedagogical activity knowledge Professional reflection Professional determination	-
Proactivity	Strategic vision Risk-taking	-
Problem-solving	-	Social innovation Creating added value

Pedagogical entrepreneurship is an important approach to improving teaching methods that focuses on developing these characteristics and qualities (Dal et al., 2016). One of the factors affecting the development of pedagogical entrepreneurship is the use of methodology and the provision of an educational environment that supports skills. For this, making the educational process more relevant to daily life, transferring experience to different situations, action-based educational processes are recommended. Examples of these educational processes include creating problem-solving focused performance tasks, assigning interdisciplinary projects, encouraging collaborative work environments, developing role-play/drama or simulation applications, taking different learning styles into account, internship applications in the field of education, and using an innovative approach that supports entrepreneurship and pedagogical entrepreneurship. Curricula need to be aligned with the skills of teachers with pedagogical entrepreneurship competencies to effectively use these educational practices and help students achieve skill acquisition (Slišāne, 2023). Pedagogical entrepreneurship, in this regard, focuses on ensuring the applicability of the curriculum in schools through workshops that foster creative learning environments (Dal et al., 2016). From here, it is understood that "entrepreneurial curriculum, innovative and creative learning

environment, entrepreneurial teacher and student roles" are among the important dimensions of pedagogical entrepreneurship (Koç Erdamar & Görkaş Kayabaşı, 2022).

Educational policies and research from different countries such as Finland and Norway emphasize that the pedagogical entrepreneurship approach should be applied in every subject. Moreover, pedagogical entrepreneurship should be present in teacher education programs at the theoretical and practical levels. Thus, after graduation, teachers in practice are expected to act as change agents. Because pedagogical entrepreneurship prioritizes the implementation of research-based, action and problem-oriented real-life situations. Students understand the complex nature of everyday life problems, explore new possibilities, research to create value in society and experience the process by reflecting on their teaching practices with this approach (Haara & Jenssen, 2019; Haara et al., 2016). In general, when the definitions of pedagogical entrepreneurship are examined, the areas of emphasis and focus of this concept are action-based teaching, active-creative-entrepreneurial and authentic learning, self-regulation ability, action and value creation competence, problem-solving and interaction with society (Haara & Jenssen, 2019; Lackeus, 2016).

Challenges encountered in implementing pedagogical entrepreneurship in education include the dominance of the economic aspect of entrepreneurship, teachers' uncertainty in the processes of assessing entrepreneurial learning and implementing entrepreneurial methods, lack of a common understanding of the concept of pedagogical entrepreneurship, the limited use of pedagogical entrepreneurship in school courses and curricula, lack of knowledge and skills in school leaders and teachers to implement this approach, and incompatibilities between practice and educational policy. To overcome these challenges, it is recommended that pedagogical entrepreneurship be integrated into teacher training programs, focusing on developing a learning approach that transforms competencies into action through entrepreneurship, rather than simply teaching knowledge about entrepreneurship (Haara & Jenssen, 2019). From this point of view, it is extremely important to simplify the conceptual framework of pedagogical entrepreneurship, to structure an educational model appropriate to the nature of pedagogical entrepreneurship, to integrate the model with teacher training programs, to plan active learning and teaching practices for pedagogical entrepreneurship-oriented science teaching, to develop activity guides in this framework, to enrich the activities with daily life practices, and to prepare new measurement tools to evaluate pedagogical entrepreneurship approach and competency areas.

References

Anderson, S., Leventhal, T., Newman, S., & Dupéré, V. (2014). Residential mobility among children: A framework for child and family policy. *Cityscape*, 16(1), 5-36. https://www.jstor.org/stable/26326856

Aydın Günbatar, S. (2019). Categorization of pedagogical content knowledge and current studies. Ş. Uluçınar Sağır (Ed.). In *Pedagogical Content Knowledge from Theory to Practice* (pp. 161-174). Pegem Academy.

Bal Incebacak, B. (2022). Entrepreneurship education models. A. Kirman Bilgin (Ed.). In *Entrepreneurship Education in Science and 5.-6.-7.-8. Grade Integrated Sample Activities* (pp. 41-88). Efe Academy.

Bikse, V., & Riemere, I. (2013). The development of entrepreneurial competences for students of mathematics and the science subjects: The Latvian experience. *Procedia-Social and Behavioral Sciences, 82,* 511-519. https://doi.org/10.1016/j.sbspro.2013.06.301

Council of Higher Education [CoHE]. (2018). Teacher training undergraduate programs. https://www.yok.gov.tr/kurumsal/idari-birimler/egitim-ogretim-dairesi/yeni-ogretmen-

yetistirme-lisans-programlari

Dal, M., Elo, J., Leffler, E., Svedberg, G., & Westerberg, M. (2016). Research on pedagogical entrepreneurship: A literature review based on studies from Finland, Iceland and Sweden. *Education Inquiry*, *7*(2), 159-182. http://dx.doi.org/10.3402/edui.v7.30036

Deveci, İ. & Beşoluk, Ş. (2022). Interdisciplinary science teaching and entrepreneurship. H. Ş. Ayvacı & M. Ergun (Eds.), In *Interdisciplinary Science Teaching* (pp. 116-143). Pegem Academy.

Deveci, İ. (2016). *Development, implementation and evaluation of entrepreneurship education modules integrated with science curriculum (5-8)* [Doctoral Thesis], Bursa Uludağ University.

Deveci, İ. (2021). Entrepreneurial mindset. Ü. Ormancı & S. Çepni (Eds*.)*. In *From Theory to Practice in 21st-Century Skills and Teaching* (pp. 565-585). Nobel Academy

Entrepreneurship Strategy and Action Plan. (2019). Turkey entrepreneurship strategy action plan (2015-2018). https://webdosya.kosgeb.gov.tr/Content/Upload/ Dosya/Mali%20 Tablolar/Gisep_2015-2018_TR.pdf

Erikson, E.H. (1968). *Identity: Youth and crisis*. W.W. Norton & Company, Inc.

European Commission (2006). Entrepreneurship education in Europe: Fostering entrepreneurial mindsets through education and learning. In *Final proceedings of the conference on entrepreneurship education in Oslo*.

European Commission (2008). *Entrepreneurship in higher education, especially within non-business studies: Final Report of the Expert Group*. Brussels.

European Commission (2012). *Entrepreneurship education at school in Europe. National Strategies, Curricula and Learning Outcomes.*

European Commission (2014). *Thematic working group on entrepreneurship education*. http://ec.europa.eu/dgs/education_culture/repository/education/policy/strategic-framework/archive/documents/ entrepreneurship-report-2014_en.pdf

European Commission, (2011). *Entrepreneurship education: Enabling teachers as a critical success factor.* Brussels.

European Commission. (2016). *Entrepreneurship education at school in Europe*. Eurydice Report. https://eric.ed.gov/?id=ED581883

European Commission. (2017). *Promoting entrepreneurship*. https://ec.europa.eu/growth/smes/promoting-entrepreneurship_en

Garnett, J. (2013). Enterprise pedagogy in music: An exploration of multiple pedagogies. *Music Education Research, 15*(1), 1–18. http://dx.doi.org/10.1080/14613808.2012.703175

Gartner, W. B. (1989). "Who is an entrepreneur?" Is the wrong question. *Entrepreneurship Theory and Practice*, *12*(4), 11-32. https://doi.org/10.1177/104225878801200401

Gehrtz, J., Brantner, M., & Andrews, T. C. (2022). How are undergraduate STEM instructors leveraging student thinking? *International Journal of STEM Education, 9*(18). https://doi.org/10.1186/s40594-022-00336-0

Gibb, A. (2005). The future of entrepreneurship education: Determining the basis for coherent policy and practice?. In *The Dynamics of Learning Entrepreneurship in a Cross-Cultural University Context*, Entrepreneurship Education Series. Kyrö, P. & Carrier, C. (Eds.). (pp. 44–66). Hämeenlinna.

Haara, F. O., & Jenssen, E. S. (2016). Pedagogical entrepreneurship in teacher education–what and why?. *Tímarit um uppeldi og menntun*, *25*(2), 183-196. https://ojs.hi.is/index.php/tuuom/article/view/2434

Haara, F. O., & Jenssen, E. S. (2019). The influence of pedagogical entrepreneurship in teacher education. In *Oxford Research Encyclopedia of Education*. 1-18. https://doi.org/10.1093/acrefore/9780190264093.013.754

Haara, F. O., Jenssen, E. S., Fossøy, I., & Ødegård, I. K. R. (2016). The ambiguity of pedagogical entrepreneurship–the state of the art and its challenges. *Education Inquiry*, *7*(2), 183-210. https://doi.org/10.3402/edui.v7.29912

Hägg, G., & Gabrielsson, J. (2020). A systematic literature review of the evolution of pedagogy in entrepreneurial education research. *International Journal of Entrepreneurial Behavior & Research*, *26*(5), 829-861. https://doi.org/10.1108/IJEBR-04-2018-0272

Heinonen, J., & Poikkijoki, S. A. (2006). An entrepreneurial-directed approach to entrepreneurship education: mission impossible?. *Journal of management development*, *25*(1), 80-94. https://www.researchgate.net/publication/242348939, www.emeraldinsight.com/0262-1711.htm

Huber, L.R., Sloof, R., & Van Praag, M. (2012). The effect of early entrepreneurship education: Evidence from a randomized field experiment [Discussion Paper]. IZA, Bonn, IZA. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2051355

Keyhani, N., & Kim, M. S. (2021). A systematic literature review of teacher entrepreneurship. *Entrepreneurship Education and Pedagogy*, *4*(3), 376-395. https://doi.org/10.1177/2515127420917355

Kirby, D. A. (2003). *Entrepreneurship*. Maidenhead: McGraw-Hill.

Koç Erdamar, G. & Görkaş Kayabaşı, B. (2022). Pedagogy and development of entrepreneurship. S. Yaman & H. Çelik (Eds.). In *Entrepreneurship Education from Theory to Practice* (pp. 39-71). Pegem academy.

Krueger Jr, N. F. (2007). What lies beneath? The experiential essence of entrepreneurial thinking. *Entrepreneurship Theory and Practice*, *31*(1), 123-138. https://doi.org/10.1111/j.1540-6520.2007.00166.x

Lackéus, M. (2015). Entrepreneurship in education: What, why, when, how. *OECD Publication. https://www.oecd-ilibrary.org/docserver/cccac96aen.pdf?expires=1730238874&id=*id&accname=guest&checksum=3F7FDB5982F9F3EC12A104823D939DB7

Lackéus, M. (2016). *Value creation as educational practice—Towards a new educational philosophy grounded in entrepreneurship?* [Doctoral Thesis]. Chalmers University of Technology.

Lackéus, M. (2020). Comparing the impact of three different experiential approaches to entrepreneurship in education. *International Journal of Entrepreneurial Behavior &*

Research, *26*(5), 937-971. https://doi.org/10.1108/IJEBR-04-2018-0236

Leffler, E. (2009). The many faces of entrepreneurship: A discursive battle for the school arena. *European Educational Research Journal*, *8*(1), 104-116. https://doi.org/10.2304/eerj.2009.8.1.10

Löbler, H. (2006). Learning entrepreneurship from a constructivist perspective. *Technology Analysis ve Strategic Management, 18*(1), 19–38. https://doi.org/10.1080/09537320500520460

Major, C. H., & Palmer, B. (2006). Reshaping teaching and learning: The transformation of faculty pedagogical content knowledge. *Higher Education, 51*(4), 619–647. https://doi.org/10.1007/s10734-004-1391-2

Major, C., & Palmer, B. (2002). Faculty knowledge of influences on student learning. Peabody *Journal of Education, 77*(3), 138–162. https://doi.org/10.1207/S15327930PJE7703_8

Martínez-Gregorio, S., Badenes-Ribera, L., & Oliver, A. (2021). Effect of entrepreneurship education on entrepreneurship intention and related outcomes in educational contexts: A meta-analysis. *The International Journal of Management Education*, *19*(3), 1-15. https://doi.org/10.1016/j.ijme.2021.100545

Ministry of National Education [MoNE]. (2018). Science, social studies, science practices course curricula. http://mufredat.meb.gov.tr/Programlar.aspx

Ministry of National Education [MoNE]. (2024). Turkey Century Education Model and curricula. https://tymm.meb.gov.tr/ogretim-programlari

Morris, M. H., & Kuratko, D. F. (2002). *Corporate entrepreneurship*. Southwestern.

Mthethwa-Kunene, E., Onwu, G. O., & de Villiers, R. (2015). Exploring biology teachers' pedagogical content knowledge in the teaching of genetics in Swaziland science classrooms. *International Journal of Science Education*, *37*(7), 1140-1165. https://doi.org/10.1080/09500693.2015.1022624

Organisation for Economic Cooperation and Development. [OECD]. (2018). *Future of Education and Skills 2030.* https://www.oecd.org/content/dam/oecd/en/about/ projects/edu/education-2040/concept-notes/Skills_for_2030_concept_note.pdf

Organization for Economic Cooperation and Development. [OECD]. (2011). Fostering innovation to address social challenges. https://www.oecd.org/sti/inno/47861327.pdf

Paloniemi, K., & Belt, P. (2015). Mismatch in teachers' ontological conception of entrepreneurship education. In (ed. J. C. Sanchez-Garcia) *Entrepreneurship Education and Training,* (pp. 261-278). Open Textbooks.

Peltonen, K. (2015). How can teachers' entrepreneurial competences be developed? A collaborative learning perspective. *Education+ Training, 57*(5), 492-511. https://doi.org/10.1108/ET-03-2014-0033

Rasmussen, A., & Nybye, N. (2013). Entrepreneurship education: progression model. *Odense: Young Enterprise Denmark. 25*(3), 1-17. https://www.ffe-ye.dk/media/44723/Progression-model-English.pdf

Riese, H. (2010). *Friendship and learning. Entrepreneurship education through mini-enterprises*. [PhD Thesis]. University of Bergen.

Riese, H. (2011). Enacting entrepreneurship education: The interaction of personal and professional interests in mini-enterprises. *Cambridge Journal of Education, 41*(4), 445–460. https://doi.org/10.1080/0305764X.2011.624998

Rollnick, M., Bennett, J., Rhemtula, M., Dharsey, N., & Ndlovu, T. (2008). The place of subject matter knowledge in PCK—a case study of South African teachers teaching the amount of substance and equilibrium. *International Journal of Science Education, 30*(10), 1365–1387. https://doi.org/10.1080/09500690802187025

San-Martín, P., Fernández-Laviada, A., Pérez, A., & Palazuelos, E. (2021). The teacher of entrepreneurship as a role model: Students' and teachers' perceptions. *The International Journal of Management Education*, *19*(1), 100358, 1-9. https://doi.org/10.1016/j.ijme.2019.100358

Seikkula, L. J., Satuvuori, T., Ruskovaara, E., Hannula, H. (2015). How do Finnish teacher educators implement entrepreneurship education?. *Education & Training, 57*(4), 392–404. https://doi.org/10.1108/et-03-2013-0029

Selanik Ay, T., & Acar, Ş. (2016). Views of classroom teachers about the acquisition of entrepreneurial skills. *Electronic Journal of Social Sciences*, *15*(58), 960-976. https://doi.org/10.17755/esosder.258829

Slišāne, A. (2021). Conceptualization of pedagogical entrepreneurship. *Human, Technologies and Quality of Education*, 673-685. https://doi.org/10.22364/htqe.2021.53

Slišāne, A. (2023). Conceptualization of Pedagogical Entrepreneurship: Theory and Results of Qualitative Research. In *INTED2023 Proceedings* (pp. 2856-2864). IATED. https://doi.org/10.21125/inted.2023.0788

Slišāne, A., & Hyytenen, H. (2023). Pedagogical entrepreneurship in teacher education curricula. Comparison of Latvian and Finnish Teacher Education Programs. *To Be Or Not To Be A Great Educator*, 72-91. https://doi.org/10.22364/atee.2022

Slišāne, A., & Rubene, Z. (2021). Entrepreneurship pedagogy: Entrepreneurial skills and mindset. International *Journal of Smart Education and Urban Society (IJSEUS), 12*(2), 60–71. http://doi.org/10.4018/IJSEUS.2021040106

Smith, E. E., & Kanuka, H. (2018). Transdisciplinary or pedagogically distinct? Disciplinary considerations for teaching certificates in higher education. *International Journal of Teaching and Learning in Higher Education, 30*(3), 388–401. https://eric.ed.gov/?id=EJ1199278

Svedberg, G. (2010). Pedagogical entrepreneurship in the formulation and realisation arena. *Creativity and Innovation: Preconditions for entrepreneurial education*, 121-129. https://l24.im/sYnU

Tarhan, M. (2020). *Introduction to Entrepreneurship Pedagogy*. Pegem Academy.

Tarhan, M. (2021). *Different Approaches in the Acquisition of Entrepreneurship Skills*. Nobel.

Toutain, O., & Fayolle, A. (2017). Labour market uncertainty and career perspectives: Competence in entrepreneurship courses. In M. Mulder (Ed.), *Competence-based Vocational and Professional Education Bridging the Worlds of Work and Education* (Technical and Vocational Education and Training: Issues, Concerns and Prospects 23) (pp. 985–1006).

Springer.

Turulja, L., Kapo, A., Kačapor, K., & Bajgorić, N. (2020). Teachers' digital competence enhancing high school students' success: the mediating role of pedagogical innovation and entrepreneurship in teaching. *14th International Technology, Education and Development Conference,* Valencia, Spain. http://doi.org/10.21125/inted.2020.1549

Uçar, S. (2020). *Entrepreneurship Education: An Overview from Primary Education to Teacher Education*. Academician.

Wang, C. L., & Chugh, H. (2014). Entrepreneurial learning: Past research and future challenges. *International Journal of Management Reviews, 16*(1), 24-61. https://doi.org/10.1111/ijmr.12007

World Economic Forum. [WEF]. (2009, April). Educating the next wave of entrepreneurs: Unlocking entrepreneurial capabilities to meet the global challenges of the 21st century. In *World Economic Forum: A Report of the Global Education Initiative.*

Yaman, S. (2023). Entrepreneurial thinking skills. G. Ekici (Ed.). In *Thinking Skills and Application Examples Guidebook*. (pp. 293-332). Vizetek.

About the Authors

Dr. Kadriye BAYRAM graduated from Selçuk University, Faculty of Education, Science Education Department with the highest honors in her department and Faculty. She completed her master's degree at Necmettin Erbakan University and her doctorate at Gazi University. During her graduate education, she gained TUBITAK-BIDEB program success scholarships. She worked as an expert at Cappadocia Technopark and participated in various activities for public-university-industry cooperation. At the same time, she participated in different activities within the scope of project-based international exchange programs in the International Relations Office. She worked as a researcher and trainer on many projects supported by TUBITAK, the Development Agency, and Scientific Research Project. She is currently the TUBITAK project manager within the scope of the postdoctoral research fellowship program. She conducts studies in subject areas such as pedagogical content knowledge, socio-scientific issues, sustainability, argumentation, and entrepreneurship education. She continues her studies at Nevsehir Haci Bektas Veli University as a Dr. Research Assistant in Science Education.

E-mail: k.bayram50@yahoo.com. **ORCID:** 0000-0002-5366-0833

Prof. Dr. Oktay ASLAN graduated from Selçuk University, Faculty of Education, Department of Science Education in 2001. The same year, he was appointed as a research assistant to the Selçuk University Faculty of Education, Department of Science Education. He completed his master's degree in 2004, and his doctorate in Science Education in 2009. In 2013, he worked as a visiting academician at Vienna University. In 2017, he received the title of associate professor in the field of Science Education; in 2022, he received the title of Professor. He works as a faculty member at Necmettin Erbakan University Ahmet Kelesoglu Education Faculty, Science Education Department. He conducts studies in the fields of nature of science, socio-scientific issues, out-of-school learning environments, creative drama, nanoscience and nanotechnology education.

E-mail: oktayaslan@gmail.com, **ORCID:** 0000-0001-7938-1413

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 2%.

To Cite This Chapter:

Bayram, K. & Aslan, O. (2024). From entrepreneurship to pedagogical entrepreneurship: an educational framework. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp.40-53). ISRES Publishing.

Entrepreneurıal Teacher Behaviors

Celalettin ÇELEBİ

Necmettin Erbakan University

Uğur ATASEVEN

Necmettin Erbakan University

Introduction

The concept of entrepreneurship can be defined in the broadest sense as the ability to innovate, develop, and recognize opportunities, transforming them into viable and marketable ideas, and adding value to products and services through time, effort, money, and skills. (Kuratko, 2014). Since entrepreneurship is not an inherited trait, the ability to acquire the skills mentioned in the definition, along with the fact that behaviors related to entrepreneurship and entrepreneurship itself are learnable disciplines (Drazin, 1985), comes into play.

The personal characteristics, mindset and perspective, skill and competency levels, and actions of entrepreneurship can be developed, making the education and training process critical for acquiring these skill sets (Lichtenstein and Lyons, 2001; Shabbir et al., 2019). It should be noted that skills and competencies are not fixed traits; they can be developed and learned through experience and education. (Mulder, 2007).

When examining definitions and skill sets related to entrepreneurship, it is possible to see that the characteristics, competencies, and qualifications associated with entrepreneurship share common components formed by the concepts of "knowledge, skills, and personality traits." (Tittel ve Terzidis, 2020). The entrepreneurship skill set consists of three groups of skills that include integrated sub-skills: entrepreneurial skills, technical skills, and management skills (Chandler and Hanks, 1994; Lerner and Almor, 2002; Cooney, 2012). Entrepreneurial skills can include self-discipline, risk-taking ability, innovative thinking, change orientation, and determination. Production processes, design, and R&D activities can be considered technical skills, while planning, decision-making, motivation, promotion and marketing, finance, and sales management can be regarded as management skills. O'Hara (2011), on the other hand, lists four main skills: the ability to recognize and explore opportunities, creative thinking, risk-taking, and organizational skills. (Shabbir et al., 2019) state that the most distinguishing feature that separates entrepreneurship from other leadership or management skills is the tendency to take risks.

Especially in recent years, educational and training programs related to entrepreneurship education practices have been rapidly spreading worldwide (Warhuus et al., 2017). Because entrepreneurship education is important as it enables individuals to develop skills in risk-taking, coping with challenges, competitiveness, and achieving success. (Kuvaas, 2008).

As educators of entrepreneurial skills, teachers play an important role in developing entrepreneurial thinking and action in students and in promoting the development of students' entrepreneurial abilities. (Gibb, 2011). In this context, the fundamental issue regarding the implementation of entrepreneurship education is what it means to be an entrepreneur in teaching practices and how entrepreneurship education can be transformed into teaching practices.

As educators of entrepreneurial skills, teachers play an important role in developing entrepreneurial thinking and action in students and in promoting the development of students'

entrepreneurial abilities. (Gibb, 2011). In this context, the fundamental issue regarding the implementation of entrepreneurship education is what it means to be an entrepreneur in teaching practices and how entrepreneurship education can be transformed into teaching practices. In the research conducted to address this fundamental issue, it has been revealed that entrepreneurial teachers who exhibit behaviors that nurture students' creativity significantly influence students' entrepreneurial intentions; that through fostering creativity in the classroom, teachers motivate students to develop an entrepreneurial mindset and act like entrepreneurs; that there is a positive relationship between teachers' entrepreneurial behaviors and behaviors that nurture creativity; the role of entrepreneurial behavior in developing creativity in education; and that entrepreneurial behavior characterized by innovative and proactive approaches is important in preparing students for the dynamic challenges of the modern world (Saygın, Say, Öztürk, Gülden, and Kaplan, 2024).

Entrepreneurial teacher behavior refers to the proactive and innovative steps educators take to improve their teaching practices and enhance student outcomes. In an increasingly complex and dynamic educational environment, it is considered important for teachers to adopt an entrepreneurial mindset that enables them to recognize opportunities, take initiative, and embrace risk-taking in their classrooms, as well as to possess the skills to initiate and implement projects (Akyürek and Göktaş, 2023; Borasi and Finnigan, 2010). This shift towards entrepreneurial behavior is very important not only because it promotes a culture of innovation in schools but also because it equips students with the critical thinking, problem-solving, and adaptability skills necessary for success in the 21st century. (Leithwood vd., 2004). Therefore, the entrepreneurial behaviors of teachers refer to their ability to act like entrepreneurs while carrying out educational and teaching activities, rather than starting a new venture or establishing a business. (Amorim Neto vd., 2020). By developing an entrepreneurial spirit, teachers can create engaging learning environments that inspire students to take ownership of their education and prepare them for the challenges of a constantly evolving world. Therefore, understanding the qualities and practices associated with entrepreneurial teacher behavior is very important for educators, school leaders, and policymakers who aim to bring about meaningful change in education.

According to Keyhani and Kim (2020), there are three main perspectives in the literature on teacher entrepreneurship. First of all, in order for the teacher to instill entrepreneurial skills in students, they themselves need to possess these skills. (Peltonen, 2015). San-Martín et al. (2021) emphasize the significant role of teachers in imparting and developing entrepreneurial skills among students in their study. Therefore, teachers who possess the characteristics associated with an entrepreneur and the necessary entrepreneurial knowledge can serve as role models for entrepreneurial behaviors, regardless of whether they have established a company, and can lend credibility to what they teach.

Secondly, it is the entrepreneurial activities that teachers undertake to improve their economic situation. In the Philippines, teachers tend to find other sources of income due to certain financial conditions. However, some teachers engage in work related to direct sales companies during their break times and working hours. (Hipolito, 2021).

Thirdly, entrepreneurs in the field of education are typically considered entrepreneurial teachers who explore innovative ideas in the classroom, encourage students to think more critically and creatively, and research the latest developments in educational fields. (Amorim Neto, Rodrigues ve Panzer, 2017). The aim of entrepreneurship in education is not for teachers to leave their profession and start a new business, but for an entrepreneurial teacher to creatively overcome the lack of resources and materials while planning and delivering their lessons with a technology-based approach. Additionally, they act like entrepreneurs when collaborating with others to increase student engagement and success. (Van Dam, Schipper ve Runhaar, 2010).

According to Keyhani and Kim (2020), teacher entrepreneurship encompasses 12 competencies and characteristics: socially motivated, dedicated, proactive, risk-tolerant, knowledgeable, innovative, skillful, opportunity-focused, visionary, collaborative, present in their work, and interested in self-improvement. Ho (2018) states that entrepreneurial teacher behaviors encompass competencies such as making innovations that add value to educational environments, taking risks to recognize and seize opportunities, taking initiative in all educational processes, possessing the ability to initiate and implement a project, and finding the necessary resources to achieve professional goals. Van Dam et al. (2010) categorized the personal qualities of teachers that could be associated with entrepreneurial behaviors as career alignment, creative thinking, entrepreneurial knowledge, and networking and team-building skills. On the other hand, the entrepreneurial environment directly and indirectly affects entrepreneurial behavior. As seen in the literature review, the competencies that entrepreneurial teachers should possess vary. However, it can be said that entrepreneurial teacher behaviors generally encompass qualities such as recognizing opportunities, taking initiative, taking risks, innovativeness and perspective development, future orientation, seeking resources for professional development, and creating a culture of shared professional development and sharing.

Recognizing Opportunities

Entrepreneurial teachers have a keen ability to identify opportunities in educational environments, which is crucial for promoting a dynamic learning atmosphere. This skill involves not only recognizing gaps in the curriculum or areas that need improvement but also understanding the unique needs of their students. (Borasi ve Finnigan, 2010). For example, a teacher might observe that students are struggling with a problem in mathematics and take the initiative to develop additional materials or activities to address this gap, thereby promoting a more inclusive and effective learning environment. Additionally, recognizing opportunities extends beyond the classroom and school; it also involves engaging with the community to identify resources, partnerships, and real-world applications that can enrich the educational experience. By adapting to these opportunities, teachers can innovate and modify their teaching methods to enhance student engagement and learning outcomes, ultimately preparing students for future challenges. Additionally, the ability to recognize opportunities plays a critical role in teachers' professional development. Anderson and Krathwohl (2001) emphasize that the processes of learning and teaching should be continuously evaluated and improved. In this context, entrepreneurial teachers seek various resources and training opportunities to support their professional development. This process not only enables teachers to improve their own knowledge and skills but also allows them to offer students richer and more diverse learning experiences.

Taking Initiative

Entrepreneurial teachers are characterized by their proactive approaches to education, often taking the initiative to innovate in their classrooms and contribute to school communities. This initiative is driven by the desire to increase student engagement and improve educational outcomes. Research shows that when teachers adopt an entrepreneurial mindset, they are more likely to implement new teaching strategies, integrate technology, and seek resources that can benefit their students. (Henry vd., 2015). This initiative often involves developing new curricula, organizing extracurricular activities, or collaborating with colleagues to promote a more dynamic learning environment, ultimately benefiting students and the school community. For example, a teacher can lead a project-based learning activity that encourages students to engage with real-world problems, thereby developing their critical thinking and problem-solving skills. Additionally, taking the initiative can contribute more to the culture of entrepreneurship in education by advocating for policy changes that promote innovative teaching practices within the school or district.

Kaufman and Sternberg (2006) state that creativity and entrepreneurship enhance teachers' ability to inspire and motivate students. Entrepreneurial teachers turn the challenges faced in education into opportunities, enabling students to have more effective and creative learning experiences. This approach also contributes to the development of students' critical thinking and problem-solving skills.

Risk Taking

Risk taking is an important component of entrepreneurial teaching because it encourages educators to step out of their comfort zones and explore new pedagogical strategies. Educators should be willing to try new teaching strategies, even if they don't bring immediate success. (Antonic ve Hisrich, 2003). This willingness to embrace uncertainty can lead to significant advancements in pedagogical practices, as teachers learn from both their successes and failures and promote a culture of innovation in their classrooms. For example, a teacher can implement a flipped classroom model where students engage with instructional content at home and participate in hands-on activities in the classroom. On the other hand, in the implementation of activities such as out-of-school learning, where teachers experience anxiety in planning and execution, the entrepreneurial qualities of teachers, especially their risk-taking behaviors, are considered important. Although this approach initially involves challenges, its potential to increase student engagement and achieve deeper learning outcomes makes it a worthwhile risk. Teachers can encourage students to step out of their comfort zones by modeling risk-taking behavior, and they can help them develop resilience and adaptability skills in the face of challenges.

Innovation and Perspective Development

Research confirms that there is a connection between teachers' innovativeness and the use of teaching methods, and that the teacher's own innovativeness and willingness to take risks are important in developing students' entrepreneurial skills (Joensuu-Salo, Peltone, Hämäläinen, Oikkonen, Raappana, 2021). Innovation in education goes beyond merely presenting new technologies or methods; it requires a fundamental shift in perspective. (Klopper ve Pendergast, 2017). Entrepreneurial teachers develop a mindset that embraces change and encourages creative problem-solving. Entrepreneurial teachers prepare their students for a rapidly changing world by providing an environment where they are encouraged to think critically and explore different perspectives. This development of perspective is very important because it allows students to approach problems with an open mind and consider multiple solutions, thereby enhancing their ability to cope with complex situations in the future. Moreover, teachers can facilitate the development of this perspective by incorporating interdisciplinary approaches that connect various subjects, allowing students to see the relevance of what they have learned in a broader context.

According to Dweck (2006), entrepreneurial teachers not only improve their own professional practices by creating an environment that values innovation, but also inspire their students to become innovative thinkers and problem solvers. These educators utilize various platforms, including online courses, webinars, and professional networks, to acquire new skills and stay updated on pedagogical trends. Research shows that entrepreneurial teachers exhibit a proactive mindset and often participate in collaborative learning environments that facilitate the exchange of ideas and resources among their colleagues (Lackéus, 2015).

Future Orientation

A future-oriented approach is very important for entrepreneurial teachers who prepare students for the challenges of future life. (Leithwood vd., 2004). This involves not only teaching the relevant content but also instilling skills such as adaptability, resilience, and critical thinking. Teachers can help students develop a growth mindset by focusing on future outcomes and enabling them to find their way in an increasingly complex and uncertain world. This future orientation also

encourages educators to stay informed about new trends and technologies, ensuring their teaching remains current and effective. For example, teachers can help students understand the importance of lifelong learning and adaptability in their personal and professional lives by discussing their future career paths and the skills needed in various fields.

Searching for Resources for Professional Development

Entrepreneurial teachers actively seek resources for their professional development. (Blackstone, 2012). This includes participating in workshops, receiving advanced training, and joining professional networks. These educators can continuously develop their skills and knowledge, implement innovative practices in their classrooms, and ultimately benefit their students and the broader educational community. Additionally, they contribute to a culture of continuous improvement in their schools by sharing their learning experiences with their colleagues. Participation in professional learning communities creates a supportive environment that encourages growth and innovation by allowing teachers to collaborate, share best practices, and collectively address challenges.

Research shows that initiatives based on collaboration with community stakeholders can provide significant financial support and resources, allowing teachers to access workshops, conferences, and advanced training programs that they would otherwise be unable to afford. (Hargreaves ve Fullan, 2012). Entrepreneurial teachers not only secure funding through these partnerships but also foster community engagement by creating a supportive environment for their professional development.

The use of digital tools and social media has also changed the way teachers access professional development resources. Entrepreneurial teachers can benefit from a vast treasure trove of knowledge and experience by joining online communities and using social networks, and they can experience personalized learning tailored to their own contexts. (Basham vd., 2016). These types of platforms allow teachers to share best practices, receive mentorship, and explore innovative pedagogical techniques. Therefore, it contributes to the professional development of teachers and the improvement of student outcomes.

Creating a Shared Professional Development and Sharing Culture

Creating a shared professional development culture is vital for encouraging entrepreneurial behaviors among teachers. (Bosma vd., 2010). Educators can learn from each other and collectively improve teaching methods by collaborating and sharing best practices. This culture of sharing not only strengthens professional relationships but also leads to improved student outcomes as teachers implement new strategies and ideas. For example, regular professional learning communities can provide a platform for teachers to discuss the challenges they face, share their successes, and collaboratively develop solutions, ultimately enriching the educational experience for both teachers and students. Additionally, the establishment of mentorship programs where experienced teachers guide new educators can further promote a culture of sharing and continuous development. Research shows that when teachers collaborate, they not only improve their own teaching strategies but also contribute to the development of a supportive community that prioritizes continuous learning and innovation. (Vescio, Ross ve Adams, 2008). This collaborative approach not only improves individual teaching practices but also fosters a shared understanding and responsibility for student success.

Entrepreneurial Teaching (Methods, Techniques, and Applications)

The use of appropriate methods and techniques in the educational environment aimed at developing an individual's entrepreneurial characteristics is also quite important (Kamaç and Kişman, 2020). Research shows that teachers with lower levels of innovation and risk-taking ability

do not use entrepreneurial teaching methods as much as more innovative and risk-taking teachers (Joensuu-Salo, Peltone, Hämäläinen, Oikkonen, Raappana, 2021). Many researchers categorize the teaching methods used in entrepreneurship education into two groups. These are referred to as "traditional methods" (which include normal classes) and "innovative methods" (which are more action-based), or they are also known as "passive methods" and "active methods," respectively. (Samwel Mwasalwiba, 2010). As seen in the literature, various methods and techniques are used in entrepreneurship education, including business simulations, videos and recordings, real business setups, games and competitions, role models and guest speakers, projects, workshops, presentations, discussions and group work, study visits, case studies, business plan creation, creative thinking, brainstorming, role-playing, critical thinking, data collection and analysis, problem-based learning, six hats teaching, snowball, creative drama, aquarium, question and answer, collaborative learning, opposing panel, concept maps, station, entrepreneurship projects and activities, activities that promote interactive learning and reflection, problem-based learning, teamwork, and learning journals (Samwel Mwasalwiba, 2010; Seikkula-Leino, 2011; Uğur, 2015). Educators can create dynamic learning environments that inspire students to take ownership of their education and develop the skills necessary for the future by using these entrepreneurial teaching methods and techniques. For example, incorporating real-world applications into lessons can help students see the relevance of what they are learning to the subject, motivating them to engage more deeply with the materials. Additionally, leveraging technology to create interactive and collaborative learning experiences can enhance student engagement and foster a sense of community within the classroom. In conclusion, entrepreneurial teaching not only benefits students but also empowers educators to be agents of change in their schools and communities.

Entrepreneurial teaching has emerged as a dynamic approach that integrates innovative methods and techniques to develop an entrepreneurial mindset among students. This pedagogical style emphasizes active learning, problem-solving, and creativity, encouraging students to take initiative and apply their knowledge in real-world contexts. At the center of this approach are experiential learning methods such as project-based learning (PBL) and design thinking, which promote practical experiences in line with entrepreneurial principles. (Dewey, 1938; Kolb, 1984). Educators can promote critical thinking and collaboration, which are essential skills for future entrepreneurs, by involving students in original projects.

Nowadays, entrepreneurial teaching techniques generally use technology to enhance learning experiences. Digital tools and platforms facilitate collaborative projects, allowing students to work together beyond geographical boundaries. For example, the use of online brainstorming applications and collaborative document editing can support teamwork and idea sharing. (Baker, 2015).

The implementation of entrepreneurial teaching is influencing various educational contexts, including higher education and adult learning, beyond traditional classroom environments. Universities are increasingly adopting entrepreneurial pedagogies to prepare students for the complexities of the modern workforce and to develop skills such as adaptability and flexibility. (Gibb, 2002). Additionally, community-based initiatives such as entrepreneurship camps and workshops provide practical opportunities for students to engage in entrepreneurial activities, thereby bridging the gap between theory and practice. In general, the methods and practices of entrepreneurship education contribute to the development of a skilled, innovative, and adaptable workforce necessary to overcome the challenges of the 21st century.

Entrepreneurial Teacher and Entrepreneurial Student

The fundamental components of entrepreneurship education are interactive. This interaction involves educators, community events, educational processes, and students. Entrepreneurship education focuses on practices that support innovation and the development of creative skills.

(Binks vd., 2006; Jones & Matlay, 2011; Morris & Liguori, 2016).

Virgin Group Founder Richard Branson, when defining entrepreneurship, said, "You can't learn to walk by following the rules." You learn by trying and falling.He uses his expressions. So, how can we teach students about risk, constant uncertainty, and taking action? How can we instill in students the skill sets and perspectives necessary for success in a future where conditions cannot be predicted from today? In this regard, Liguori (2023) states, "Our goal is not just to hear ourselves talk, but to truly educate the entrepreneurs of the future and encourage them to take action."He shares three insights with educators through his statements:

1. There is power in cross-pollination.

2. Extracurricular learning is essential.

3. No child learns to ride a bicycle from lessons.

Entrepreneurial learning takes place both within and outside the curriculum. Trying again and again after failure, reflecting on failure, and learning to succeed are part of daily life and are ways to acquire an entrepreneurial mindset. This situation is defined as "productive failure." (Advance HE, EEUK, IOEE, ISBE, SFEDI & QAA, 2019). One of the teacher's responsibilities in classroom and activity management is to transform classrooms into places where students feel safe, rather than places where they risk failure. (Liguori, 2023). A teacher aiming to impart entrepreneurial skills should be aware that "entrepreneurship is not a spectator sport" (Aulet, 2019).

"Entrepreneurship is a team sport." (Aulet, 2019). Although the image of "being an entrepreneur" is popular and effective, most entrepreneurial activities involve small teams. In exhibiting entrepreneurial behavior, it is important to develop elements such as proposal development and modification, receiving feedback, designing and presenting the product, promoting the product, and identifying opportunities, which constitute different aspects of entrepreneurship. Having an entrepreneurial mindset requires practicing collaborative reasoning, connecting with others, and engaging with them. In entrepreneurship, teamwork fosters innovative ideas by promoting a dynamic synergy of different perspectives, knowledge, and skills. Collective creative ideas are needed to identify new opportunities and solve complex problems through collaborative thinking and the exchange of experiences. Team members can leverage each other's thinking skills to refine and mature the perspectives and ideas necessary for entrepreneurial success through various stages. (Parthasarathy, Doboli & Paulus, 2011).

"Entrepreneurship and innovation are two different sides of the same coin."Entrepreneurship is driven by innovation. Innovation, being an entrepreneurial behavior, can be considered the driving force of entrepreneurship. (Growth Analysis, 2024). Successful entrepreneurs are often those who are extremely innovative. Innovation gives life to ideas and improves existing processes. Entrepreneurship, on the other hand, is the tool that transforms these innovations into developing companies/businesses. In other words, innovation and entrepreneurship drive progress together.

Steve Jobs' quote, "It's more fun to be a pirate than to join the navy," can be considered the starting point of entrepreneurial intent. One of the sub-skills that a teacher can help students develop in order to enhance their entrepreneurial skills could be "doing what needs to be done differently than expected." When entrepreneurship is considered as doing something that has never been done before or doing it in a way that has never been done before, the "pirate spirit" can create awareness for students, encourage learning, and remind them at every opportunity that other options also exist. At the end of the activities, having students ask themselves the reflective question "What could I have done differently?" can lead to a deeper understanding of the problem

that needs to be solved.

Conclusion

In conclusion, entrepreneurial teacher behavior plays an important role in transforming educational practices and promoting a culture of innovation in schools. Educators can effectively identify improvement opportunities by adopting an entrepreneurial mindset, take the initiative in implementing new strategies, and ultimately engage in risk-taking activities that enhance students' learning experiences. This proactive approach not only benefits individual classes but also contributes to the overall development of a more dynamic and responsive education system that meets the diverse needs of students in a rapidly changing world.

Additionally, the development of entrepreneurial behaviors among teachers is necessary to prepare students for future challenges. Educators model critical thinking, adaptability, and problem-solving skills, empowering students to take ownership of their learning and develop the competencies necessary for success in the 21st century. Schools can support teachers in their entrepreneurial efforts by prioritizing professional development and promoting a collaborative culture of shared learning, ultimately leading to improved educational outcomes and a more innovative learning environment.

References

Advance HE, EEUK, IOEE, ISBE, SFEDI & QAA (2019). Enterprise and Entrepreneurship Education Framework. Advance HE. The University of Queensland, https://www.advance-he.ac.uk/guidance/teaching-and-learning/enterprise-andentrepreneurship

Akyürek, M. İ., ve Göktaş, E. (2023). İnovatif Okul Liderliği ve Girişimci Öğretmen Davranışlarının Okul Mutluluğu Üzerindeki Etkisi: Özel Okullar Örneği. *Anadolu Eğitim Liderliği ve Öğretim Dergisi,* 11(1), 29-47.

Amorim Neto, R. D. C., Picanço Rodrigues, V., Campbell, K., Polega, M., & Ochsankehl, T. (2020, April). Teamwork and entrepreneurial behavior among k-12 teachers in the United States. *In The Educational Forum* 84(2), 179-193.

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives: complete edition. Addison Wesley Longman, Inc..

Antoncic, B., & Hisrich, R. D. (2003). Clarifying the intrapreneurship concept. *Journal Of Small Business And Enterprise Development,* 10(1), 7-24.

Aulet, B. (2019). What I've Learned About Teaching Entrepreneurship: Per-spectives of Five Master Educators. Retrieved from http://www.d-eship.com/articles/what-ive-learned-about-teaching-entrepreneurship-per-spectives-of-five-master-educators/ Erişim tarihi: 04.11.2024

Baker, M. J. (2015). Collaboration in collaborative learning. *Interaction Studies,* 16(3), 451-473.

Basham, J. D., Hall, T. E., Carter Jr, R. A., & Stahl, W. M. (2016). An operationalized understanding of personalized learning. *Journal of Special Education Technology,* 31(3), 126-136.

Binks M., Starkey K., Mahon C. L. (2006). Entrepreneurship education and the business school. *Technology Analysis & Strategic Management,* 18(1), 1–18.

Blackstone, A. (2012). Principles of sociological inquiry—Qualitative and quantitative methods. Boston, MA: FlatWorld.

Borasi, R., & Finnigan, K. (2010). Entrepreneurial attitudes and behaviors that can help prepare successful change-agents in education, *The New Educator,* 6(1), 1–29.

Bosma, N. S., Stam, F. C., & Wennekers, A. R. M. (2010). Intrapreneurship: An international study, Scales Research Reports H201005, EIM Business and Policy Research.

Chandler, G. and Hanks, S. (1994a), Market attractiveness, resource-based capabilities, venture strategies and venture performance, *Journal of Small Business Management*, 12(1), 27-35.

Cooney, T.M. (2012), Entrepreneurship skills for growth-orientated businesses, Report for the Workshop on 'Skills Development for SMEs and Entrepreneurship.

Dewey, J. (1938). Experience and Education. Kappa Delta Pi.

Drazin, R. (1985), Innovation and entrepreneurship: practice and principles, *Human Resource Management,* 24(4), 509.

Dweck, C. S. (2006). Mindset: The new psychology of success. Random house.

Fullan, M., & Hargreaves, A. (2012). Reviving teaching with 'professional capital'. *Education Week,* 31(33), 30-36.

Gibb, A. (2002). In pursuit of a new 'enterprise'and 'entrepreneurship'paradigm for learning: creative destruction, new values, new ways of doing things and new combinations of knowledge. *International Journal Of Management Reviews,* 4(3), 233-269.

Gibb, A. (2011) Concepts into practice: meeting the challenge of development of entrepreneurship educators around an innovative paradigm. The case of the International Entrepreneurship Educators' Programme (IEEP). *International Journal of Entrepreneurial Behaviour & Research,* 17(2), 146–165.

Growth Analysis (2024). Report: Entrepreneurship and innovation, Serial number: Report 2009:11, Reference number: 2009/053, https://www.tillvaxtanalys.se/in-english/publications/reports/reports/2009-01-20-entrepreneurship-and-innovation.html Erişim tarihi: 04.11.2024

Gruber, M., Huang-Saad, A., Liguori, E., Reid, J., & Terjesen, S. (2022). What I've learned about teaching entrepreneurship: Perspectives of five master educators. *In Annals of Entrepreneurship Education and Pedagogy*, 2023, 2-29.

Henry, C., Hill, F., & Leitch, C. (2015). Entrepreneurial teaching: creating a new approach to learning in the classroom. *International Journal of Entrepreneurial Behavior & Research,* 21(5), 754-771.

Hipolito, G. B. (2021). Personal entrepreneurial skills of public school teachers. *Open Access Library Journal,* 8(04), 1.

Ho, M. C. S. (2018). Conceptualizing teachers' entrepreneurial behavior: An exploratory review. *International Journal of Liberal Arts and Social Science,* 6(1), 14-28.

Joensuu-Salo, S., Peltonen, K., Hämäläinen, M., Oikkonen, E., & Raappana, A. (2021). Entrepreneurial teachers do make a difference – Or do they? *Industry and Higher Education,* 35(4), 536-546.

Jones C., Matlay H. (2011). Understanding the heterogeneity of entrepreneurship education: Going beyond Gartner. *Education + Training,* 53(8/9), 692–703.

Kamaç, H., Kişman, ZA. (2020). Türk girişimciliğinin tarihi ve gelişimi. *Balıkesir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi,* 1(2), 129-148.

Kaufman, J. C., & Sternberg, R. J. (Eds.). (2006). The international handbook of creativity. Cambridge University Press.

Keyhani, N., & Kim, M. S. (2021). A systematic literature review of teacher entrepreneurship. *Entrepreneurship Education and Pedagogy*, 4(3), 376-395.

Klopper, C., & Pendergast, D. (2017). Agile leadership and responsive innovation in initial teacher education: An Australian case study. *International Journal for Cross-Disciplinary Subjects in Education,* 8(3), 3160-3168.

Kolb, D. A. (1984). Experience as the source of learning and development. Upper Sadle River: Prentice Hall.

Kuratko, D.F. (2014). Entrepreneurship: Theory, process, and practice. South Western Cengage Learning, Mason, OH, USA (2014).

Kuvaas, B. (2008), An exploration of how the employee–organization relationship affects the linkage between perception of developmental human resource practices and employee outcomes, *Journal of Management Studies,* 45(1), 1-25,

Lackeus, M. (2015). Entrepreneurship in education: What, why, when, how. Entrepreneurship 360 background paper. OECD-LEED. https://www.oecd.org/cfe/ leed/BGP_ Entrepreneurship-in-Education.pdf

Leithwood, K., Louis, K. S., Anderson, S., & Wahlstrom, K. (2004). How leadership influences student learning. Review of research. Wallace Foundation.

Lerner, M. and Almor, T. (2002), Relationships among strategic capabilities and the performance of women-owned small ventures, *Journal of Small Business Management,* 40(2), 109-25.

Lichtenstein, G.A. and Lyons, T.S. (2001), The entrepreneurial development system: transforming business talent and community economies, *Economic Development Quarterly,* 15(1), 3-20.

Liguori, E. (2023). What I've Learned About Teaching Entrepreneurship, https://www.aacsb.edu/insights/articles/2023/08/what-ive-learned-about-teaching-entrepreneurship, Erişim tarihi: 04.11.2024

Morris M. H., Liguori E. (2016). Preface: Teaching reason and the unreasonable. In Morris M. H., Ligouri E. (Eds.), Annals of entrepreneurship education and pedagogy. Edward Elgar Publishing.

Mulder, M. (2007), Cometencia: la esencia y la utilización del konsepto en la formación profesional inicial y permanente, europeade formación profesional, *Revista Europea de Formación Profesional Núm.* 40, 5-24.

O'Hara, B.J. (2011), Entrepreneurship in Ireland, Gill and Macmillan, Dublin.

Parthasarathy, N., Doboli, S. & Paulus, P. B. (2011). Entrepreneurship, Editor(s): Mark A. Runco, Steven R. Pritzker, Encyclopedia of Creativity (Second Edition), Academic Press, 2011, pp. 461-467.

Peltonen, K. (2015). How can teachers' entrepreneurial competences be developed? A collaborative learning perspective. *Education&Training,* 57(5), 492–511.

Samwel Mwasalwiba, E. (2010). Entrepreneurship education: a review of its objectives, teaching methods, and impact indicators. *Education+ training,* 52(1), 20-47.

San-Martín, P., Fernández-Laviada, A., Pérez, A., & Palazuelos, E. (2021). The teacher of entrepreneurship as a role model: Students' and teachers' perceptions. *The International Journal of Management Education,* 19(1), 100358.

Saygın, M., Say, S., Öztürk, İ.Y., Gülden, B. & Kaplan, K. (2024). A Step towards Sustainable Education: Does an Entrepreneurial Teacher Nurture Creativity? Sustainability 2024, 16, 7948.

Seikkula-Leino, J. (2011). The implementation of entrepreneurship education through curriculum reform in Finnish comprehensive schools. *Journal of Curriculum Studies,* 43(1), 69-85.

Shabbir, M.S., Muhammad. and Kassim, N. (2019), Entrepreneur as an individual review of recent literature on entrepreneurial skills, *Opcion,* 35, 582-599.

Tittel, A. and Terzidis, O. (2020), Entrepreneurial competences revised: developing a consolidated and categorized list of entrepreneurial competences*, Entrepreneurship Education,* 3(1), 1-35.

Uğur, B. (2015). Girişimcilik eğitiminin ilköğretim programlarına konulmasına yönelik model önerisi, (Yayınlanmamış Yüksek Lisans Tezi). Anadolu Üniversitesi, Sosyal Bilimler Enstitüsü, Eskişehir.

Van Dam, K., Schipper, M., & Runhaar, P. (2010). Developing a competency-based framework for teachers' entrepreneurial behaviour. *Teaching and Teacher Education,* 26(4), 965-971.

Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching And Teacher Education,* 24(1), 80-91.

Warhuus, J.P., Tanggaard, L., Robinson, S. and Ernø, S.M. (2017), From I to We: collaboration in entrepreneurship education and learning?, *Education + Training,* 59(3), 234-249

About the Authors

Celalettin ÇELEBİ works as a faculty member at Necmettin Erbakan University Ereğli Faculty of Education. Her areas of expertise and study are curriculum development and Primary Education Classroom Teaching.

E-mail: celalcelebi75@gmail.com, **ORCID:** 0000-0002-2189-6403.

Uğur ATASEVEN works at Necmettin Erbakan University. He holds a PhD in Basic Education Classroom Education. His field of study is entrepreneurship education.

E-mail: ataseven70@gmail.com, **ORCID:** 0000-0002-5954-8746.

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 9%.

To Cite This Chapter:

Çelebi, C. & Ataseven, U. (2024). Entrepreneurial teacher behaviors. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp. 54-65). ISRES Publishing.

Section 3.

Sustainability

Green Schools and Green Education: Towards a Sustainable Future

Kadriye KAYACAN

Necmettin Erbakan University

Nuriye KOÇAK

Necmettin Erbakan University

Introduction

Human activities have been a factor influencing the environment since ancient times. Initially, this impact was small, and the environment was able to eliminate it through its own natural mechanisms. Today, the negative impact of the rapidly increasing human population on the environment is clearly observable. In recent years, various parts of the world have been facing natural disasters as a result of climate change, including droughts, floods, rising sea levels, severe winds, and deadly summer heatwaves. These events have led to an incalculable loss of both life and property. If the current indifference to environmental protection continues, it is highly likely that humanity will face many more disasters. Recognizing that there is no time to lose and that they bear a responsibility, many educational leaders have prioritized conservation and environmental awareness. As a result of the relationship between education and the environment, the concept of green schools has emerged. This section will discuss the concept and importance of green schools, green school designs, green school practices, and the topic of environmental education.

The Concept and Importance of Green Schools

In the early stages of settled life, humans, who recognized the resources provided by the Earth, benefited from these resources and were able to maintain balance, lost this equilibrium with the Industrial Revolution, which can be regard as another pivotal moment in the course of history. With the production, industrial and urbanization activities in the light of technological developments, the use of exhaustible resources and fossil fuels has increased unconsciously and the destruction of the natural environment and the earth has become a universal problem (Özdemir, 2023). Due to the destruction caused by these problems, the living space of our world and the quality and nutritional value of many products, from the air we breathe to the food we eat and drink, are decreasing. The evident emergence of the traces of this change has compelled humanity to take action and finally feel the necessity to do something (Bulut & Çakmak, 2018). The concept of sustainable development emerged when politicians, international social society organizations, scientists, artists and other people who could make their voices heard by large masses frequently raised this problem. The concept of sustainable development, defined in the United Nations' Brundtland Report as "meeting the needs of the present without compromising the ability of future generations to meet their own needs," emphasizes the conscious and responsible use of natural resources and the preservation of the balance between humanity and nature. It underscores the importance of planning development to meet the needs of both present and future generations. This requires responsible and conscious use of natural resources while maintaining the balance between humanity and the environment(BM, 1987). Sustainable development stands out as a key effort to address today's most critical global issues. This concept entails using current resources while considering environmental, social, and economic factors in an integrated manner, with an emphasis on meeting the needs of future generations. The most important thing to be done in order to realise these goals is to raise conscious individuals by creating a conscious society. Thus, education is a crucial determining factor for the realization of sustainable development, as schools serve as societal institutions responsible for the education of individuals. (Atıcı, 2019).

Education should be recognized as a process through which individuals and societies can achieve their highest potential, including formal education, public awareness and educational programs. Education is essential for promoting sustainable development and enhancing individuals' capacity to provide solutions to environmental and development issues.

Basic education provides a foundation for all types of environmental and development education, while the integration of environmental and development education as an essential part of learning is necessary. Both formal and informal education are essential for changing individuals' attitudes, enabling them to assess and solve sustainable development problems. (BM, 1993; Gough, 2020). The concept of "Education for Sustainable Development" (ESD) first emerged in United Nations documents during the latter half of the 20th century. Its development is closely tied to the implementation of key policy frameworks adopted by the global community at the 1992 Rio de Janeiro Conference on Environment and Development. At this summit, world leaders emphasized that education is one of the key factors in achieving sustainable development and a better, more secure future, and that it is a decisive element in driving change (Bulut & Çakmak, 2018). In this regard, green schools emerge as institutions that contribute to achieving sustainable development goals by integrating the principles of environmental, social, and economic sustainability into educational processes, benefiting both individuals and communities (**Figure 1**).

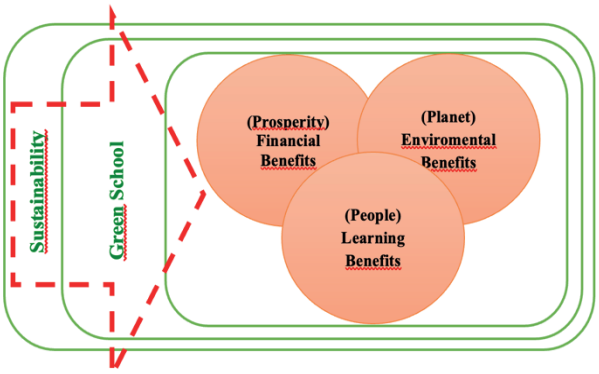

Figure 1. Green schools in the context of the sustainability movement adapted by Kensler (2012)

Green schools represent one of the ways in which the education sector responds to and engages with the sustainability movement. Green schools are educational environments that prepare students to become leaders and individuals equipped with the knowledge, values, and skills necessary to act effectively based on an understanding of how the natural world functions, recognizing patterns that connect human activities to nature. A green school is much more than a curriculum or a building made of brick and mortar; it is a social responsibility and a lifelong process. Green schools are institutions that work directly with teachers, students, administrators, officials, and various communities to create programs that transform all schools into healthy learning environments. The importance of these practices and the observed positive effects of green initiatives on students have led to the rapid spread of the green school movement worldwide. The concept of a green school was first introduced in Europe in the early 1990s with developments in environmental education and sustainability in order to promote sustainable educational practices, and continued with the idea of an Ecological School proposed by the The Foundation of European Environmental Education (FEEE) in 1994. Its aim is to gradually adapt environmental education into all areas of school management and establish a comprehensive environmental management system for schools. However, Europe's green campus plan was initially limited to environmental education in primary and secondary schools, and to sustainability education in colleges and universities (Zhao et al., 2015). In the following years, alongside various studies on green schools, the United States Green Building Council (USGBC), as the world's largest developer of environmental and building technologies, advanced its efforts to provide all

students with access to green schools by establishing the Green Schools Center in 2010. This initiative was supported by the LEED (Leadership in Energy and Environmental Design) rating system, which certifies buildings. The Green Schools Centre supports schools to reduce their environmental impact, achieve energy efficiency and create healthy learning environments, while at the same time promoting students' environmental awareness and education on sustainability (https://www.usgbc.org/press/about-center-green-schools, 20.10.2024). FEEE and USGBC are two major leading international 'green' non-governmental organisations, with FEEE Global focusing on the educational aspects of green schools and USGBC focusing on the building and environmental aspects of green schools. Today, FEEE runs the Eco-School programme, which claims to have 49,000 school participants in 64 countries. Until 2001, its name was 'European Foundation for Environmental Education, FEEE' because its projects were implemented only in European countries; in 2001, at the General Assembly held in Copenhagen, Denmark, the name was changed to 'International Foundation for Environmental Education, FEE' when South Africa became a member (TURÇEV, 2024). The origins of the green school movement in architecture and education are outlined below (Iwan & Rao, 2017).

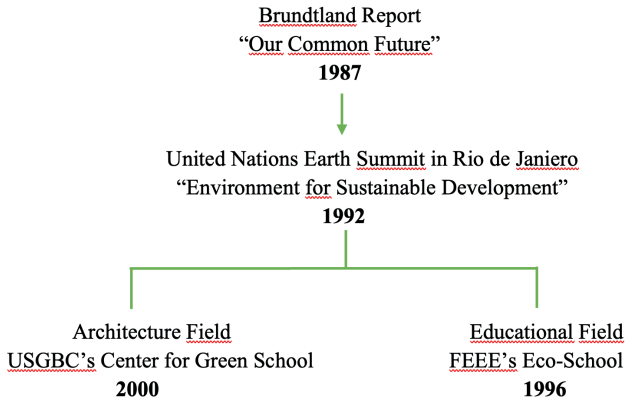

Figure 2. The origins of green schools related movements (Iwan & Rao, 2017)

According to the U.S. Green Building Council (USGBC), a green school is a building or facility designed to foster a healthy learning environment while conserving energy, resources, and money. According to UNESCO, the term "Green School" is defined as an approach to Education for Sustainable Development (ESD). This definition emphasizes the importance of schools becoming both safe and resilient learning spaces, while also being innovative centers where students and local communities are equipped with the knowledge, skills, values, and attitudes necessary to cope with the effects of climate change (UNESCO, 2024). Gordon defines a green school as the physical outcome of a process in which the planning, design, and construction phases are carried out together, considering the performance of a building throughout its 50 to 60-year life cycle (Gordon, D.E. 2010). In another definition, a green school is described as "a school building that saves energy, resources, and money while creating a healthy environment that supports learning." (Bademcioğlu, 2017). Each country generally defines green schools in its own way, as there is no universally accepted standard definition. In the current trend, terms such as "green," "eco," "healthy," "sustainable," and "high-performance" are often used interchangeably (Warju et al., 2017; Zuraini 2017; Kara 2024). Despite different definitions of green schools, the goal is the same; green schools are educational institutions that aim to make our world sustainable by creating a community of learners who understand how nature works, who can see how human activities are connected to nature, and who prepare students to become leaders and citizens with the knowledge, values and skills to act effectively based on this understanding (Center for Ecoliteracy, 2010). Green schools serve the purpose of having positive environmental and social characteristics by providing a healthy, safe, comfortable, functional physical environment that supports the health and development (physical, social and intellectual) of all those who interact with the school,

especially students and teachers (Demir, 2012). At the same time, eliminating toxic substances, using resources sustainably, creating green school gardens and buildings, providing healthy food and creating active learning-teaching environments can be counted as the aims of the green school (http://www.greenschools.net/section.php-id=10.html) 25. 10.2024). The fundamental framework of a green school is shown in **Fig. 3**.

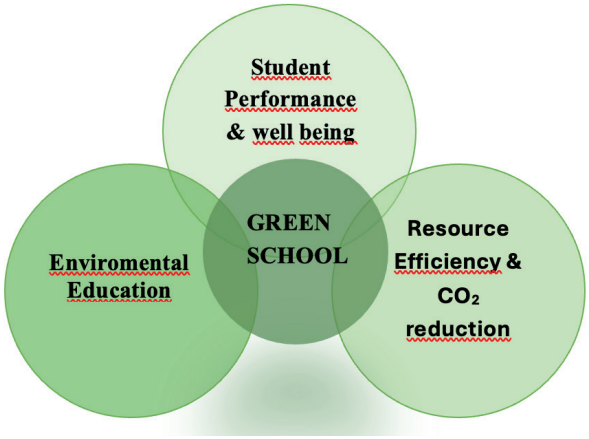

Figure 3. The basic framework of green school (Zhao et al., 2015)

According to the Green School Centre USGBC, the general characteristics that a school that can be considered green should have are listed as follows:

- Conserve energy and natural resources.
- Improve indoor air quality.
- Remove toxic substances from children's places of learning and play.
- Utilise daylighting strategies and improve classroom acoustics.
- Reduce the burden on water and wastewater treatment.
- Promote waste management efforts for the entire community.
- Protect clean drinking water and help manage stormwater runoff.
- Encouraging recycling.
- Promote the protection of habitats.
- Reduce demand on local landfills (Zhao et al., 2015; Ramli et al., 2012).

As a result, green schools are educational institutions that adopt environmentally friendly practices in many different areas from energy to water, from waste to natural materials, providing students with sustainability awareness and providing significant benefits both environmentally and economically. Green schools not only create a healthy and efficient learning environment for students but also promote a sustainable lifestyle and environmental awareness within the broader community. For these reasons, green schools are becoming increasingly important as a cornerstone of future education systems. Investments in this field are critically significant for both the present and the future of our world. In this context, the importance of eco-friendly approaches and building designs applied in the design of green schools is increasing. Green building designs play a critical role for these schools to achieve their sustainability goals and offer various innovative methods to increase the efficiency of school buildings with environmentally friendly features.

Green School Designs

School buildings are places where students come together to learn various types of knowledge, develop essential skills, and receive education to become productive members of society. For students who spend most of their time in school, the educational structures are of significant importance in terms of health and comfort. In this regard, the desire to leave healthier, safer, more efficient, and livable spaces for future generations makes it essential for educational buildings to possess sustainable features (Tavşan&Yanılmaz, 2019; National Research Council 2007). A school building that provides a healthy environment conducive to learning while also saving energy, resources, and costs is defined as a green school building (Bademcioğlu, 2017). Green school buildings are not only physical spaces for education but also sustainability-focused environments that instill environmental awareness in students. With the advancement of eco-friendly technologies and design approaches, green schools play a significant role as the educational structures of the future. The design of green schools is influenced by factors such as environmental considerations, building placement, climate conditions, seasons, natural light utilization, and energy efficiency. Additionally, sustainable material selection, water management systems, maintenance, repair, cleaning practices, as well as interior design factors such as humidity, ventilation, and acoustics, play a crucial role. All these factors contribute to the environmental performance of the school, providing a healthy learning environment that enhances the health, productivity, and overall well-being of students and teachers (**Figure 4**). To maintain the balance of nature, it is essential to raise individuals who are aware of sustainability and to construct buildings that cause as little harm to the environment as possible throughout their life cycle (Evran, 2012).

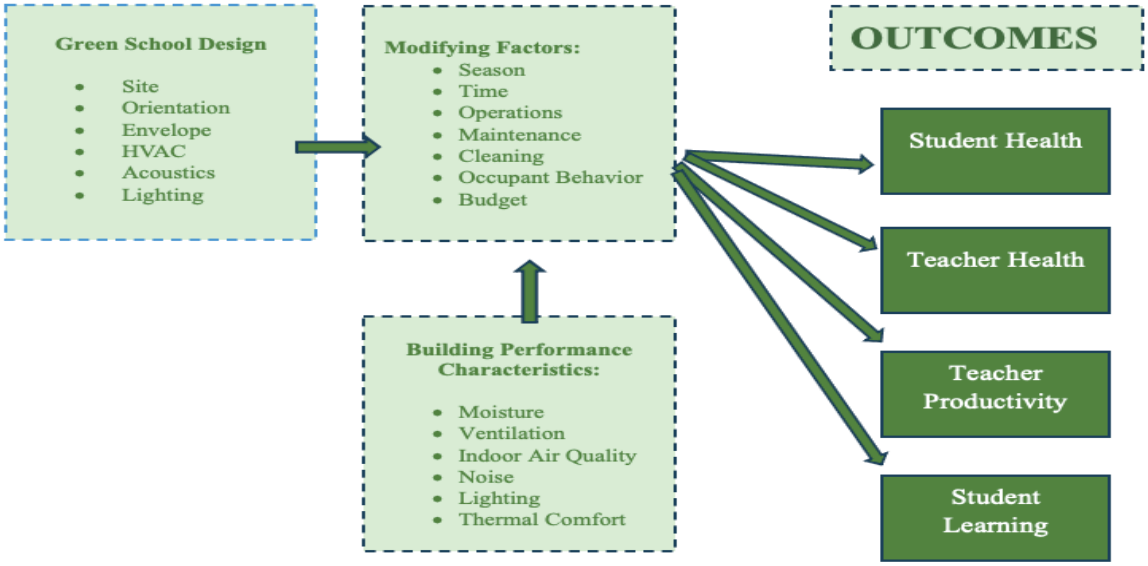

Figure 4. The relationship between green school design, learning, health, and productivity. (National Research Council, 2007)

Sustainability criteria in green school buildings aim to design more efficient, healthy, and long-lasting structures by balancing environmental, economic, and social factors. These criteria not only focus on reducing environmental impacts but also aim to make educational environments healthier and more efficient. It is important that schools aiming to gain sustainable development goals have sustainable qualities structurally in terms of the messages they give to the environment and the individuals receiving education in them. Sustainability criteria in educational buildings are examined under different headings in many sources. Some of the sustainability criteria that should be applied in green schools are explained below.

Energy Efficiency

School buildings rank among the top public buildings in terms of energy consumption, and energy costs typically represent the largest expenditure in most school budgets. Therefore, reducing energy consumption in schools is of significant economic importance (Ezema et al., 2022). Green schools feature design elements that minimize energy consumption. For example, the use of solar panels and energy-efficient heating and cooling systems, the installation of sensor-based smart lighting, and the use of smart thermostats reduce the environmental footprint of school buildings. Additionally, utilizing natural light and proper building orientation can also reduce the need for heating. Energy-efficient buildings have lower operational costs and contribute to more efficient learning processes for students. There are various examples of green schools around the world that focus on energy efficiency. One of the best examples of sustainable living is the Green School project in Bali, brought to life by the environmentally-conscious and design-focused couple, John and Cynthia Hardy (**Figure 5 a, 5b**). The school, built on profound wisdom, places equal importance on all areas of life. The primary material used in the school is bamboo, a traditional material of Bali, and it serves as an educational facility for local children as well as those from different parts of the world. The school, constructed with bamboo—an easily renewable, durable, lightweight, and flexible material—derives its energy from renewable sources. Located by the Ayung River and near forested areas, the Green School generates its energy through solar panels and generators powered by water.

Figure 5a. The moment of studying in open-air bamboo classrooms overlooking the gardens

Figure 5b. Student school buses, BioBuses

Water Efficiency

The continuity of clean water that we can leave as a legacy to future generations is of great importance, requiring the conscious use of resources, water conservation, prevention of water pollution, and raising awareness about the importance of water. Sustainable water management

can be considered as reducing water consumption through the application of water efficiency technologies alongside changes in user behavior. Schools use a significant amount of water daily for heating and cooling systems, restrooms, faucets, cafeterias, laboratories, outdoor play areas, and landscaping. Implementing sustainable water systems in green schools provides an important opportunity to educate students about the significance of conserving our natural resources (Rabab et al., 2019). In green schools, the implementation of rainwater harvesting systems, the use of water-saving fixtures, reducing water consumption in landscaping, reusing gray water from sinks and showers for irrigation or cleaning, and installing systems that prevent rainwater from directly reaching the building's foundation while allowing water to accumulate, contribute to significant water conservation. Green schools raise awareness among students through practices that promote water efficiency, helping them develop water-saving habits (Okasha et al., 2016; Demir, 2012). Uaso Nyiro Primary School, located in the arid Central Highlands of Kenya, has been named one of "the two greenest schools in the world" by the U.S. Green Building Council. The school has not only made a significant impact on its educational environment but has also undertaken a vital project addressing a critical issue in its arid region. The school has not only served as a sustainable educational space but has also provided a solution to the region's most pressing issue—water scarcity—by harvesting rainwater. The school collects 350,000 liters of rainwater annually, and the water, filtered through a clay-based system, is even used for agricultural activities like irrigation in the school garden. The rainwater collected from the roof is provided to the school within its own habitat, ensuring that it reaches many people (**Figure 6.)** (https://www.yesilist.com/dunyadan-3-yesil-okul/.).

Figure 6. The Uaso Nyiro primary school's water collection system

Indoor Air Quality

Indoor environments, where individuals spend approximately 90% of their time, contain gases, particles, air pollutants, and volatile organic compounds such as formaldehyde, which the WHO has highlighted as harmful to human health. Outside of the home, schools are indoor environments where children spend a significant portion of their time and are often their first social spaces in life (Sa´ et al., 2024). Therefore, it is crucial to prevent the negative health effects of poor air quality in schoolchildren. There is strong evidence that exposure to indoor air pollutants in educational buildings affects children's health, academic performance, and engagement. Improving indoor air quality has been shown to make students' time spent at school more productive and reduce health-related issues (Branco et al., 2024, Sadrizadeh et al., 2022). In green schools, the use of non-toxic indoor coatings, cleaning products, and school materials is crucial to improve air quality. Additionally, when constructing a green school building, it is important to avoid sources of pollution such as wet areas, nearby hazards, or fumes from highways, and to keep the school building away from parked vehicles. Natural ventilation systems improve indoor air quality, allowing students to focus better and learn in a healthier environment. For this reason, a green school building should be designed and constructed with a large number of openable windows (Ramli et al., 2018).

Natural Lighting

In the design of school buildings, balancing daylight and energy performance is crucial. It is well-established that the quality of learning, which is a fundamental activity for children spending about 30% of their day at school, is directly linked to natural daylight. Daylight plays a significant role for students in terms of memory retention, mental activity, and psychological well-being (Erlalelitepe et al., 2011; Alkhatatbeh et al., 2023). It is well-known that natural daylight has positive effects on students' health, mood, and performance. By effectively utilizing daylight, the need for artificial lighting can be minimized, contributing to the country's economy. To make the most efficient use of daylight, it is important to consider the proper orientation of school buildings, the selection of large windows, the use of skylights, and the preference for light-colored materials that increase the interior light levels. At the same time, to reduce and control the negative effects of daylight such as glare and reflection, sun shading panels can be used on the exterior facade, light shelves and shading panels can be used indoors. According to Barker (1982), in schools and classrooms, the lighting level must be at its optimum level to ensure that all tasks are completed effectively and to protect the eye health of both staff and students. Furthermore, he argues that proper lighting significantly contributes to students receiving education under the most suitable conditions and helps individuals become healthier and more productive (Tavşan&Yanılmaz, 2019). Nortside Elementary School in North Carolina, which has been awarded LEED Platinum certification, is a good example of a classroom environment created with natural lighting (**Figure 7**).

Figure 7. The use of natural lighting at Northside Elementary School in North Carolina (https://www.usgbc.org/projects/northside-elementary-school?view=overview)

Acoustics

Sound is one of the factors that affect both the physical and psychological health of individuals. Noisy educational environments cause mental stress and psychological issues for both students and teachers. Therefore, ensuring good acoustics in school environments plays a crucial role in creating the most conducive learning environment for students. The negative effects of noise pollution on human health are well-documented and widely recognized. Especially in educational buildings, noise, which reduces the perception and learning skills of students and causes distraction, is an issue that should be carefully examined at the design stage. School climate is the most important factor determining the quality of education in schools. Noise disrupts the school climate and reduces the efficiency of education and training activities. (Bulunuz et al., 2018). Noise pollution can come from a wide variety of sources, particularly in school environments. External sources include aircraft, traffic, rain, noise from playgrounds and outdoor sports, and noise from nearby school buildings. Inside the school, sounds from pupils and teaching activities can be transmitted between floors and through the walls. When designing green school buildings, controlling sound

in instructional areas should also be carefully considered (Liu et al., 2023). Arcadia Primary School, located in Scotland, is a great example of creating acoustically comfortable environments through the use of high-quality materials (**Figure 8**).

Figure 8. Arcadia primary school in Scotland is an educational environment that regulates acoustics through the use of high-quality materials

Green School Practices

In learning, when individuals engage in hands-on experiences, apply their acquired skills in real-life situations, and observe the impact of their actions, it enhances the durability of their behaviors. This experiential learning process increases retention and helps individuals internalize what they've learned, making it more likely that they will continue applying these behaviors over time (Dewey, 1952; Perkins, 1991; Piaget, 1969; Vygotsky, 1978; Bruner, 1990). Therefore, having schools with sustainable structures and curricula aligned with green education will positively support students' learning and implementation processes. Green schools play a key role in developing environmental awareness and sustainability skills in students, contributing to building a healthy future. For children, it is thought that having sustainable, environmentally friendly systems around them at all times, especially in the school environment, and getting used to them will cause them to look favorably on these systems in the future (Özburak, 2019).

Ensuring the quality of the education process is a necessary foundation for achieving sustainable development goals. Education, aligned with these principles, not only involves the transfer of knowledge but also helps individuals develop awareness and responsibility regarding environmental and social issues. Today, education is seen as a crucial tool for addressing challenges like pollution, biodiversity loss, and climate change. It shapes the values, perceptions, and awareness necessary to tackle these current environmental problems (Hnatyuk er al., 2024).

School programs should be designed to raise awareness in individuals about respecting nature, protecting the environment, and preserving it for future generations. This is essential for fostering environmental awareness, ethical values, attitudes, skills, and behaviors that support sustainable development, as well as encouraging meaningful public participation in decision-making. For environmental and development education to be effective, it must engage with the dynamics of both the physical/biological and socio-economic environments, as well as human development, which may include spiritual aspects. Such education should be integrated across all disciplines, utilizing both formal (in-school) and informal (out-of-school) methods, and employ effective communication tools. (Gough, 2020).

A green school is defined as a learning institution that takes a holistic approach to education for sustainable development. These schools contribute to addressing environmental issues such as climate change through educational programs, school facilities, activities, management, and collaboration with the community. The aim of green schools is to provide students with knowledge and skills about the social, economic, cultural and environmental aspects of sustainable development (UNESCO, 2024). Focusing on developing green education in this field, FEE (Foundation for Environmental Education) launched Green-Schools and Eco-Schools (2014), the largest sustainable school programs in the world, providing students with fun and hands-on learning opportunities. These programs aim to teach students to take an active role and make contributions toward creating a sustainable world. FEE has created the following table to show how green schools can help achieve the sustainable development goals set by the United Nations, which are expected to be reached by 2030(**Table 1**).

Table 1. *Eco-schools reflect the following sustainable development goals (SDGs)*

	**HOW ECO-SCHOOLS ADRESSES THİS SDG**	**SUGGESTED TOPİC LİNK**
	**No Poverty** Eco-Schools is an inclusive programme which can be adapted to any social and cultural background	**Global Perspective**
	**Zero Hunger** Several eco-schools topics promote improved and sustainable food production. Many schools have gardens to teach sustainable growing techniques, local food products and the importance of biodiversity in agriculture.	**Global Perspective, Outdoor learning**
	**Good Health and Well-being** The Healty Living topic promotes the health and well-being of students and the wider community and makes environmental connections to health and safety.	**Healty Living**
	**Quality Education** The Eco-Schools methodology is a poerful tool for providing quality education for sustainable development at all school levels. Its whole instutional approach ensures an inclusive implementation throughout the whole kindergarten, school or campus and the involvement of all children and students.	**All Themes**
	**Gender Equality** The implementation of Eco-Schools programme also Works towards the achievement of gender equality by giving all students and teachers the equal right to participate in the Eco Committee and the activities which are realeted to the Eco-School programme.	**All Themes**
	**Clean Water and Sanitation** Within the Eco-Schools programme students are being sensitised to the sustainable use of water and sanitation. The water topic especially focuses on this issue providing an introduction to the importance of water both locally and globally and by raising awareness of how simple actions can substantially cut down water use.	**Water**
	**Affordable and Clean Energy** The Eco-Schools programme promotes energy saving initiatives and innovative solutions to reduce energy consumption within the schools within students' and teachers' homes as well as within the wider community. All members of the school work together to increase the awareness of energy issues and to improve the energy efficiency within the school. Furthermore, the students learn how to save energy at home.	**Energy**
	**Decent Work and Economic Growth** The Eco-Schools programme promotes and fosters a deep understanding for sustainability issues among students which are also of increasing importance in the working environment. Through the implementation of the programme students learn how to take leadership in sustainability development and to find sustainable solutions. Their knowledge and experiences gained through the Eco-Schools	**All Themes**

	**Industry, Innovation and Infrastructure** Through the implementation of the Eco-Schools programme innovation in sustainable develeopment is enchanced within the education sector. Especially EcoCampus provides a framework for scientific in sustainable innovaitons and practices.	**Waste, Energy, Transport**
	**Reduced Inequalities** Eco-Schools is a global programme, allowing the adoption to national and local cultures and contexts. To date, 64 countries on six continents have joined the programme, and the international coordination of Eco-Schools is continuously encouraging new countries to participate in the programme in order to widen the network and to give Access to education for sustainable development to all.	**Climate Change, Global Perspective**
	**Sustainable Cities and Communities** By integrating themes such as Sustainable Living. Waste Managemenet and Responsible Consumption into the curriculum, students learn how to reduce the environmental impact of their schools as well as of their personel lifestyles. Through the fostering of responsible behaviour within the school environment, students will also learn how to value and protect the cultural and natural heritage in their countries, as well as abroad.	**Litter, Waste, Transport**
	**Responsible Consumption and Production** The Eco-Schools programme supports responsible consumption and production th through many of its Themes. Students are encouraged to to reflect on their consumption habits and develop ideas and solutions for a more sustainable use of resources. Furthermore, education on resources. Fur recycling and the reduction of waste are integral parts of the Eco-Schools programme. Through the Litter Less Campaign, which is a joint initiative of the Wrigley Company Foundation and FEE, students are educated about litter, encouraging a long-term behavioural change.	**Waste**
	**Climate Action** Many of the countries running the Eco-Schools programme help schools and communities build Climate Change resilience. Examples of school activities include projects for rainwater harvesting, soil stabilisation, food production, sanitation, and waste management, amongst many others.	**Climate Change**
	**Life Below Water** Marine litter and the exploitation of the oceans are two of the most urgent matters of the twenty-first century, which is why one of Eco- Schools Themes is especially based on marine and coastal environments. Students learn about the sources of marine litter and its negative effects on the marine flora and fauna. Furthermore, the importance of using the oceans' resources responsibly is communicated to the students.	**Marine & Coast**
	**Life On Land** The Eco-Schools programme promotes the protection, restoration and the sustainable u use of terrestrial ecosystems through many different activities developed and implemented by the Eco Committee and the pupils. The Great Plant Hunt, a joint initiative of Toyota Motor Europe and FEE, is a special campaign which focuses on biodiversity with a particular emphasis on plants and their associated species. It aims to educate students about biodiversity, its importance, and encourage them to take positive action.	**Biodiversity & Nature**
	**Peace, Justice and Strong Institutions** Justice and democratic values are integral elements of the Eco-Schools programme. Through the Eco Committee the pupils learn how democratic decision-making works and how to respect the views and opinions of others.	**Global Citizenship**
	**Partnerships For The Goals** Through Education for Sustainable Development, the Sustainable Development Goals are implemented within the Eco-Schools network worldwide. Nationally and internationally, the programme cooperates with institutional and corporate partners to develop new projects and to support initiatives that also help towards sustainable development. Amongst others, a Memorandum of Understanding with The International Foundation for the Young Masters Programme (SYMP) for the promotion of overall sustainability awareness and the educational platform The Goals.org on sustainable development was signed.	**Eco Partner**

The Green School Quality Standard aims to align accreditation criteria for schools that prioritize sustainability. This standard targets accreditation providers such as civil society networks, international associations, and governments, with a particular focus on recognizing and supporting schools' sustainability efforts in the field of climate change education. Additionally, it serves as a guide for educational institutions and policymakers. To achieve compliance with the standard, accreditation systems are required to include at least one-third of the recommended activities in the areas of governance, facilities, education, and community engagement. A climate-

ready green learning environment should be structured as outlined below (**Table 2**).

Table 2. *A climate-ready green learning environment (https://www.unesco.org/en/education-sustainable-development/greening-future/schools)*

SCHOOL GOVERNANCE	**TEACHING AND LEARNING**
…entrust the Green Committee to develop a Green School vision and policy and cover 1/3 of suggested activities on • Cultivating sustainable practices • Ensuring daily sustainable practices • Resilience and climate proof governance • Establishing a green community	…develop lesson plans on ESD and climate change education and cover 1/3 of suggested activities on • Integrating ESD with an emphasis on climate change in teaching and learning • Fostering meaningful connections beyond the school • Hands-on projects and initiatives • Leadership and capacity building
FACILITIES AND OPERATION	**COMMUNITY ENGAGEMENT**
…set up a monitoring team and cover 1/3 of suggested activities on • Climate education, awareness and training • Developing a climate-friendly infrastructure • Ensuring climate resilience and disaster preparedness • Promoting school safety and educational continuity management • Promoting green procurement and ethical purchasing	…organize awareness campaigns for the school and the surrounding community and cover 1/3 of suggested activities on • Building climate resilience in the community • School's contribution to community resilience to climate change • Local community support for education responses to climate change • General community-based climate awareness

Education on environmental and sustainability issues should be future-oriented, helping students develop a positive perspective as they face the current challenges of the planet. The importance of a positive attitude for students lies in the fact that they are the individuals who will shape the future of a nation. Their outlook on life should be grounded in a mindset that always carries hope for the best and avoids despair in the face of the worst. A positive attitude is crucial for laying the foundation for a successful and fulfilling life. One of the Sustainable Development Goals, *quality education*, emphasizes the ideal behaviors of students in schools and their contributions to building a sustainable learning community. The skills that a green school can foster in students—think, act, and reflect—are summarized under the main headings in the table below (**Table 3**).

Contributions of Green Schools to Education

Green schools make education more impactful and meaningful by incorporating eco-friendly practices and sustainability-focused approaches. These schools not only instill environmental awareness in students but also positively influence their academic achievements and overall development. The contributions of green schools to education can be outlined as follows:

1.Improving Student Achievement: Green schools enhance academic performance by providing healthy indoor environments and access to natural surroundings. Factors such as natural lighting, clean air, and low noise levels contribute to better focus and increased efficiency in learning processes (Higgins et al., 2005). Furthermore, sustainable building improvements positively impact students' physical and mental well-being, ultimately supporting their academic achievements (Chatzidiakou et al., 2017).

Table 3. *Green School Skills (https://www.greenschool.org/wp-content/uploads/2018/11/Green-School-Skills.pdf, https://www.greenschool.org/wp-content/uploads/2016/03/Green-School-Skills-.pdf)*

THİNK	ACT	REFLECT
Think Creatively Be original. Be imaginative • *Find creative (outside the box) solutions to problems: find divergent thinking strategies* • *Work to your skills and strengths - thinking and Idea spaces, differenti ated assignments* • *Be curious and inquire - Ask great questions*	**Activate** Feel empowered and empowered others. Take action. Make a difference. • *Be a leader; put knowledge to action; experience fully* • *Build trust and empower others to meet goals* • *Model positive behaviour* • *Inspire others to action by taking a stand, taking initiative, taking risks and taking responsibility*	**Be Aware** Look within. Figure yourself out. • *Understand how one learns best and sustain a passion for lifelong learning* • *Be aware of oneself of one's emotional self, the impact of one's emotions on others and of one's personal responsibility for emotional regulation* • *Be aware of oneself and one's personal impact on the community, both locally and globally* • *Be mindful and practice mindfulness*
Think Critically Dig deeper. Ask why. Make connections. • *Exercise skepticism - Question and evaluate credibility and authority* • *Test assumptions* • *Analyze and evaluate evidence, data and arguments*	**Collaborate** Confident alone. Stronger together. Find your way. • *Collaborate and be part of a team (even if that means working alone) Find your role in the whole, and sharing responsibility for goals Consider multiple perspectives*	**Solve Problems** Figure it out. Go for it. • *Apply logic and innovation to investigations and scenarios* • *Set goals, keep focus, develop and implement process* • *Plan, prioritize and manage time and logistic*
Think in Systems Step back and see the whole picture • *See whole systems as more than a collection of parts* • *Identify how human and natural systems interact and impact one another* • *Employ compass tools and activities*	**Communicate** Process, organize, & coherently express ideas • *Listen actively* • *Consider purpose, audience and style* • *Interpret and express ideas graphically, verbally and numerically*	**Adapt** Bend like bamboo • *Change - being receptive and adaptive to change* • *Deal positively to unpredictable circumstances or setbacks* • *Accept and learn from failure. Adjust processes to meet goals*

2.Increased Environmental and Social Awareness: Green schools not only teach students to be environmentally conscious but also reinforce a sense of social responsibility. Integrating sustainability issues into the curriculum equips students with the knowledge and skills necessary to address environmental challenges. This, in turn, strengthens their sense of social responsibility and helps them make environmentally friendly decisions in the future (Lai et al., 2014). Furthermore, incorporating sustainability topics encourages students to think critically about the world around them, fostering a generation of individuals who are more likely to engage in environmentally conscious behaviors. The inclusion of real-world problem-solving, such as working on sustainability projects or addressing local environmental concerns, also helps cultivate

a deeper understanding of the importance of social responsibility and the role they play in it (Fisk, 2010; Cutter-MacKenzie & Smith, 2003).

3. Education on Climate Change and Sustainability: Green schools promote education on global issues such as climate change and sustainability. These schools encourage students to actively participate in environmentally conscious projects, which enhances their involvement in environmental activities and raises awareness on these critical topics (UNESCO, 2021). Through such initiatives, green schools aim to equip students with the skills and knowledge to contribute to solving pressing global challenges related to the environment.

4.Improvement of the Learning Environment: Green schools enhance learning environments by providing eco-friendly buildings and classrooms. Well-designed classrooms promote better learning and increase student interaction. These schools optimize learning processes by adopting a more responsive approach to students' needs, creating environments beneficial for student success (Earthman, 2004). By focusing on sustainable design and thoughtful classroom layouts, green schools ensure that the physical space supports both academic achievement and student well-being.

5. Long-Term Retention and Interest in Education: The environment-focused education provided in green schools fosters long-term interest in environmental issues among students. This helps students grow into individuals with sustainability and environmental awareness, not only during their school years but throughout their lives (Fisk, 2010).

Social and Economic Benefits of Green Schools

Green schools, by adopting eco-friendly practices and sustainability principles, not only provide ecological benefits but also offer significant social and economic advantages. Here are the social and economic benefits of green schools

Social Benefits

- Health and Well-being Improvement: Green schools enhance students' physical and mental health by providing clean air, natural light, and healthy living spaces. This environment helps students focus better and increases their overall well-being (Chatzidiakou et al., 2012).
- Development of Sustainability Awareness in the Community: Green schools raise environmental awareness among students and teachers, contributing to the spread of this consciousness. This, in turn, helps foster the adoption of eco-friendly habits at the community level. By promoting sustainable practices, green schools play a crucial role in encouraging broader societal shifts towards environmental responsibility.
- Strengthening Social Bonds: Green school projects enable collaboration between students, teachers, and families. This fosters the development of strong social bonds within the school community (Fisk, 2010).

Economic Benefits

- Energy and Resource Conservation: Green schools reduce costs through energy-efficient and water-saving practices. The use of renewable energy sources and sustainable building designs lowers operational costs, contributing to overall savings (U.S. Green Building Council, 2017). These measures not only promote environmental responsibility but also provide long-term financial benefits for schools.
- Long-Term Economic Savings: Energy-efficient building designs result in lower heating and cooling costs. Additionally, practices like water conservation and waste management offer long-term economic benefits (Earthman, 2004). These strategies not only reduce operational costs but also contribute to a more sustainable and cost-effective school environment over

time.

- Contribution to the Local Economy: Green school projects create job opportunities for local green technologies and the construction industry. Additionally, collaborating with companies that supply eco-friendly materials supports the local economy (McGinnis & McNally, 2018). This approach not only fosters environmental sustainability but also boosts the economic development of the surrounding community by generating employment and promoting sustainable business practices.
- Future Employment Opportunities for Students: Students raised with environmental awareness in green schools are better equipped for employment in sustainability and eco-friendly sectors, which in turn supports economic growth (UNESCO, 2021). By developing skills related to environmental responsibility, these students are prepared to contribute to and thrive in industries focused on sustainability and green technologies, enhancing both their personal career prospects and the broader economy.

Green schools not only fulfill environmental responsibilities but also make significant contributions to economic and social sustainability by enhancing the overall well-being of communities. By adopting sustainable practices, they support long-term ecological, economic, and social benefits, thus fostering a more resilient and prosperous future for both students and the broader society.

Green Education

The terms "Green School" and "Green Education" are frequently used as synonyms. Both in academic discourse and among the general public, expressions such as green education are commonly employed to refer to environmental education within both formal and informal contexts.

Even simple activities, such as introducing children to recycling, can be considered green education, as they raise awareness about the impact of human actions on the earth and other people (Pancheri-Ambrose & Tristchler-Scali, 2013). Green education is an educational approach aimed at increasing individuals' knowledge about environmental issues and raising awareness about sustainability.

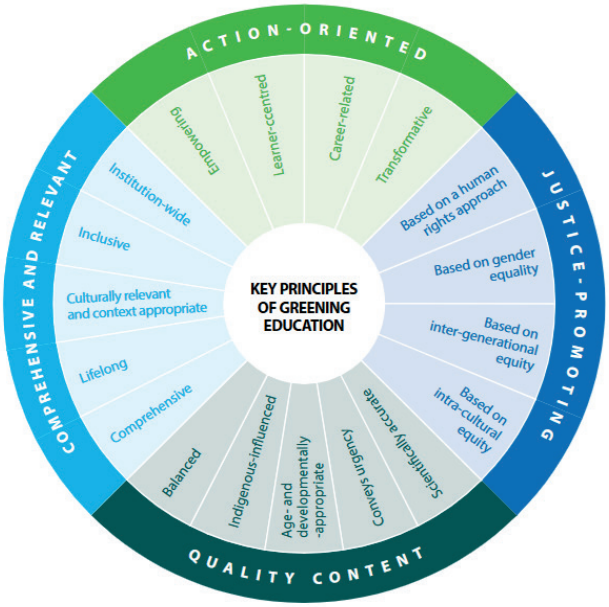

Figure 9. Key principles of greening education

This education seeks to teach students lifestyles that are in harmony with nature, encourage eco-friendly practices, and develop a sense of environmental responsibility. Green education is a teaching process that encompasses not only ecological sustainability but also social and economic sustainability (UNESCO, 2014). This approach sensitizes students to global environmental issues and encourages them to actively participate in solving these problems (Sterling, 2001). Additionally, green education aims to raise environmental sensitivity, fostering more conscious individuals who make environmentally respectful decisions and contribute to building sustainable communities.

FEE identifies the greatest threats facing the world as climate change, biodiversity loss, and environmental pollution. By promoting a better understanding of the causes and the environmental, social, and economic impacts of these issues, FEE aims to work with its members to educate and empower communities to take action and implement solutions to mitigate the effects of these issues at the local, national, and global levels. In line with these goals, the key principles of the climate change curriculum developed by UNESCO (2024) are outlined below (**Figure 9**).

Action-Oriented

Empowering: Green schools empower students by boosting their confidence, decision-making abilities, and important skills such as analysis and communication. This approach helps students gain the knowledge and values needed to deal with sustainable development challenges and effectively address climate change.

Learner-Centred: Pedagogical approaches, such as critical, participatory, problem-based, student-centered, and experiential learning, actively engage students in the learning process. These methods encourage learners to critically examine their personal experiences and natural environments while constructing their own understanding and knowledge.

Career-Related: It includes practices (problem-solving, collaboration, innovation etc) or ideas that can be applied to career choices and workplace practices.

Transformative: It supports local and global efforts to change human behaviors and systems, and to address the underlying causes of climate change.

Justice-Promoting

Based on a Human Rights Approach: This approach promotes and supports a universal understanding of human rights, especially the rights of children and young people, such as the rights to health, education, equal access to information, and freedom from discrimination. By focusing on human rights, climate change education aims to raise awareness that encourages young people to understand their own rights, respect the rights of others, and speak up for those whose rights are being violated.

Based on Gender Equality: This approach addresses how gender norms affect inequality and how these inequalities can increase vulnerability to climate change. It highlights that gender-based inequality, by examining the impacts of climate change on women, children, and other marginalized groups, shows that these groups are at greater risk.

***Based on Inter-Generational Equity*:** This approach aims to foster an understanding that not only protects the rights of the current generation but also considers the rights and responsibilities of future generations. It supports environmental sustainability and the equitable distribution of resources.

***Based on Intra-Cultural Equity*:** This approach aims to develop a vision of environmental, economic, and social justice and equality between societies and cultures. Achieving justice among communities of different cultures within the same generation requires the equitable distribution of resources and opportunities. This promotes equality between communities and fosters global solidarity.

These justice-promoting approaches teach students and the community not only environmental responsibility but also important values such as social and economic equality in the fight against climate change.

Quality Content

Scientifically Accurate: The content is based on evidence related to climate change and sustainable development. Scientific data and research ensure that the information used in education is reliable and valid.

Conveys Urgency: Green education emphasizes the urgency of adequately responding to the growing climate emergency. This raises students' awareness of global environmental crises, while recognizing the importance of swift and effective action to address these problems.

Age and Developmentally-appropriate: The content is designed according to the developmental levels and abilities of children and young people. Education is shaped in a way that is appropriate for the student's age, cognitive abilities, and socio-emotional development level.

Indigenous-İnfluenced: The education includes the knowledge and perspectives of local and, especially, indigenous peoples. This ensures the recognition of long-standing knowledge and traditional practices, particularly regarding environmental sustainability. The relationship of indigenous groups with the natural environment is a significant source of learning in the fight against climate change.

Balanced: The education addresses the cognitive, social, emotional, and behavioral dimensions of learning in a balanced way. This ensures that green education adopts a holistic approach, preparing students both mentally and emotionally for environmental issues. A balanced approach encourages students to think more deeply, develop empathy, and take effective action when faced with global challenges such as climate change.

Comprehensive and Relevant

Comprehensive: Green education provides comprehensive, accurate, evidence-based, and age-appropriate opportunities for learning about sustainable development and climate change. This education is continuously delivered throughout the student's formal, informal, and non-formal educational processes (e.g., through museums and libraries) and also includes areas such as TVET (Technical and Vocational Education and Training). This ensures that students consistently acquire deeper knowledge over time.

Lifelong: Green education refers to a continuous learning process that begins at an early age, where new knowledge is built upon previous learning. This process encourages students to acquire more comprehensive knowledge at each stage through a spiraled curriculum approach.

Culturally Relevant and Context Appropriate: Green education provides learning outcomes related to local climate change issues and solutions. It also focuses on the cultural structures and norms that influence people's choices regarding sustainable development and climate change. The education reflects the social context by taking into account cultural diversity and local realities.

Inclusive: Green education involves a range of actors both inside and outside of the educational system, including experts, parents, community members, and local leaders. These actors provide alternative perspectives, new skills, and intergenerational and indigenous knowledge on climate change issues and solutions. They work together to understand climate challenges and develop potential solutions.

Institution-Wide: The principles of green education are integrated into every aspect of the learning environment and influence institutional culture and practices. This ensures the adoption of sustainability principles throughout the organization in the overall strategy and implementation of educational institutions.

When developing an educational curriculum, three fundamental questions must be addressed: what content will be taught, how the teaching will be conducted, and where the teaching environment will be provided (Tyler, 1949). A curriculum plan for climate change, one of the three major issues focused on by FEE, has been prepared by UNESCO (2024). In this curriculum, the answers to these fundamental questions are as follows:

WHAT TO LEARN	HOW TO LEARN	WHERE TO LEARN
• Address cognitive, socio-emotional learning and taking action • Contextualized emphasizing the relevance of local knowledge	• Learner-centred, experiential, and reflective • Integrated approach • Holistic assessment	• Schools through a whole institution approach • Communities through public awareness campaigns • Youth-created social movements • Nature-based museums and UNESCO-designated sites

In the process of curriculum development, there are specific learning outcomes that students are expected to achieve by the end of their education. Learning outcomes refer to explicit statements that define the knowledge, understanding, and/or competencies a learner is expected to acquire by the conclusion of a learning period. These outcomes represent the measurable results of the learning process, typically articulated in terms of a combination of knowledge, skills, abilities, attitudes, and understanding that an individual is anticipated to attain through successful engagement in a specific educational experience. (Adam, 2006). The learning outcomes expected from students aged 5-18 in the curriculum prepared by UNESCO for climate change are summarized in the following infographic:

In 2019 and 2020, the Foundation for Environmental Education (FEE) encouraged teachers to create and submit lesson plans that foster an action-oriented pedagogy focused on specific Sustainable development Goals (SDGs). The following lesson plan was selected:

There is still much to be done for schools around the world to become green and sustainable. Green schools, which adopt the concept of sustainability in their buildings and curricula, remain a minority compared to the total number of educational institutions. Many schools face financial and structural challenges that hinder the implementation of sustainable practices. The global spread of green schools is of great importance, as it enables more children and young people to receive an education that respects nature, culture, and society, while encouraging them to contribute to a more just, balanced, and sustainable world. Green schools are key to raising environmental awareness in future generations, teaching skills for living in harmony with nature, and fostering responsible individuals for the future.

With the development of new technologies and sustainable construction methods, more efficient and environmentally friendly school buildings are becoming more common, and these schools will serve as the educational institutions of the future by integrating renewable energy use, water conservation, the use of natural materials, and environmentally friendly transportation options.

Green schools are also learning environments that attach great importance to environmental education by offering a green curriculum in addition to the traditional courses in their curriculum and various activities aimed at raising awareness of these issues. Additionally, green schools are educational environments that emphasize environmental education by integrating a green curriculum alongside traditional subjects, as well as offering various activities designed to raise awareness of environmental issues. These activities aim to emphasize environmental education, making green schools learning environments that prioritize sustainability. In green schools, students have the opportunity to participate in projects and activities that promote sustainability, social equity, and community involvement, such as tree planting, establishing organic gardens, composting, waste collection, cleaning beaches and rivers, and recycling projects. In this way, they mature into mindful and responsible individuals.

Let's Save Water !

Introduction: This lesson plan aims to make students aware of the challenges of drinking water usage and wastage at a global and local level.

Objectives or Learning Outcomes Students will be able to:

• Understand the importance of saving drinking water.

• Develop their research, presentation and digital skills.

• Make conscious choices related to water.

• Promote active citizenship.

Time required: • Session 1 (150 min): Students conduct research in small groups about water scarcity in general and water usage at school. Then, students present their results as digital posters. Finally, students post their reserach on social media. • Water invoice, PPT presentation and Student's Book. • Videos: Aquametragem; Water, our future?

Resources required:

• Water invoice, PPT presentation and Student's Book.

• Videos: Aquametragem; Water, our future?

Activity

Classroom session 1

•The teacher projects an image related to the school's water bill and asks students about activities that use water at school.

•The teacher writes students' ideas about water consumption in a projected padlet.

•The teacher asks students to establish the relationship between the waste rate and the water consumption.

•Students form groups of 4. Students research about the availability of water on Earth, the water cycle, the water sources that reach the school area and the company responsible for waste treatment. The teacher must refer them to reliable sources for this research.

•Students are asked to suggest ways to reduce water consumption and water wasted.

•Students present the results of their work to the others in the form of digital posters.

*This lesson plan has been taken from the Eco-Schools website (https://www.ecoschools.global/lesson-plans-for-teachers).

Particularly in developing countries that are dependent on external energy resources, it is important to emphasize green schools that provide a healthy environment while fostering the necessary environmental awareness. In conclusion, green schools are educational institutions that invest not only in today's children, who are committed to sustainability and ready to deal with environmental challenges, but also in the future of the entire planet.

References

Adam, S. (2006). An introduction to learning outcomes. Introducing Bologna objectives and tools. E. Froment, J. Kohler, L. Purser, L. Wilson (Eds.), EUA Bologna handbook: Making Bologna work (article B.2.3-1), European University Association (EUA)/Raabe, Berlin.

Alemdağ, E., & Taş, Ç. S. (2019). Evaluation of the studies on thermal comfort in educational buildings. *14. Ulusal Tesisat Mühendisliği Kongresi* (pp. 1073–1084). İzmir, Türkiye.

Alkhatatbeh, B. J., Kurdi, Y., & Asadi, S. (2023). Multi-objective optimization of classrooms' daylight performance and energy use in U.S. climate zones. *Energy and Buildings, 297*, 113468. https://doi.org/10.1016/j.enbuild.2023.113468

Atıcı, R. (2019). Student attitudes in class factors affecting. *The Journal of Academic Social Science Studies, 8(28), 413-427.*

Demir, A. (2012). *Green school: Effects on education, environment, and sustainability* [Master Thesis]. Inönü University, Institute of Educational Sciences.

Bademcioğlu, M. (2017). *Evaluating school buildings according to the criteria of green schools in the sample city of İstanbul* [Master Thesis]. Yıldız Technical University Institute of Social Sciences.

Barker, L. L. (1982). *Comminication in the classroom*. Prentice Hall Inc.

BM (1987). Report of the World Commission on Environment and Development : note / by the Secretary-General.

Branco, P. T. B. S., Sousa, S. I. V., Dudzińska, M. R., Ruzgar, D. G., Mutlu, M., Panaras, G., Papadopoulos, G., Saffell, J., Scutaru, A. M., Struck, C., & Weersink, A. (2024). A review of relevant parameters for assessing indoor air quality in educational facilities. *Environmental Research, 261*, 119713. https://doi.org/10.1016/j.envres.2024.119713

Brundtland, G.H. (1987). *Our common future: Report of the world commission on environment and development.* Oxford University Press.

Bruner, J. S. (1990). *Acts of meaning*. Harvard University Press.

Bulunuz, M., Bulunuz, N., Tavşanlı, Ö. F., Orbak, A. Y., Mutlu N., (2018). Evaluation the views of elementary teachers about the level of noise pollution at schools, Its reasons, effects and control. *Kastamonu Education Journal, 26(3),* 661-671. https://doi.org/10.24106/kefdergi.412246

Bulut, B., & Çakmak, Z. (2018). Sustainable development education and ıts reflection on curricula. *Uluslararası Türkçe Edebiyat Kültür Eğitim (TEKE) Dergisi, 7(4),* 2680-2697.

Center for Ecoliteracy. (2010). What is a Green School? https://www.ecoliteracy.org/sites/default/files/CEL-What-is-a-Green-School.pdf

Chatzidiakou, L., Mumovic, D., & Summerfield, A. J. (2012). What do we know about indoor air quality in school classrooms? A critical review of the literature. *Intelligent Buildings International, 9(3)*, 180-206. https://doi.org/10.1080/17508975.2012.725530

Cutter-MacKenzie, A., & Smith, R. (2003). Ecological education: The role of children in sustainable environmental practice. *Environmental Education Research, 9(4),* 397-416.

doi: 10.1007/978-3-319-03740-0

Denan, Z., Awang, A. H., Mazlan, M. A. H., Majid, N. H. A., Rahim, Z. A., & Sanusi, N. A. Z. (2017). The implementation of environmental education and green programs in schools to achieve sustainability. *Advanced Science Letters, 23*(7), 6261–6265. https://doi.org/10.1166/asl.2017.9248

Dewey, J. (1952). *Experience and nature* (2nd ed.). Open Court Publishing Company.

Earthman, G. I. (2004). Prioritization of 31 criteria for school building adequacy. *The Journal of Educational Administration, 42(3),* 293–308. https://doi.org/10.1108/09578230410534832

El-Nwsany, R. I., Maarouf, I., & Abd el-Aal, W. (2019). Water management as a vital factor for a sustainable school. *Alexandria Engineering Journal, 58*(1), 29-38. https://doi.org/10.1016/j.aej.2018.12.012

Erlalelitepe, İ., Aral, D., & Kazanasmaz, Z. T. (2011). Investigation of educational buildings in terms of daylighting performance. *Megaron, 6*(1), 39–51.

Evran, A. (2012). *A research on sustainable construction and educational buildings* [Master Thesis]. Bursa Uludag University.

Ezema, I. C., Nwosisi, H. C., Uwuigbe, C., & Ogheneovo, A. (2022). Greening the School Energy System: A Nigerian Case Study. *European Journal of Energy Research*, *2*(4), 17–25. https://doi.org/10.24018/ejenergy.2022.2.4.68

Fisk, W. J. (2010). Health and productivity gains from better indoor environments and their relationship with building energy efficiency. *Annual Review of Energy and the Environment, 35,* 309-331.

Gordon, D. E. (2010). *Green schools as high performance learning facilities*. National Clearinghouse for Educational Facilities. https://files.eric.ed.gov/fulltext/ED512700.pdf

Gough, A., Lee, J. C. y Tsang, E. P. K. (eds.). (2020). *Green schools globally: Stories of impact on education for sustainable development.* Springer Nature Switzerland.

Higgins, S., Hall, E., Wall, K., Woolner, P., & McCaughey, C. (2005). The Impact of the Physical Environment on Learning. *The Impact of Classroom Lighting on Learning. Building Research & Information, 33(4),* 340-352. doi:10.1080/09613210500161861

Hnatyuk, M., Yeshchenko, T., Ivasiuta, M., Vitruk, N., & Kolesnykov, A. (2024). Implementing smart technologies for teaching Ukrainian language across secondary and higher education: case studies and practical recommendations. Multidisciplinary Science Journal, 6.

http://www.greenschools.net/section.php-id=10.html. 15. 10.2024.

https://www.ekoyapidergisi.org/10-surdurulebilir-okul-binasi-ornegi.20.10.2024.

https://www.greenschool.org/wp-content/uploads/2016/03/Green-School-Skills-.pdf 16.10.2024.

https://www.greenschool.org/wp-content/uploads/2020/11/Prospectus-2020Web.pdf. 15.10.2024

https://www.usgbc.org/press/about-center-green-schools, 20.10.2024.

https://www.yesilist.com/dunyadan-3-yesil-okul/. 22.10.2024

Iwan, A., & Rao, N. (2017). The green school concept: Perspectives of stakeholders from award-winning green preschools in Bali, Berkeley, and Hong Kong. *Journal of Sustainability Education, 16*, 1-15.

Kara, Y. (2024). Green schools as a sustainable education model from the perspective of school social work. *Journal of Society & Social Work, 35*(3), 537–561. https://doi.org/10.33417/tsh.1298975

Karsono, B., Arar, M. S. A., Wahid, J., & Saleh, B. (2020). Bamboo application in building design: Case study of green school, Bali, Indonesia. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 11*(3), 1-15. https://doi.org/10.14456/ITJEMAST.2020.133

Kensler, L. A. W. (2012). Ecology, democracy, and green schools: An integrated framework. *Journal of School Leadership, 22*(4), 789–814. https://doi.org/10.1177/105268461202200406

Lai, J. C., Shum, M. S. K., & Zhang, Y. (2014). Sustainability education in schools: An overview of current practices. *Environmental Education Research, 20(6),* 876-891. https://doi.org/10.1080/13504622.2013.833594

Liu, C., Zang, Q., Li, J., Pan, X., Dai, H., & Gao, W. (2023). The effect of the acoustic environment of learning spaces on students' learning efficiency: A review. *Journal of Building Engineering, 79*, 107911. https://doi.org/10.1016/j.jobe.2023.107911

McGinnis, P., & McNally, C. (2018). Economic benefits of green schools. *International Journal of Sustainability in Higher Education, 19(4),* 694-710.

National Research Council. (2007). *Green schools: Attributes for health and learning*. The National Academies Press. https://doi.org/10.17226/11756

Okasha, R., Mohamed, M., & Mansour, M. (2016). Green schools as an interactive learning source. *Journal of Al-Azhar University Engineering Sector, 11*(40), 1091-1100. https://doi.org/10.21608/auej.2016.19401

Özburak, Ç. (2019). The concept of sustainable architecture in early childhood: Built environment education. *NEU Journal of Architecture Faculty 1(1),* 1-12.

Özdemir, B. (2023). *Application of smart materials on building facades for sustainable construction* [Master Thesis]. Balıkesir University.

Pancheri-Ambrose, B., & Tritschler-Scali, J. (2013). Beyond Green: Developing Social and Environmental Awareness in Early Childhood. YC Young Children, 68(4), 54-58,60-61. https://www.proquest.com/scholarly-journals/beyond-green-developing-social environmental/docview/1439083008/se-2

Perkins, D. N. (1991). What constructivism demands of the learner. *Educational Technology, 31(9)*, 19–21.

Piaget, J. (1969). *The intellectual development of the adolescent.* In G. Caplan, & S. Lebovici (Eds.), Adolescence: Psychosocial perspectives. New York: Barre Books.

Ramli, N. H., Masri, M. H., Zafrullah, M., Taib, H. M., & Abd Hamid, N. (2012). A comparative study of green school guidelines. *Procedia - Social and Behavioral Sciences, 50*, 462-471. https://doi.org/10.1016/j.sbspro.2012.08.050

Ramli, N. H., Masri, M., Taib, M. Z., & Abd Hamid, N. (2018). A review of green school design guidelines. *Journal of Asian Behavioural Studies, 3*(8), 1–8. https://doi.org/10.21834/jabs.v3i8.272

Sa, J. P., Chojer, H., Branco, P. T. B. S., Forstmaier, A., Alvim-Ferraz, M. C. M., Martins, F. G., & Sousa, S. I. V. (2024). *Title of the article*. *Journal of Building Engineering, 98*, 1. https://doi.org/10.1016/j.jobe.2024.110952

Sadrizadeh, S., Yao, R., Yuan, F., Awbi, H., Bahnfleth, W., Bi, Y., Cao, G., Croitoru, C., de Dear, R., Haghighat, F., Kumar, P., Malayeri, M., Nasiri, F., Ruud, M., Sadeghian, P., Wargocki, P., Xiong, J., Yu, W., & Li, B. (2022). Indoor air quality and health in schools: A critical review for developing the roadmap for the future school environment. *Journal of Building Engineering, 57*, 104908. https://doi.org/10.1016/j.jobe.2022.104908

Sterling, S. (2001). *Sustainable education: Re-visioning learning and change*. Green Books.

Tavşan, F., & Yanılmaz, Z. (2019). Sustainable approaches in educational buildings. *Journal of Art and Design(24),* 359-383.

Türçev (2024, May 15). Türçev. https://www.turcev.org.tr/v2/icerikDetay.aspx?icerik_id=76.

Tyler, R. W. (1949). *Basic principles of curriculum and instruction.* University of Chicago Press.

United Nations (2016). Sustainable development goals: 17 goals to transform our world. https://www.un.org/sustainabledevelopment/sustainable-development-goals/.

U.S. Green Building Council. (2017). *Green schools: A guide to sustainable education facilities*.

UNESCO. (2014). *Shaping the future we want: UNESCO and education for sustainable development*. https://unesdoc.unesco.org/ark:/48223/pf0000230171

UNESCO. (2021). *Global education monitoring report 2021: Education and the climate crisis*. https://www.unesco.org/gem-report/en/2024ccec

UNESCO. (2024). *Green school quality standard: Greening every learning environment*. United Nations Educational, Scientific and Cultural Organization. https://doi.org/10.54675/LOCX2930

Vygotsky, L. (1978). Interaction between learning and development. *Readings on the Development of Children, 23(3)*, 34–41.

Warju, , Harto, S.P., Soenarto, & Hartmann, M.D. (2017). Evaluating the Implementation of Green School (Adiwiyata) Program: Evidence from Indonesia . *International Journal of Environmental and Science Education, 12*(6), 1483-1501.

Zhao, D.-X., He, B.-J., & Meng, F.-Q. (2015). The green school project: A means of speeding up sustainable development? *Geoforum, 65*, 310–313. https://doi.org/10.1016/j.geoforum.2015.08.012

About the Authors

Kadriye KAYACAN completed her undergraduate education in 2002 at Selçuk University, Faculty of Education, in Science and Mathematics Education program. She earned his master's degree in 2008 from the Institute of Science at Selçuk University and her doctorate in 2014 from the Institute of Education at Gazi University. She is currently serving as an Associate Professor in the Science Education Department of the Mathematics and Science Education department at Konya Necmettin Erbakan University Ahmet Keleşoğlu Faculty of Education. Her scientific studies focus on science education, inquiry based learning, web 2.0 tools, brain based learning. **Kadriye KAYACAN** has numerous published articles, book chapters, and conference papers in the field of science education.

E-mail: kadriyekayacan@gmail.com, **ORCID:** 0000-0003-1531-6991

Nuriye KOÇAK is a professor at Necmettin Erbakan University, located in Konya, Türkiye, at the Ahmet Keleşoğlu Faculty of Education, Department of Mathematics and Science Education, Department in the Science Education. Her scientific studies focus on chemistry, inorganic chemistry, green chemistry, occupational safety and expertise, science education, and teacher education. **Nuriye KOÇAK** has authored numerous research articles, conference papers, and book chapters on these topics. Additionally, she is a occupational safety expert.

E-mail: nuriye42@gmail.com, **ORCID:** 0000-0002-0531-3538

Similarity Index

Tme similarity index obtained from the paligarism software for this book chapter is 15%.

To Cite This Chapter:

Kayacan K. & Koçak N. (2024). Green schools and green education: towards a sustainable futureIn. S.A. kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp. 66-90). ISRES Publishing.

Ethical Considerations on Climate Change and Sustainable Development

Blerina KARAGJOZI

University of Tirana

Introduction

"Act so that the effects of your actions are in harmony with the permanence of genuine human life." Hans Jonas

This work examines ethical philosophy and some questions related to philosophical genesis of ecological crisis together with ethical issues raised in the age of technology. Hans Jonas, a German-American philosopher and bioethicist, is known for his work in environmental ethics and the philosophy of technology, particularly concerning the ethical implications of technological advancements. Jonas engaged into various ethical concerns, offering insightful perspectives that continue to shape contemporary discourse. He was deeply worried by the rapid pace of technological advancement and its potential consequences for humanity. Central to his ethical concerns was the concept of "the imperative of responsibility," which he articulated in his influential work "The Imperative of Responsibility: In Search of an Ethics for the Technological Age". Jonas argued that as humans gain unprecedented power through technology, they also bear an unprecedented responsibility for the consequences of their actions. He elaborates on the need for an ethical framework that prioritizes the long-term well-being of both present and future generations, urging for a profound reconsideration of our relationship with nature and technology.

One of Jonas's key concerns was the ethical implications of modern biotechnology, particularly genetic engineering. He warned against the "arrogance" of manipulating the very essence of life without fully understanding the long-term consequences. Jonas feared that the pursuit of technological progress without a proper ethical reflection could lead to catastrophic outcomes, such as the loss of human dignity and the erosion of moral values. His ethical stance called for cautiousness, humility, and a deep respect for the fundamental value of life.

Furthermore, Jonas was deeply worried by the environmental crisis and the unsustainable exploitation of natural resources. He argued that humanity's relentless pursuit of growth and consumption was leading to ecological devastation and endangering the survival of future generations. Jonas urged for a fundamental shift in values, advocating for an ethic of stewardship and respect for the natural world. He emphasized the connection of all living beings and the moral imperative to preserve the integrity of ecosystems for the sake of biodiversity and the well-being of future generations.

In addition to his concerns about technology and the environment, Jonas dealt with ethical issues related to politics, society, and human freedom. He warned against the dangers of totalitarianism and the erosion of individual autonomy in an increasingly technocratic society. Jonas called for a renewed emphasis on human dignity, freedom, and moral responsibility as essential principles for navigating the complexities of the modern world.

Philosophy and Ethical Considerations as a Path towards a Sustainable Future

In his influential work in contemporary moral philosophy, "The Imperative of Responsibility: In Search of an Ethics for the Technological Age", Jonas explores the ethical implications of modern technology and its impact on human existence, as a response to the ethical challenges posed by modern technological developments. Jonas highlights the ethical implications of modern biotechnology, genetic engineering, and environmental degradation, urging for a fundamental

reconsideration of our values and priorities. He warns against the *commodification* of life and the instrumentalization of nature, advocating instead for an ethic of stewardship and respect for the natural world.

Technology as the subject of ethical considerations stems from the simple fact that technology is a manifestation of human power, meaning an action, and all human actions are subject to moral scrutiny. It is also true that the same power can be for good or ill, and by using it, humans can obey to ethical norms or violate them. (Jonas, 1979). Central to his critique is the concept of the *imperative of responsibility*, which he argues must guide our relationship with technology. He emphasises the need for a moral framework that prioritizes the long-term well-being of both present and future generations, calling for humility, caution, and a deep respect for the value of life in the face of technological power (Jonas, 1979).

In his essay "Reflections on Technology, Progress and Utopia", Hans Jonas provides an introductory description on the meaning of progress as a term in the Western world reference. Jonas analyses out of historical and geographical references how the progress refers to public rather than private sphere, which is "a peculiarly "Western" fact". "While there is hardly a civilization anywhere and at any time which does not, or did not, speak of individual progress on paths of personal improvement, for example, in wisdom and virtue, it seems to be a special trait of modern Western man to think of progress pre-eminently as an attribute-actual or potential- of the collective-public reals…" (Jonas, 1981).

Within the technological development, progress as a term, has evolved to a quasi-untouchable concept, given the economic, power, and political gains. But at the same time, the unavoidability of progress and that specifically technological progress is inevitable is itself a *utopic* consideration of the fact that humanity cannot stop at any point the technological development but can only submit to its effects without any power to control it.

Hans Jonas's reflections on technology, progress, and utopia provide a deep ethical critique of modernity and its belief on technological advancement as a universal solution to human problems. In his works, particularly "The Imperative of Responsibility" and "The Phenomenon of Life", Jonas presents a different perspective that challenges the until then prevailing optimism about the trajectory of technological progress.

At the core of Jonas's inquiry is the question of what it means to be alive. Drawing on insights from existential phenomenology and biology, Jonas argues that life is characterized by a unique mode of being, that cannot be reduced to mere physical or chemical processes. He proposes a holistic approach to understanding life, emphasizing its irreducibility and autonomy as a phenomenon distinct from lifeless matter (Jonas, 1966).

Jonas introduces the concept of "ontological priority" to describe the fundamental difference between living and non-living beings. According to Jonas, living organisms possess an inherent drive toward self-preservation and self-realization, which distinguishes them from inert matter. He argues that the essence of life lies in its capacity for autonomy, self-organization, and purpose, which cannot be fully explained by mechanistic theories of nature. (Jonas, 1966)

Building on this ontological framework, Jonas explores the teleological dimension of life, supporting that living organisms exhibit a purposeful striving toward specific ends. Unlike non-living objects, which are governed by deterministic laws, living beings are characterized by a creative freedom that allows them to pursue their own goals and adapt to changing circumstances. Jonas's teleological account of life challenges mechanistic and reductionistic approaches to biology, offering a more holistic and dynamic understanding of living systems.

Furthermore, Jonas reflects on the ethical implications of his biological ontology, arguing that the autonomy and fundamental value of living beings demand moral consideration. He emphasizes the ethical imperative to respect and protect the integrity of life, both human and non-human, against the threats posed by technological manipulation and environmental degradation. Jonas's ethical stance is grounded in a deep respect for the mystery and complexity of life, calling for a more harmonious relationship between humanity and the natural world.

By questioning the assumption that technological progress necessarily leads to human flourishing, arguing instead that it brings about new ethical dilemmas and existential risks, he warns against the *hubris* of human mastery over nature, cautioning that the relentless pursuit of technological progress without ethical reflection could lead to catastrophic consequences for humanity and the planet.

Moreover, Jonas challenges the idea of progress as a certain march toward a utopian future, arguing that it often comes at the expense of human dignity, freedom, and moral integrity. He criticizes the modern obsession with efficiency, productivity, and consumerism, calling for a more holistic understanding of progress that involves not only technological innovation but also moral and spiritual growth.

In disagreement to the technocratic vision of utopia, Jonas suggests for a more modest and sustainable future based in humility, responsibility, and respect for human and non-human life. He calls for a revaluation of our relationship with technology and nature, emphasizing the importance of ethical deliberation, democratic participation, and cultural renewal in shaping a more human and ecologically sustainable society.

Jonas recognizes the unquestionable human power of being at the same time capable to command but also obliged to prevent. Considering technology as a creation and exercise of human power, that is a form of human action, and as all human actions should undergo a moral analysis so that every human action is compliant to ethical norms and doesn't go against. In this duality, human potential can actualize the opportunity to think responsibly and act ethically (Jonas, 1982).

Technology, as a human power, clearly falls under this general truth. But does it constitute a special case that requires an effort of ethical thinking, different from that which accompanies any human action and has been sufficient for all its kinds in the past? (Jonas, 1982) Jonas indeed thinks and tries to argue that it does constitute a novel and special case in human history.

This special case lies on the *human capacities*. Technology has enabled humanity with an unseen and unprecedented power to shape the world, manipulate nature, and alter the course of human evolution. This power asymmetry creates unique ethical challenges, as the consequences of technological interventions can be far-reaching and irreversible.

Within the ethical framework, Jonas stresses the importance of considering the long-term implications of actions rather than just short-term gains. Unlike many ethical dilemmas that have immediate consequences, the impacts of technology often unfold over long periods and across generations. Hans Jonas emphasized the importance of considering the long-term implications of technological developments, as decisions made today can have profound effects on future generations, potentially altering the course of human civilization.

Technological systems are characterized by their complexity and unpredictability, making it difficult to foresee all potential consequences of technological interventions. This uncertainty complicates ethical decision-making, as it is challenging to assess the risks and benefits of new technologies with certainty.

Jonas expressed concerns about the potential threats that technology poses to human

dignity, autonomy, and freedom. He warned against the dehumanizing effects of technology and the erosion of moral values in a technocratic society, calling for a renewed emphasis on human-centred values in the face of technological progress.

Ecological Crisis and the Threat We Pose to the Planet's Ecology

In his essay "Philosophy at the End of the Century", Hans Jonas describes the genesis of the ecological crisis he sees arising from "the threat we pose to the planet's ecology". In this essay he treats philosophical issues not only through a comparative method but rather considered the comparison itself as a holistic overview for matters that can deal with a wide range of anything and everything. Like natural sciences that have a well-defined and clearly recognized method for them to follow, philosophy enjoys the possibility to reflect on the method used by every other science and can identify and possibly produce a binding method of philosophizing, which maybe it never will do so (Jonas et al., 1994).

Jonas considers philosophical views as of a personal nature, as a combination of personal contributions to ongoing discussions by acts of freedom of analyses and invites social researchers to turn their eyes to the past, raise questions on the certainty of the scientific findings so to ensure their accuracy at the present. By doing so, we should treat the past as a subject of historical interest. He underlines the "supremacy" of philosophical considerations versus scientific considerations past the centuries and human development. He argues that while there can no longer be an alchemist or astrologer whom we take seriously, we can still take seriously an Aristotelian or Hegelian because in philosophy we cannot have a binding consensus about what is correct and what is false. Moreover, we cannot even desire one, it would spell the death of philosophy (Jonas et al., 1994).

This approach is quite interesting, in paving the way towards freedom of will and choice, that both determine the responsibility that comes as a result of voluntary actions. Jonas calls for self-examination while taking individual decisions that will affect the state of beings. His views on philosophy, as a subject of thought, as a practice of analysis, as a matter to develop intuition through exploring irrationality and making logical decisions informed by historical lessons and scientific findings, is a combination of human physical sensations (needs) versus the estimations of logical qualitative awareness by posing quantitative questions. He mentions the phenomenology of Husserl while analysing the simple statement of "I am hungry" where the biological needs are questioned by the unphilosophical considerations whether there is enough food and how to obtain it, and consequently raising questions concerning social justice and the concept of the just and unjust distribution of property as well as good and bad form of society (Jonas et al., 1994).

Jonas continues that based on such biological needs, and on such non-philosophical considerations a truth from Bertold Brecht comes strong as Mack says in Threepenny Opera "First comes the grub, then come the morals." in other words "food comes first, and moral interest comes after". In a metaphorical way, the meaning of such saying relates to meeting the survival needs which in the times of Great Depression (1929-39) was stronger than ethical actions. Humans need to eat first, and after that, can pray for the bad deeds caused to feed their hunger. This concept comes in line with Brecht's criticism about capitalism and the bourgeoisie.

In the latter half of the 20th century, Jonas's work moves away from traditional ethical frameworks, particularly from Immanuel Kant's categorical imperative, and deals with the unprecedented power that humanity holds over nature through technology. Heidegger's critique of technology (Heidegger, 1977), a complex and deeply philosophical critique rooted in his concern for the impact of modern technology on human existence, culture, and the relationships between humanity and the world, inspired Jonas, especially his criticism of technology as an instrumental force challenging human existence.

Jonas is strongly shaken by the occurrences of the Second World War. The reality of what the world and humanity had been experiencing together with the tasks it left behind could not be ignored. From the heaven of eternal thought, philosophical contemplation descended to earth with its conflicting forces and intervened in the course of affairs. Politics and society became the dual focus of philosophical interest. Noble abstention and distancing from events of the day was not an option any longer, therefore moral engagement permeated theoretical investigation (Jonas et al., 1994).

One of the events that made Jonas rethink the role of technological development in the industrialized Western world was the nuclear bomb thrown over Hiroshima (August, 1945). By using the scientific research combined with technological advantage, this act enabled the end of Second World War but at the same time triggered a whole new concept of fear, anxiety and moral questions posed in the face of a human-developed continuous and collective danger, a real uncontrollable threat for self-destruction. Jonas argues that under these newly arisen circumstances the philosophical critique on the role of technological development found itself covered by shadows of terror (as in the case of Gunther Anders). Jonas was deeply affected by the scripts, terror and realization from his fellow friend writer and researcher Anders. "Yes, it is incontrovertible that August 6, 1945, namely Hiroshima, meant a fracture for me. It has been the deepest rupture of my life, but certainly not the first." (Anders, 1961).

After a few years in 1954, Anders would be heading towards the establishment of an anti-nuclear movement. This moment - Ander says, - of awareness has served as a Copernican revolution of *hope* (the not-yet) gives way to living *without hope* (the no-longer) to researchers and scientists having witnessed the nuclear devastation of Hiroshima and Nagasaki. Anders attended in 1958 an antinuclear meeting in Tokyo where he presented in a seminar on the topic of "Theses for the atomic age" where he spoke about the nuclear threat that foreshadows a "world without humanity," highlighting the radical contingency of human life, which is now defined as "suspended": "we are those who exist-still. The entire humanity is eliminable." (Anders, 1958).

The unpredictability and uncontrollability of the technological triumph over human race and world of species, suddenly unveiled the real threat of a catastrophe and apocalypse initiated potentially by human factors. Technology has shown its negative sides and activated therefore a whole new basis for new philosophical questions to be asked.

We will continue to raise questions about technology. Asking constructs a way. Therefore, I would advise focusing primarily on the manner and not concentrating attention on isolated sentences and themes. The manner is a way of thinking. All ways of thinking, in the manner of perception, lead through language in an extraordinary way. We will raise questions about technology, and for this, we must prepare a relationship of freedom towards it. The relationship will be free if it opens our human existence to the essence of technology (Heidegger, 1977). While assessing critically Heidegger's pessimism, Jonas incorporates Heidegger's insights to develop a more constructive philosophy that acknowledges the double potential of technology for both harm and benefit.

Jonas's exploration of technology as an ethical subject provides a comprehensive and provocative framework for navigating the ethical challenges presented by technological advancement. His emphasis on the ethics of responsibility, the unpredictability of technological outcomes, the biophysical foundation of ethics, and the principle of responsibility contribute together to a holistic approach to thinking about the future.

Moral engagement and raising people's awareness continuously – a lesson that comes from Socrates – is a moral duty of the philosopher. Therefore, Jonas considers the task of moral philosophy to discuss the controversial problem of nuclear weapons as a sensitive area

of non-clearly defined boundaries that as a result and product of human mind, together with the previous dreams of power would have to be accompanied with new unforeseen and unforeseeable challenges. For this to be achieved, Jonas proposes a novel cooperation between philosophers, scientists, and representatives of the life sciences, to clarify the new questions that arise from new discoveries for example the advancements in the biological and medical research.

In all he does, man seeks some good as end or means (Aristotle, 1893). What is the good that man seeks as an end scope with these technological advancements, might one ask in the Aristotelian light of ethics? Why is the technological development a concern of philosophy and moral philosophy? Until now – according to Jonas – philosophy has posed questions about the good life of the individual, about the good society, about the good state. Since its beginnings, it has always concerned itself with human actions insofar as these occurred between human beings but scarcely ever with the human individual as an acting force in nature (Jonas et al., 1994).

Is there any dual struggle between good and evil that characterizes this new phenomenon of human development? Suddenly – as Jonas discusses - one of the oldest philosophical questions, that of the relationship between human being and nature, between mind and matter- in other words, the age-old question of dualism- took on a totally new form (Jonas et al., 1994).

The human individual has always tried to describe nature, and then posed questions to understand natural phenomenon, making a good use of it. Inspired by the Enlightenment philosophers who brought faith in human reasoning through rationalism, science, and the growth of industrial economic theories enabled by technological development, humanity fell into the trap of the so-called human right to use natural resources for unlimited benefits and economic development. But to address this problem a new conception of human beings should be developed to discuss on the disastrous impact of human development upon nature.

Jonas poses to the philosophical table a very practical problem, the *urgent threat of extinction*. Such threat is posed to the biosphere and not only to human race and is magnified due to the developments of technology and its impact on the natural environment. He calls for a reconciliation between our special status as humans in the centre of our only world, the planet Earth, as the only source of our life and the universe. Humankind has arrived at the stage of development, when human ambition has caused perhaps unintentionally the threat of a crisis lit by the flashes of an approaching storm. The planet Earth, its present and its future has become the central concern of philosophy.

Perceiving itself as a dominant species, regardless of the destructive consequences for the less favored, humanity now finds itself facing the only way to exist, through a new ecological perspective. Ethical responsibility includes non-human entities and the environment, emphasizing an ecological perspective that highlights the fundamental value of biodiversity and the need to maintain the delicate balance of ecosystems.

By using scientific knowledge, brought to the discussion by natural sciences, Jonas conveys the example from Copernicus. To our knowledge – he says - to our knowledge it is no longer the entire cosmos that is the dwelling place of life but solely our planet Earth. Nothing in the remainder of the gigantic universe guarantees that there must be such a dwelling place at all. Therefore, we must regard ourselves and all life around us as a cosmic rarity, a stroke of luck that caused a potentiality, hidden in matter's womb and as a rule remaining hidden, to become, as an exception, reality (Jonas et al., 1994). As we continue to discuss on the implications of rapid technological advancements, Jonas's insights remain crucial, urging us to maintain an ethical stance that prioritizes responsibility, ecological awareness, and the well-being of current and future generations.

At the core of his discourse is the broad idea of responsibility, asserting that the extraordinary power given to humanity by technological progress requires an equivalent ethical obligation. Jonas's ethical framework brings together responsibility, predictive ethics, biodiversity, sustainable technological development, and the Promethean gap into a comprehensive vision for navigating the ethical challenges of the technological age. In his view, a key component constitutes predictive ethics, whereby a proactive and careful approach to technological progress should be maintained, emphasizing the importance of ethical reflection before embarking on journeys within the new technological frontiers. Jonas expands the ethical scope beyond anthropocentric views, emphasizing the crucial value of biodiversity and calling for a responsible approach that acknowledges the interaction of all forms of life.

Late in the evolution of life we encounter ourselves- human beings. We appeared on the scene only very recently. The span of time from the Paleolithic Age to the era of scientific technology is a long one in human history but very short in evolutionary terms, and since the rise of the modern natural sciences in the seventeenth century the tempo of change has accelerated exponentially. What we are experiencing today is the paradox of excessive success that threatens to turn into a catastrophe by destroying its own foundation in the natural world. In the history of life, our entrance was an event with immense consequences, and it has not yet been determined whether we are equal to them. With us, the power of thought intervened in Earth's further development and severely impaired those biological mechanisms in effect until then that ensured the equilibrium of ecological systems (Jonas et al., 1994).

Environmental Crisis, Climate Change and Sustainable Development

To our generation, living in times when the exploitation of nature, the voracious use of natural resources, the mining operations for mineral extraction, large-scale fishing operations, uncontrolled carbon dioxide emissions, and global consumption practices, driven by rapid economic growth under the guise of capitalism and market dominance, have resulted in massive environmental destruction. Sustainability is a key criterion for responsible technological progress, ensuring the well-being of the planet and future generations. What is the fundamental responsibility of humans towards our planet, the conservation of nature, respect for biodiversity, and the ethical issues that arise from this? How do local social values interact with global powers regarding environmental issues to address the environmental threat to humanity's future? What is required of science, society, and morality in times of environmental crisis and threats from climate change?

Let us consider an example of the Earth's Sustainability Index, an alarm bell for the level of consumption that we as global citizens have embraced without being aware that it is precisely, we who, with our greed for everything and now, are depleting natural resources that are not infinite. In 1970, Canadian ecologist William Rees introduced the concept of the "ecological footprint," a method to measure human demand for products related to ecosystems and biomass. This method quantifies the demand for resources and supply in terms of the necessary natural area to support these needs. Using a zone as a measure of natural capital supporting life was chosen to highlight that many basic ecosystem services and ecological resources are directed from areas where photosynthesis occurs, demonstrating how humanity is constrained by nature's capacity to transform low-quality solar energy into high-quality chemical energy and living matter.

In 1990, inspired by Rees's work and his ecological footprint concept, Swiss regional planner Mathis Wackernagel and American biologist Susan Burns founded the International Footprint Network, dedicated to promoting the concept of the ecological footprint. Thanks to their research, it was possible to calculate in 2006 that Earth Overshoot Day, the date when humanity's demand for ecological resources and services exceeds what Earth can regenerate in that year, was December 19, marking the first time the scale of the planet's natural resource consumption was highlighted. In less than four years, by 2010, this date was recalculated to be August 21, reflecting

a significant increase in the level of global resource consumption. In 2017, the date fell on July 29, indicating the increase in ecological deficit, and by 2019, global calculations touched July 25. During the year 2020 and the COVID-19 pandemic, the date underwent a recalculation a few days later, offering a correlation on how the reduction in human activity could delay the date of Earth Overshoot Day. Why is it important to think about the unsustainable way we are using our planet's resources? Let's pause for a moment and reflect on our actions, decisions, way of life and *our responsibility* to future generations and those who have not yet been born.

Scientists who have studied climate issues, through scientific findings, have shown that humans are responsible for almost all global warming over the past 200 years. Through the burning of fossil fuels, greenhouse gases (GHGs) are released (including carbon dioxide and methane) which act as a protective layer around the Earth. This "greenhouse" layer traps outgoing solar heat and has contributed to rising temperatures on the planet's surface faster than at any other time in at least the last two thousand years. (IPCC 2023)

We live in a time when the melting of icebergs poses a real threat. Researchers at the University of Leeds have discovered the dramatic impact of climate change on Greenland's iconic ice sheet. Over the past three decades, approximately 28,489 square kilometres, equivalent to the size of Albania, have melted, leaving behind rugged rocks, boulders, and shrub-covered areas (Grimes et al., 2024).

A risk of global catastrophe lies ahead of us. Ice melting, the rising oceans, disappearing lands on one side, and the burning forests, dried-up rivers, and desertification on the other. Death as an image of extinction combined with the science of loss of life must be reconsidered as a new concept of social change, through sustainable development and the lenses of bioethics for a real future for all.

Climate change poses one of the most pressing challenges of our time, with far-reaching implications for ecosystems, economies, and human well-being. In the face of this existential threat, sustainable development emerges as a crucial framework for addressing the interrelated goals of environmental protection, economic growth, and social equity.

At this point, the key element in Jonas's ethical framework, with the notion of the *Promethean gap* becomes so real. This term refers to the mythical figure Prometheus, who stole fire from the gods to empower humanity. The gap refers to the disparity between the increasing technological power of humanity and its ability to predict and control the consequences of this power. Unlike Prometheus, who faced divine punishment, humans must confront the unintended consequences of their technological advancements.

Using this concept, Jonas presents the need for ethical reflection. Through the Imperative of Responsibility, he seeks to bridge this gap by promoting a reflective and responsible approach to technological progress. Decision-makers must engage in ethical reflection before advancing technologies, emphasizing a proactive and anticipatory mindset, highlighting that ethical reflection must be an integral aspect of decision-making during the development and use of new technologies.

Technology as the subject of ethical considerations stems from the simple fact that technology is a manifestation of human power, meaning an action, and all human actions are subject to moral scrutiny. It is also true that the same power can be for good or ill, and by using it, humans can adhere to ethical norms or violate them (Jonas, 1979). Taking responsibility, for Jonas, means fulfilling the human capacity for *thought* and *ethics*. The human capacity to be "who one is" is achieved not only through language and reasoning but extends to ethical actions of responsibility in the world.

The Earth does not have sufficient resources, and by relying on the myth of Prometheus to illuminate the ethical challenges arising from humanity's unprecedented control over the natural world, we have a glimmer of hope to rekindle the light of the future. But again, in Jonas *Critique of Utopia "*for the first time in the annals of man, thanks to the powers of technology, the dream appears to be capable of turning into a task… Nothing could tempt the might of Prometheus unbound more than the dream of the highest earthly good believed within its reach, and nothing can become more dangerous to mankind than a mistaken pursuit of it." (Jonas, 1981).

Conclusions

In summary, Hans Jonas's work on the ethics of technology challenges society to approach technological advancements with a deep sense of responsibility and consideration for far-reaching consequences on the environment, future generations, and the overall well-being of the planet. Jonas considered technology to be a special case for ethics due to its unprecedented power, temporary scope, complexity, alteration of nature, ethical void, and threats to human dignity. His work underscores the importance of developing an ethical framework to guide technological development and ensure that it serves the well-being of humanity and the integrity of the natural world.

Overall, Hans Jonas's reflections on technology, progress, and utopia offer a profound critique of modernity and a compelling vision for a more ethical and sustainable future. His philosophical insights have had a significant impact on the field of environmental ethics and continue to be important in discussions surrounding the ethical dimensions of technological progress. His work continues to inspire scholars and policymakers to confront the ethical challenges of technological advancement with wisdom, foresight, and a deep sense of moral responsibility. Sustainable technological progress, a cornerstone of his philosophy, supports the integration of ethical considerations into scientific and technological processes, prioritizing long-term consequences for the planet and future generations.

Technology enables humans to intervene in the natural world in unprecedented ways, blurring the boundaries between humanity and nature. Jonas raised ethical concerns about the manipulation of nature and the potential loss of biodiversity, emphasizing the importance of preserving the integrity of ecosystems and respecting the fundamental value of non-human life forms. As society struggles with the ethical dimensions of technological advancement, Jonas's insights offer a compelling framework to ensure responsible and sustainable progress that prioritizes the well-being of current and future generations.

Jonas warned against the *hubris* of technological mastery and the temptation to manipulate the world without fully understanding the consequences of our actions. He argued that with increased technological power comes an increased moral responsibility to act ethically and consider the potential impacts of our decisions on future generations. Jonas argues that as humans gain unprecedented power through technology, they also bear an unprecedented responsibility for the consequences of their actions. Applied to climate change, this principle underscores the moral imperative to mitigate greenhouse gas emissions, adapt to changing environmental conditions, and safeguard the integrity of ecosystems for future generations. Sustainable development, therefore, requires a fundamental shift in values and priorities, placing the long-term well-being of both present and future generations at the forefront of decision-making.

He emphasizes the importance of humility and precaution in the face of uncertainty. Climate change presents complex and interconnected challenges, characterized by nonlinear and unpredictable impacts. Sustainable development calls for a precautionary approach that recognizes the fundamental limits of human knowledge and acknowledges the complex uncertainties of ecological systems.

In Jonas's view, technology operates within an ethical space, as it is driven primarily by the pursuit of efficiency and profit. He called for the development of an ethical framework to guide technological development, emphasizing the need for values such as responsibility, humility, and respect for life.

Climate change disproportionately affects vulnerable communities, intensifying inequalities and injustices within and between generations. Sustainable development requires a commitment to equity, social justice, and solidarity, ensuring that the benefits and burdens of environmental stewardship are distributed fairly across society.

In conclusion, Hans Jonas's insights offer valuable guidance for addressing climate change and advancing sustainable development. We can build a more resilient, equitable, and sustainable world for current and future generations, by embracing the ethic of responsibility, cultivating humility and precaution, and promoting intergenerational justice.

References

Aristotle (1893). *The Nicomachean ethics of Aristotle* (5th ed.). London: Kegan Paul, Trench, Trubner & Co.

Anders, G. (1962). Theses for the atomic age. *The Massachusetts Review*, *3*(3), 493-505.

Anders, G. (1961). *Essere o non essere: Diario di Hiroshima e Nagasaki, trans*. Renato Solmi.

Change, O. C. (2007). Intergovernmental panel on climate change. *World Meteorological Organization*, *52*, 1-43.

Grimes, M., Carrivick, J. L., Smith, M. W., & Comber, A. J. (2024). Land cover changes across Greenland dominated by a doubling of vegetation in three decades. *Scientific Reports*, *14*(1), 3120.

Heidegger, M. (2009). *The question concerning technology.* (pp. 9-24).

Ruland, R. (1963). The American Plays of Bertolt Brecht. *American Quarterly*, *15*(3), 371-389.

Jonas, H. (2001). *The phenomenon of life: Toward a philosophical.* Northwestern University Press.

Jonas, H. (1979). Toward a philosophy of technology. *The Hastings Center Report*, *9*(1), 34-43

Jonas, H. (1982). Technology as a subject for ethics. *Social Research*, *49*(4), 891-898.

Jonas, H. (1984). *The imperative of responsibility: In search of an ethics for the technological age*. University of ChicagoPress.

Jonas, H., Hannum, H., & Hannum, H. (1994). Philosophy at the end of the century: a survey of its past and future. *Social Research*, *61*(4), 813-832.

Wackernagel, M., & Galli, A. (2007). An overview on ecological footprint and sustainable development: a chat with Mathis Wackernagel. *International Journal of Ecodynamics*, *2*(1), 1-9.

About the Author

Blerina Karagjozi is studying at University of Tirana, Faculty of Social Sciences, Department of Philosophy, Doctoral Program Boulevard "Gjergj Fishta", Tirana, Albania. Blerina holds a bachelor's degree (2003) and a master's degree (2006) in Social Sciences from the University of Tirana, with a focus on Political Philosophy and Social Studies. Since 2022, she is pursuing her doctoral studies in the Department of Philosophy of the University of Tirana focusing in Ethics of Environment, dedicating her research to bridging intellectual ambitions with practical contributions that can benefit her country's development. Throughout her career, she has been deeply committed to fostering human values, human rights, and sustainable development. She has devoted her professional efforts to supporting Albania's growth, with a strong belief that ethical research and thoughtful action led by ethical principles can serve as a foundation for meaningful and sustainable progress. Blerina is a writer on social issues, an enthusiast of humanity, arts and culture, embodying the values of human rights. Her work reflects a strong commitment to environmental sustainability, governance, and public accountability, particularly in supporting Albania's path toward European integration and broader global development goals.

E-mail: bkaragjozi@gmail.com, ORCID : 0009-0004-7583-4445

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 1%

To cite this article:

Karagjozi, B. (2024). Ethical considerations on climate change and sustainable development. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp.91-101). ISRES Publishing.

Section 4.

Problems and Expectations of Preservice Teachers

Assessment of Unemployment Anxiety and Influencing Factors in Pre-Service Teachers

Ahmet KARA

University of Kastamonu, Turkey

Munise SECKİN-KAPUCU

University of Eskisehir Osmangazi, Turkey

Ayşe AYPAY

University of Eskisehir Osmangazi, Turkey

Introduction

In recent years, unemployment and unemployment anxiety have significantly increased, especially in Turkey. Most of the faculties of education in Turkey have different undergraduate programs, and these programs produce thousands of graduates every year. As the number of graduates increases yearly, so does the number of candidates for the KPSS. As the quota for the positions to be appointed is very low compared to the number of graduates, it becomes more and more difficult for pre-service teachers to be appointed every year. As a reflection of this, the majority of pre-service teachers, especially those who are still studying, experience unemployment anxiety from the pre-service period onwards. The problem of pre-service teachers not being appointed has turned into a vicious circle with the addition of thousands of new graduates every year to the existing pre-service teachers who have yet to be appointed despite the quota reductions for teacher recruitment. This situation causes an increase in the anxiety levels of both graduates and pre-service teachers who are still studying and causes them to be more pessimistic about their expectations for their professional future compared to previous years. In summary, due to many reasons, such as educational policies that lead to high quotas for almost all teaching fields without taking into account the supply-demand balance, unplaced graduates in different fields, the addition of tens of thousands of new teachers each year to the number of pre-service teachers who take the KPSS in the hope of being appointed, and policies to reduce quotas in appointments, pre-service teachers' chances of being appointed are decreasing and their anxieties about unemployment are increasing. The economic and political factors and educational policies that cause this situation are variables that pre-service teachers cannot control. Unemployment anxiety caused by these variables in pre-service teachers is not only an economic problem for pre-service teachers; it is a multifaceted phenomenon with personal, psycho-social components. For this reason, it is believed that examining the factors influencing unemployment anxiety and the effects of unemployment anxiety on pre-service teachers in this book chapter will help to understand this problem better.

Unemployment Anxiety

Unemployment is defined as the absence of a continuous source of income that can ensure subsistence (Paul & Moser, 2006). Unemployment is defined as all persons not employed in the reference period who have used at least one of the job search channels to look for a job in the past three months and who can start work within two weeks (Turkish Statistical Institute [TÜİK], 2019). The fact that people are in a state of unemployment, or that they lack motivation to work, to look for a job, and qualifications that may be suitable for work, leads to the formation of anxiety in them. Anxiety is the state of restlessness and fear an individual feels in a disturbing and threatening situation (Yetişensoy & Şahin, 2020).

It is predicted that young people or groups of young people who experience unemployment anxiety, even during the education process they receive to get a job, will be more affected by unemployment and anxiety situations resulting from unemployment. Accordingly, they are more open to the risk of unemployment (Demirtaş & Kara, 2022b). Young people experience feelings of hopelessness, stress, anxiety, and helplessness in the face of unemployment and experience anxiety during the job search process (Akgün et al., 2007). Hammarström and Janlert (1997) examined anxiety and depressive symptoms of youth unemployment in a longitudinal study. In the study, individuals were interviewed in their last year of compulsory education, and the same individuals were interviewed again five years after their education. At the end of the study, it was found that there was an increase in anxiety symptoms among people who had experienced a long period of unemployment. At the same time, unemployment was found to be the most critical factor in the negative changes in the mental health of these individuals.

Unemployment anxiety is known to be one of the most common types of anxiety, especially among university students in Turkey (Kara et al., 2019). In Tayfun and Korkmaz's (2016) study, it was observed that there was an increase in unemployment anxiety among senior university students towards graduation and that the ego of students who thought they would be unemployed was negatively affected. This situation increased their anxiety levels. Pre-service teachers in different branches stand out as the segments that experience unemployment anxiety most intensely. Presently, the importance of preventing unemployment anxiety among pre-service teachers increases. This is because, in parallel with the reduction of unemployment anxiety, individuals' hopes of finding a job increase (Mohammed & Devecioglu, 2018), individuals experience less stress and depression (Tayfun & Korkmaz, 2016); career calling and career adaptability increase (Kara et al., 2019). In addition, individuals will have a more positive attitude towards the teaching profession (Yetişensoy & Şahin, 2020). As a result, it is predicted that conducting studies to prevent unemployment anxiety will significantly contribute to the mental development, economic income (Güney & Çelik, 2019; Ng et al., 2015), and career development of individuals.

Factors Influencing Unemployment Anxiety

Based on theoretical explanations and empirical studies, this book chapter has identified the factors influencing pre-service teachers' unemployment anxiety. These factors are economic and political (employment and teacher recruitment policies), individual (life skills, career adaptability), psychological (hopelessness, career stress, and intolerance of uncertainty), and sociological (perceived social support and social capital) (Figure 1).

Economic and Political Factors

Employment

Economic growth and employment are two macroeconomic variables that determine the economic policies of many countries (Murat & Yılmaz-Eser, 2013). However, it is generally accepted in economic theory that economic growth in a country increases employment (Kreishan, 2011). Economic growth measures the ability of the economy to produce goods and services using existing resources such as capital and labor (Arı, 2016; Lozanoska & Dzambaska, 2014). Despite economic growth in many countries, from developed to developing countries, employment and unemployment have not increased or reduced as much as needed (Takım, 2010). While it is expected that there should be no unemployment problem in countries with high growth rates, it has been observed that this expectation has not been realized due to the multifaceted and complex structure of unemployment (Göktaş-Yılmaz, 2005).

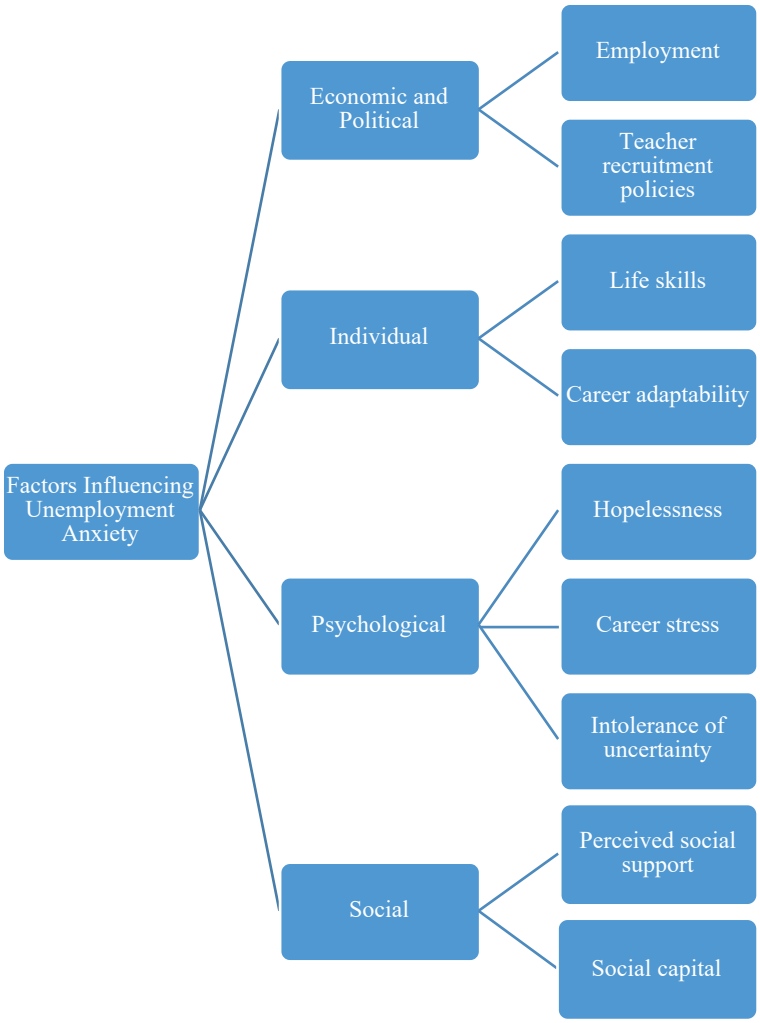

Figure 1. Factors influencing unemployment anxiety

Turkey's economic growth and unemployment are similar to those of developing countries. It can be said that the studies examining the relationship between economic growth and unemployment in Turkey are not sufficient (Bağcı & Börü, 2018; Takım, 2010). In a study conducted by Göktaş-Yılmaz (2005), a unidirectional causality was observed from the unemployment rate to the growth rate, while no causality was found between the growth rate and the unemployment rate. In another study by Öztürk and Sezen (2018), econometric methods were used to analyze whether there is an inverse relationship between economic growth and unemployment in Turkey as in theory. As a result of the study, it was concluded that economic growth in Turkey reduced the unemployment rate during the period analyzed. Another study by Üzar and Akyazı (2018), covering the period 2000-2016, aimed to determine whether the causality relationship between economic growth and unemployment in 34 OECD countries is compatible with the information provided by economic theory. As a result of the study, a causality relationship was found between economic growth and unemployment and between unemployment and economic development. In this context, it can be said that growth and unemployment influence each other.

Teacher recruitment policies

Unemployment is one of the causes and consequences of poverty (Sodipe & Ogunrinola, 2011). In addition, unemployment causes various problems not only economically but also individually, psychologically, and sociologically. For this reason, policies to reduce unemployment are among the authorities' priorities (Arı, 2016).

Those with higher levels of education have also felt the negative impact of unemployment on the unemployed. The unemployment problem of graduates is deeply felt as a significant social problem. Unemployed teachers make up the largest proportion of the army of unemployed graduates. Factors such as economic ups and downs, government policies, budget allocations, the duration of compulsory education, the population at the age of mandatory education, and the number of teachers in the current system affect teacher employment (Lönnqvist, 2013).

From the beginning of the Republic until 1996, there was a continuous shortage of teachers. Attempts were made to overcome this shortage by training teachers who graduated from village institutes, by training teachers by letter, by accelerated training, and finally, in 1996, by appointing all graduates of faculties and colleges as classroom teachers (Akyüz, 2015). In Turkey, the condition of passing the Public Personnel Selection Examination (KPSS) has been required to appoint teachers since 2000. In 2023, 572,019 applicants applied for the examination, and 480,543 candidates took the examination. The total number of appointed positions for different branches was 45,000. For the 2024 KPSS Undergraduate Educational Sciences session, 526,947 candidates applied, and 475,624 took the exam (KPSS, 2024). However, in 2024, the total number of staff employed in different fields will be 20,000. In addition, according to the statistics of the Council of Higher Education (YÖK, 2024), our country has 97 active faculties of education. Apart from education faculties, many faculties (arts and sciences, engineering, theology, etc.) recruit certified teachers through pedagogical training programs. This situation means that many more university graduates than those trained and graduated by the faculties of education join the army of those waiting to be appointed as teachers. As a result, the employment problem of getting appointed as a teacher grows exponentially. In recent years, the issue of unappointed teachers has become one of the priority employment problems that must be solved. This situation requires government policy planning to reduce and prevent teacher unemployment.

Individual Factors

Life skills

Life skills are defined as skills that can be learned and used in everyday life, enabling people to succeed in different environments (Danish et al., 2004). It is stated that these skills can facilitate the development of psychological skills needed in daily life (Papacharisis et al., 2005). Life skills improve the quality of life by enabling the individual to adapt to the environment in which he/she lives (Danish et al., 2004) and, at the same time, strengthen the individual's ability to meet the needs and demands of society (Prajapati, 2017). These skills are seen to be compatible with 21st-century skills and to support individuals in their daily lives. Life skills education is included in the education programs of different countries. However, it has been found that there are differences in life skills education between developing and developed countries (Nasheeda et al., 2019). In Turkey, analytical thinking, decision-making, creative thinking, entrepreneurship, communication, and teamwork skills are emphasized among life skills (MEB, 2018).

The literature shows that there is an indirect relationship between unemployment anxiety and life skills. In other words, there is a theoretical explanation for the ability to cope with stress and emotions, which are sub-dimensions of life skills and unemployment anxiety. For example, in the psychological model of unemployment, unemployment anxiety, experiencing stress, and being in a depressive mood are interrelated concepts. In this model, individuals are recommended to avoid stressful environments and use coping methods to solve the problem from different perspectives to reduce unemployment anxiety (Ergül, 2019). As a result, based on the above theoretical explanation and logical inferences, it can be said that life skills can be an individual variable that can positively contribute to combating unemployment anxiety.

Career adaptability

Finding a job matching young people's training is not always possible. In this case, individuals need skills to adapt to different conditions. One such skill is career adaptability. Career adaptability is a basic structure that includes attitudes, competencies, and behaviors necessary for young individuals to adapt to their jobs and changing business life in the career development process (Eryılmaz & Kara, 2020; Yousefi et al., 2011). This ability also includes critical skills that individuals should have in decision-making processes related to their work life and career (Demirtaş & Kara, 2022a; Duffy, 2010). Savickas and Porfeli (2012; 2013) discussed the sources of career adaptability in four dimensions: concern, control, curiosity, and confidence.

In Kara et al.'s (2019) study, the increase in the career adaptability of individuals reduces their unemployment anxiety. In Demirtaş and Kara's (2022b) study, increasing university senior students' career adaptability decreased their unemployment anxiety. Based on these findings, it is understood that career adaptability is a crucial individual structure in reducing unemployment anxiety.

Psychological Factors

Hopelessness

Hopelessness is defined as negative expectations about the future (Beck et al., 1974). According to Li et al. (2024), hopelessness refers to the negative feeling that results from the perception that the likelihood of change in the adverse outcomes experienced by the individual is low or irreversible. In the literature, there are studies on the relationship between hopelessness and unemployment anxiety.

In the study by Dinc et al. (2024), the mediating role of future anxiety was found to be significant in the effect of unemployment anxiety on levels of hopelessness in young adults. Yalçın (2022) emphasized that hopelessness and unemployment anxiety are related concepts among young adults. Karakus (2018) found that students' belief that they will have problems finding a job after graduation is an important predictor of the hopelessness they experience. Consequently, based on the studies above, it can be said that hopelessness is a psychological factor associated with unemployment anxiety.

Career stress

Career stress is described as the stress associated with occupational problems such as uncertainty, employment pressure, conflict, and lack of information that individuals experience in their career development (Zhang et al., 2022). In other words, career stress is a negative situation that may arise during uncertainty or conflict in creating and developing an individual's career journey (Jung, 2020). Furthermore, career stress is a structure conceptualized with employment pressure, career ambiguity, external conflict, and lack of information (Özden & Sertel-Berk, 2017).

There is evidence in the literature of the relationship between career stress and unemployment anxiety. For example, Noor et al. (2024) reported that financial difficulties and economic threats caused stress among unemployed youth and job seekers. Demirtaş and Kara (2022b) found that career stress was an important psychological variable that predicted unemployment anxiety. Mamun et al. (2020) revealed that financial difficulties and threats experienced by unemployed youth increase their stress levels. As a result, in line with the above studies, it is considered that career stress is a psychological variable related to unemployment anxiety.

Intolerance of uncertainty

Intolerance of uncertainty is defined as the behavioral, emotional, and cognitive reactions that an individual develops against adverse events caused by daily uncertainty (Pan et al., 2024). According to Bird et al. (2024), intolerance of uncertainty is the tendency of an individual to react negatively to uncertain situations. Intolerance of uncertainty is classified as a structure including anticipatory and inhibitory anxiety components (Sarıçam et al., 2014).

When the literature is examined, findings indicate the relationship between intolerance of uncertainty and unemployment anxiety. For example, the findings of Ayhan et al. (2022) and Li et al. (2012) showed that there is a positive relationship between intolerance of uncertainty and unemployment anxiety, and the findings of Chen and Zeng (2021) showed that intolerance of uncertainty is an important predictor of unemployment anxiety. In conclusion, based on these findings, intolerance of uncertainty has been proven to be a psychological variable associated with unemployment anxiety.

Social Factors

Perceived social support

Perceived social support refers to the extent to which an individual perceives his/her social network (family, friends, and important social people) as supportive when he/she needs help (Safi et al., 2024). Perceived social support is the level of help, attention, and respect a person perceives from the social system (family, friends, and important others, etc.) (Yuan et al., 2024).

There are studies in the literature emphasizing that perceived social support is effective in reducing unemployment anxiety. To make this more concrete, Brimah et al. (2021) emphasized that social support is an important protective factor that reduces unemployment; Milner et al. (2016) reported that unemployed workers with high social support felt better psychologically than those without. Lorenzini and Giugni (2010) stated that social support is vital in young people's coping with unemployment. Consequently, based on the studies mentioned above, it can be said that perceived social support is a social factor that has a protective function in reducing unemployment anxiety.

Social capital

Social capital is the sum of the actual or potential resources an individual can access and mobilize based on their membership in a social network (Chen & Li, 2024). According to Hmimou et al. (2024), social capital refers to a set of potential resources connected and accessible based on the individual's social network. McArdle et al. (2007) state that social capital is the employability aspect of an individual's interpersonal connections (knowing who they know) relevant to their career.

When the literature is reviewed, some studies show that social capital effectively reduces unemployment anxiety. For example, Guney and Celik (2019) determined that as individuals' social capital levels increase, their unemployment anxiety decreases. Hmimou et al. (2024) emphasized the effect of social capital on an individual's likelihood of finding a job. In addition, it was underlined that social capital is an important social variable in shaping the individual's self-perception, providing access to career-related information and resources, and reducing the negative consequences of unemployment (McArdle et al., 2007). As a result, based on the studies above, it is understood that social capital is a protective social variable associated with unemployment anxiety.

Conclusion

In this book section, the unemployment anxiety of pre-service teachers is evaluated multidimensionally from economic, political, individual, psychological, and sociological perspectives. In this book section, the factors influencing pre-service teachers' unemployment anxiety are determined in line with the literature's theoretical explanations and empirical studies. In this context, economic and political factors (employment and teacher recruitment policies), individual factors (life skills, career adaptability), psychological factors (hopelessness, career stress, and intolerance of uncertainty), and sociological factors (perceived social support and social capital) are discussed.

Based on the theoretical knowledge and empirical research findings included in this book chapter, some suggestions can be developed to prevent the unemployment anxiety of pre-service teachers. These suggestions can be listed as follows:

- Pre-service teachers can decrease unemployment anxieties by using career adaptability skills such as career planning, exploration, control, and confidence.
- Pre-service teachers can reduce unemployment anxieties by developing life skills such as communication, interpersonal relations, empathy, and self-awareness.
- Pre-service teachers can decrease unemployment anxieties by regulating negative emotions such as fear, stress, pessimism, and hopelessness.
- Pre-service teachers can reduce unemployment anxieties by discovering social support resources related to their career development and using them in their social capital.

As a result, pre-service teachers' individual, psychological, and sociological empowerment can facilitate their awareness of career opportunities in their environment and increase their chances of being employed in public and private educational institutions by improving their self-confidence and self-esteem.

Acknowledgement

This book chapter was generated from Eskisehir Osmangazi University, BABSIS- Project, Eskisehir, with ID: 1760 and project code: SCD-2022-1760.

References

Arı, A. (2016). An analysis of the relationship between the economic growth and unemployment in Turkey: A new cointegration test. *Research Journal of Politics, Economics and Management*, *4*(2), 57-67.

Ayhan, D., Seki-Öz, H., & Bingöl, U. (2022). The impact of intolerance to uncertainty on unemployment anxiety in nursing students during pandemic: Role of resilience. *Gevher Nesibe Journal of Medical & Health Sciences*, *7*(18), 12-24. http://dx.doi.org/10.46648/gnj.366

Bağcı, E., & Börü, M. K. (2018). Relationship between economic growth and unemployment: An econometric analysis in Turkey. *International Journal of Academic Value Studies (JAVStudies)*, *4*(22), 890-897

Beck, A. T., Weissman, A., Lester, D., & Trexler, L. (1974). The measurement of pessimism: The hopelessness scale. *Journal of Consulting and Clinical Psychology*, *42*(6), 861-865. https://doi.org/10.1037/h0037562

Bird, S., Moid, L. A. E., Jones, C. A., & Surtees, A. D. (2024). The relationships between restrictive/repetitive behaviours, intolerance of uncertainty, and anxiety in autism: A systematic review and meta-analysis. *Research in Autism Spectrum Disorders*, *117*, 102428. https://doi.org/10.1016/j.rasd.2024.102428

Brimah, B. A. P., Olanipekun, W. D. P., Abu, Z. P., & Awe, O. I. (2021). Evaluation of youth employment and social support operation programme on unemployment reduction in ilorin metropolis. *University Journal of Management and Social Sciences (HUJMSS)*, *3*(1), 142-150.

Chen, L., & Zeng, S. (2021). The relationship between intolerance of uncertainty and employment anxiety of graduates during COVID-19: The moderating role of career planning. *Frontiers in Psychology*, *12*, 694785. https://doi.org/10.3389/fpsyg.2021.694785

Chen, M., & Li, W. (2024). Social capital development on interest-based networks: examining its antecedents, process, and consequences. *Humanities and Social Sciences Communications*, *11*(1), 1-10. https://doi.org/10.1057/s41599-024-02609-1

Danish, S., Forneris, T., Hodge, K., & Heke, I. (2004). Enhancing youth development through sport. *World Leisure Journal*, *46*(3), 38-49. https://doi.org/10.1080/04419057.2004.9674365

Demirtaş, A. S., & Kara, A. (2022a). Cognitive control and flexibility as predictor of career adaptability in emerging adults. *Kastamonu Education Journal*, *30*(2), 390-397. https://doi.org/10.24106/kefdergi.803515

Demirtaş, A. S., & Kara, A. (2022b). Career adaptability and unemployment anxiety in Turkish senior undergraduate students: The mediating role of career stress. *Turkish Psychological Counseling and Guidance Journal*, *12*(64), 19-33. https://doi.org/10.17066/tpdrd.1095894

Dinc, M. S., Super, J. F., Kuzey, C., & Güngörmüş, A. H. (2024). The impact of unemployment anxiety of young adults on their hopelessness level: Mediating role of future anxiety. *Journal of East-West Business*, 1-31. https://doi.org/10.1080/10669868.2024.2415028

Duffy, R. D. (2010). Sense of control and career adaptability among undergraduate students. *Journal of Career Assessment*, *18*(4), 420-430. https://doi.org/10.1177/106907271037458

Ergül, E. (2019). *Unemployment anxiety and working life perception of higher education youth: An application on Eurasia university student* [Unpublished doctoral dissertation]. University of Avrasya.

Eryılmaz, A., & Kara, A. (2020). Investigation of the effectiveness of career adaptability psycho-education program on career adaptability levels of students. *Hacettepe University Journal of Education*, *35*(4), 733-745. https://doi.org/10.16986/HUJE.2019050340

Göktaş-Yılmaz, Ö. (2005). Causality relationship between growth and unemployment rates in Turkish economy. *Istanbul University Econometrics and Statistics e-Journal*, (2), 63-76.

Guney, A., & Celik, E. (2019). Relationship between social capital and unemployment anxiety: An application on last class students at Ataturk university faculty of economics and administrative sciences. *Istanbul Journal of Economics*, *69*(1), 103-131. https://doi.org/10.26650/ISTJECON2019-0005

Hammarström, A., & Janlert, U. (1997). Nervous and depressive symptoms in a longitudinal study of youth unemployment—selection or exposure?. *Journal of adolescence*, *20*(3), 293-305. https://doi.org/10.1006/jado.1997.0086

Hmimou, A., Kaicer, M., & El Kettani, Y. (2024). The effects of human capital and social capital on well-

being using SEM: Evidence from the Moroccan case. *Quality & Quantity*, *58*(4), 3107-3131. https://doi.org/10.1007/s11135-023-01794-6

Jung, Y. M. (2020). Nursing students' career identity, satisfaction with major, and career stress by career decision type. *Japan Journal of Nursing Science*, *17*(1), e12281. https://doi.org/10.1111/jjns.12281

Kara, A., Altınok, A., & Şahin, C. (2019). Career adapt-abilities and career calling as a predictor of unemployment concerns for university senior grade students. *MANAS Journal of Social Studies*, *8*(3), 2294-2307. https://doi.org/10.33206/mjss.533767

Karakus, Ö. (2018). Depression and hopelessness levels of university students according to their opinions on finding employment or falling out of labor force in Turkey. *Universal Journal of Educational Research*, *6*(1), 190-194. https://doi.org/10.13189/ujer.2018.060120

KPSS (2024). *KPSS undergraduate candidate numbers by sessions*. https://dokuman.osym.gov.tr/pdfdokuman/2024/KPSS/LISANS/sayisalbilgiler_kid23082024.pdf

Kreishan, F. M. (2011). Economic growth and unemployment: An empirical analysis. *Journal of Social Sciences*, *7*(2), 228-231.

Li, L., Zhong, Y., Liang, S., & Quan, P. (2024). Gender differences in sleep latency between low and high hopelessness individuals. *Current Psychology*, 1-11. https://doi.org/10.1007/s12144-024-06804-w

Li, Z., Wu, M., Tao, L., & He, X. (2012). Relationships between self-esteem, intolerance of uncertainty, career decision-making difficulties and job anxieties. *Chin. J. Clin. Psych, 20*, 564–566.

Lorenzini, J., & Giugni, M. (2010). Youth coping with unemployment: The role of social support. *Revue Suisse de Travail Social*, *11*, 80-99

Lozanoska, A., & Dzambaska, E. (2014). Economic growth and unemployment: An empirical analysis (A case study on the republic of Macedonia). *Economic Development/Ekonomiski Razvoj*, *16*(3), 153-169.

Lönnqvist, A. (2013, April 19). Teacher Projections and Employment. *Paper presented at the meeting of MEB Teacher Projections*, Ankara.

Mamun, M. A., Akter, S., Hossain, I., Faisal, M. T. H., Rahman, M. A., Arefin, A., ... & Griffiths, M. D. (2020). Financial threat, hardship and distress predict depression, anxiety and stress among the unemployed youths: A Bangladeshi multi-city study. *Journal of Affective Disorders*, *276*, 1149-1158. https://doi.org/10.1016/j.jad.2020.06.075

McArdle, S., Waters, L., Briscoe, J. P., & Hall, D. T. T. (2007). Employability during unemployment: Adaptability, career identity and human and social capital. *Journal of Vocational Behavior*, *71*(2), 247-264. https://doi.org/10.1016/j.jvb.2007.06.003

Ministry of National Education [MiNE]. (2018). *Primary education institutions (primary schools and secondary schools) science course (3rd, 4th, 5th, 6th, 7th and 8th grades) curriculum*. Ankara: Ministry of National Education, Board of Education and Training.

Milner, A., Krnjacki, L., Butterworth, P., & LaMontagne, A. D. (2016). The role of social support in protecting mental health when employed and unemployed: A longitudinal fixed-effects analysis using 12 annual waves of the HILDA cohort. *Social Science & Medicine*, *153*, 20-26. https://doi.org/10.1016/j.socscimed.2016.01.050

Mohammed, S. A., & Devecioglu, S. (2018). Unemployment anxiety of student taking sports education in university. *Journal of Education and Training Studies*, *6*(7), 17-27.

Murat, S., & Yılmaz-Eser, B. (2013). The relatıonshıp between economic growth and employment in Turkey: The validity of jobless growth phenomenon. *Hak İş International Labor and Society Magazine*, *2*(3), 92-123.

Nasheeda, A., Abdullah, H. B., Krauss, S. E., & Ahmed, N. B. (2018). A narrative systematic review of life skills education: effectiveness, research gaps and priorities. *International Journal of Adolescence and Youth*, *24*(3), 362–379. https://doi.org/10.1080/02673843.2018.1479278

Ng, J., Ranasinghe, T., Shi, G., & Yang, H. (2015). Income smoothing due to unemployment concerns. *Singapore Management University School of Accountancy Research*. http://dx.doi.org/10.2139/ssrn.2528972

Noor, R., Sultan, S., & Salman, R. (2024). Psychological health of unemployed young jobseekers: Roles of financial hardship, economic threat, and parental pressure. *Bulletin of Business and Economics (BBE)*, *13*(2), 595-598. https://doi.org/10.61506/01.00367

Özden, K., & Sertel-Berk, Ö. (2017). Reliability and validity study of Turkish version of the Korean Career Stress Inventory (KCSI). *Studies in Psychology*, *37*(1), 35-51. http://dergipark.gov.tr/iupcd

Öztürk, S., & Sezen, S. (2018). Analysıs of the relationship between economic growth and unemployment: The case of Turkey. *Mustafa Kemal University Journal of Social Sciences Institute*, *15*(41), 1-14.

Pan, L., Qiu, W., Hu, Z., & Li, J. (2024). Intolerance of uncertainty and internet addiction among college students in China post-pandemic era: The mediating role of future anxiety. *Scientific Reports*, *14*(1), 20098. https://doi.org/10.1038/s41598-024-70988-1

Papacharisis, V., Goudas, M., Danish, S. J., & Theodorakis, Y. (2005). The effectiveness of teaching a life skills program in a sport context. *Journal of Applied Sport Psychology*, *17*(3), 247-254. https://doi.org/10.1080/10413200591010139

Paul, K. I., & Moser, K. (2006). Incongruence as an explanation for the negative mental health effects of unemployment: Meta-analytic evidence. *Journal of Occupational and Organizational Psychology*, *79*(4), 595–621. https://doi.org/10.1348/096317905X70823

Prajapati, R. K., Sharma, B., & Sharma, D. (2017). Significance of life skills education. *Contemporary Issues in Education Research*, *10*(1), 1-6. https://files.eric.ed.gov/fulltext/EJ1126842.pdf

Safi, F., Areshtanab, H. N., Ghafourifard, M., & Ebrahimi, H. (2024). The association between self-efficacy, perceived social support, and family resilience in patients undergoing hemodialysis: A cross-sectional study. *BMC Nephrology*, *25*(1), 207. https://doi.org/10.1186/s12882-024-03629-4

Sarıçam, H., Erguvan, F. M., Akın, A., & Akça, M. Ş., (2014). The Turkish short version of the Intolerance of Uncertainty (IUS-12) Scale: The study of validity and reliability. *Route Educational and Social Science Journal*, *1*(3), 148-157. http://doi.org/10.17121/ressjournal.109

Savickas, M. L., & Porfeli, E. J. (2012). Career Adapt-Abilities Scale: Construction, reliability, and measurement equivalence across 13 countries. *Journal of Vocational Behavior*, *80*(3), 661-673. https://doi.org/10.1016/j.jvb.2012.01.011

Sodipe, O. A., & Ogunrinola, O. I. (2011). Employment and economic growth nexus in Nigeria. *International Journal of Business and Social Science*, *2*(11), 232-239.

Takım, A. (2010). The relation between economic growth and unemployment in Turkey: Granger Causality Test. *Dumlupınar University Journal of Social Sciences*, (27), 1-8.

TÜİK (2019). *Household labor force statistics bulletin*. http://www.tuik.gov.tr/PreHaberBultenleri.do?id=30687.

Üzar, U., & Akyazı, H. (2018). Econometric Analysis of the relationship between economic growth and unemployment at the OECD countries. *Cumhuriyet University Journal of Economics and Administrative Sciences*, *19*(2), 463-479.

Yalçin, Y. G. (2022). Unemployment anxiety and hopelessness in university students. *Journal of Education and Recreation Patterns*, *3*(2), 130-146. https://doi.org/10.53016/jerp.v3i2.67

Yetişensoy, O., & Şahin, İ. F. (2020). Investigation of the relationship between social studies teacher candidate's unemployment worries and their attitudes toward teaching profession. *Hacettepe University Journal of Education*, *35*(3), 627-643.

Yousefi, Z., Abedi, M., Baghban, I., Eatemadi, O., & Abedi, A. (2011). Personal and situational variables, and career concerns: Predicting career adaptability in young adults. *The Spanish Journal of Psychology*, *14*(1), 263-271. https://doi.org_10.5209/rev_SJOP.2011.v14.n1.23Yuan, Z., Li, W., Ding, W., Song, S., Qian, L., & Xie, R. (2024). Your support is my healing: The impact of perceived social support on adolescent NSSI—a sequential mediation analysis. *Current Psychology*, *43*(1), 261-271. https://doi.org/10.1007/s12144-023-04286-w

YÖK (2024). *Higher education information system*. https://istatistik.yok.gov.tr/

Zhang, Z., Yu, X., & Liu, X. (2022). Do I decide my career? Linking career stress, career exploration, and future work self to career planning or indecision. *Frontiers in Psychology*, 13, 997984. https://doi.org/10.3389/fpsyg.2022.997984

About the Authors

Ahmet KARA is an associate professor of Department of Psychology at Kastamonu University in Kastamonu, Turkey. He has studies on Career Adaptability, Career Construction Model of Adaptation, and Unemployment Anxiety.

E-mail: ahmetkara@kastamonu.edu.tr, **ORCID:** 0000-0002-1155-619X.

Munise SECKIN-KAPUCU is a professor of Mathematics and Science Education at Eskisehir Osmangazi University in Eskisehir, Turkey. She has studies on science and technology program, teaching the nature of science, and the use of different technologies in science courses.

E-mail: mseckin@ogu.edu.tr, **ORCID:** 0000-0002-9202-2703.

Ayşe AYPAY is a professor at the Department of Guidance and Psychological Counseling at Eskişehir Osmangazi University in Eskişehir, Turkey. Her works are in the field of educational psychology.

E-mail: aypaya@ogu.edu.tr, **ORCID:** 0000-0001-5292-4270.

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 9%.

To Cite This Chapter:

Kara, A., Seckin-Kapucu, M., & Aypay, A. (2024). The use of technology in environmental problems. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp.102-113). ISRES Publishing.

Use of Modern Pedagogical Design in the Training of Future Mathematics Teachers

Gulzhamal USSAINOVA

Korkyt Ata Kyzylorda University

Angyssyn SEITMURATOV

Korkyt Ata Kyzylorda University

Introduction

The use of digital technologies and interactive tools is an important aspect of modern pedagogical design. For example, online platforms, electronic textbooks, multimedia tools and virtual simulations allow future teachers to organize the learning process in a new way. These methods increase visualization and interactivity in teaching, and create conditions for easy acceptance of educational material by students.

In addition, modern pedagogical design not only provides subject knowledge to future teachers, but also allows them to learn innovative teaching methods. This increases their professional competence and raises the quality of education to a new level. As a result, future mathematics teachers can make the teaching process interesting, modern and effective. David Merrill, one of the famous ideologues of the use of information technologies in education, emphasized that "information is still not self-teaching" ("Information is not instruction"). This issue has been deeply discussed among pedagogical teams in the last ten years. According to Merrill, too often there is too much interest in the technological side of learning without focusing on the actual learning outcomes.

The effectiveness, efficiency, and usability of any e-learning resource depends on proper planning or design, known in professional parlance as "pedagogical design."

Pedagogical design is a relatively young discipline. If we look at the meaning of the term Instructional Design, it consists of two words: Instruction and Design. The word "Instruction" in a general sense refers to a set of activities that are the basis for teaching. Design is a generic term meaning any "creative pattern". The goal of instructional design is to plan and create opportunities for individual learners in a wide range of learning situations. This means that you need to plan an effective and systematic training project.

There are several phrases associated with the word "Instruction". The most common are Instructional Science, Instructional Technology, Instructional Design. Pedagogical science provides theoretical implementation of teaching. Teaching technologies are an applied aspect of pedagogical science, based on pedagogical design.

The meaning of the phrase Instructional Design/pedagogical design is defined by the word Design itself. Design itself is considered a science and means a plan of action based on a specific goal. Pedagogical design is a teaching discipline that has entered science in the last forty years. It is a new profession based on the theory and content of psychology and the theory of multimedia environment. Many scientists have given their own definition of pedagogical design. Let's look at some of them:

- Pedagogical design means the use of systematic processes to define a learning problem, to feel what needs to be done to find a solution to this problem, and to implement these solutions (McArdle, 1991).

-pedagogical design is a science that fully describes the conditions for embedding, evaluating and distributing situations based on education (Richey, 1986).

-pedagogical design is an integrated process of examination of demand and learning goals and educational methods that satisfy this demand (Briggs, 1992).

Simply put, pedagogical design is a pedagogical tool that makes teaching and learning materials attractive, effective, and efficient. "A doctor designs human health, an architect designs space, and a pedagogic designer designs human knowledge" (van Patten, 1989) highlights the importance of pedagogical design.

Table 1. *Definitions of the concept of "pedagogical design"*

R. Gagne	Pedagogical design-learning is strictly based on pedagogical guidelines. The researcher assigns an important role to inform the learning process [Gagne, 1985].
R.Richey	Pedagogical design is the development of situations based on education, evaluation The science of law and conditions of implementation are fully described [Richey, 1986].
G. Reinmann	Pedagogical design is a system of procedures that includes the analysis of learning needs and goals, as well as the development of didactic tools to meet these needs [Reinmann et al., 2009].
McArdle	Pedagogical design - systematic processes for defining the teaching problem application means realizing what needs to be done to find a solution to this problem and implementing these solutions [McArdle, 2010].
W. Dick, L. Carey, J. O. Carey	Pedagogical design as a systematic form of teaching (not the implementation of instructions). Interrelation of learning context and content: learning environment, methods of delivering materials to students, learning activities and teaching instructions. [Dick et al., 2005].
A.Yu. Uvarov	Pedagogical design as a systematic (systematized) use of knowledge (principles) about effective educational work (learning and teaching) in the process of designing, developing, evaluating and using educational materials [Uvarov, 2003].
E.V. Tikhomirova	Pedagogical design is defined as a systematic way of creating a course of study based on content, style and order of narration, as well as on the way it is presented. [Tikhomirova, 2017].
M.V. Moiseeva, V.N. Podkovyrova, I.M. Radchenko	Researchers consider pedagogical design as a pedagogical technology, a targeted process of creating pedagogical systems, a tool that makes educational materials attractive and effective [Moiseeva, Podkovyrova, Radchenko, www].
S.A. Kurnosova	Pedagogical design is an information and educational space where students can fully reveal their capabilities and abilities and show the necessary personal qualities [Kurnosova, 2011].
A.G. Klepikova	Pedagogical design is a psychological-the entire process of developing electronic learning and methodological materials based on pedagogical, technological, ergonomic and methodological requirements, including analysis, design, development, application, evaluation of the effectiveness of these developments [Klepikova, 2009].

K.G. Krechetnikov	The main goal of pedagogical design is to provide the most rational video to the student. shows that it is the creation and maintenance of an environment in which psychologically favorable and pedagogically correct development of subjects is ensured based on communication, communication and coordination of various types of educational resources [Krechetnikov, 2019]

The canonical definition of pedagogical design in foreign theory and practice is given by Merrill, Drake, Lacey and Pratt suggested: "pedagogical design is a scientific discipline that deals with the development of the most effective, rational and convenient teaching methods and systems that can be used in the field of professional pedagogical practice" (Merrill, Drake, Lacy, & Pratt, 1996). Depending on the positions of the researcher, the pedagogical design can be explained as follows:

a) process - a complex process of analyzing educational goals and characteristics of learners, designing the educational process, developing optimal pedagogical solutions that contribute to increasing the quality of education, and their subsequent application and evaluation; assessment of teaching materials, types of activities, information resources and their effectiveness of teaching and learning principles; Dick and Carey (2000), Gerlach and Ely (2000) presented in the form of such models.

b) the field of knowledge about effective strategies of training programs, i.e. psychology, ideas of late behaviorism, B. Bloom's taxonomy, cybernetics, ergonomics, behavioral psychology, cognitive science, etc. b. a certain body of knowledge that includes (Johari, Chen, & Toh, 2005).

c) reality is a continuous and non-linear process, where planning and development takes place, taking into account the context and feedback, until the desired result is obtained as a result of a series of successive approximations (iterative or recursive approach) [8; 9]. As Willis points out, all stages are interwoven like walls in an impossible triangle (see Figure 1.) (Willis, 1995).

Figure 1. Penrose triangle

In Russian science, researchers interpret pedagogical design differently. A. Yu. Uvarov presents it as "systematic application of knowledge" in addition to the set of procedures for creating effective educational materials (Uvarov, & Yu, 2003). Klepikova considers pedagogical design as "a whole process of developing electronic learning and methodical materials based on psychological-pedagogical, technological, ergonomic and methodological requirements" (Klepikova, 2009).

Krasnyansky and Radchenko considers it a "pedagogical tool that makes teaching and learning materials attractive, effective, and efficient." (Krasnyansky & Radchenko, 2006). Melnikov, within the framework of the fractal-resonance approach, Sinitsyn defines pedagogical design as "a multi-level information system in which each object affects a person and generates various information signals that form several connections that cause a certain response, that is, resonance." The vast majority of Russian researchers tend to associate pedagogical design with electronic resources and distance learning and consider it as follows:

a) field of pedagogical knowledge on designing a quality new educational environment;

b) the process of creating an environment that corresponds to the didactic principles and logic of the educational process; c) the process of developing highly effective educational materials;

d) study subject.

We visualize the principles of pedagogical design, the system of teaching theory of one of the founders of this direction of pedagogy, Robert Gagnier, in the form of the following diagram:

1. Determines what the audience needs. This is in the sense of informational needs and perception characteristics. All this should be related to the expected result.

2. Sets educational goals (or an individual course), reveals them through individual tasks.

3. Selects / compiles educational materials suitable for the audience and set goals, formalizes them for more effective presentation.

4. Develops a results evaluation system.

Learning conditions, on the one hand, should stimulate the development of the learner's cognitive, motivational and activity spheres, and on the other hand, should be pedagogically sound, attractive and ergonomic. According to modern Russian and foreign experts (Abyzova, et al.) pedagogical design can help.

Based on the research of the above-mentioned authors, pedagogical design can be accepted and defined as a new direction of theoretical and practical knowledge, and research within the framework of the requirements for pedagogical activities leads to the achievement of the necessary learning results. This process includes the analysis of learning needs and the development of learning environments and learning tools that are distinguished by their pedagogical effectiveness, methodological relevance and appropriateness.

Materials and Basic Methods

Pedagogical design cannot be accepted unilaterally. On the one hand, it is a process, on the other - a subject, and on the third - a reality or teaching model. Its capabilities are not sufficiently studied and mastered by teachers, so it cannot allow full use of its educational potential. Pedagogical design is aimed at the development of integrative, project, interdisciplinary thinking of the future teacher and creates an opportunity to adapt to the social and professional sphere.

According to Lowyck, "pedagogical design is the most rational presentation of the interrelationship and combination of various types of educational resources that ensure the psychologically comfortable and pedagogically sound development of educational subjects, by choosing the best tools, taking into account the content of the educational material and the target audience. creative idea, planning and design of specific activities of the teacher to achieve results" (Lowyck, 2023).

With its help, it is possible to form the readiness of future teachers to carry out educational activities, to expand the personal capabilities of participants in educational relations, to create attractive conditions for achieving educational results, and to create an effective individual direction of education.

Analyzing and researching the works of foreign and Russian scientists, considering the issues of pedagogical design, creating and further supporting learning events with the help of

information and communication, digital technologies, content and content of pedagogical design made it possible to determine the theoretical rules that determine its features. However, in these works, insufficient attention is paid to pedagogical design tools, and there is insufficient research on the effectiveness of their use. Gretsova understands pedagogical design tools as "pedagogical tools created based on the principles of pedagogical design, ethically verified and aesthetically designed" and distinguishes visual, audiovisual and subject-spatial tools (Gretsova, Nedogreeva, Yu. Pribylova., 2022). The author believes that "pedagogical tools are transformed by design tools in order to improve the reception, memory and assimilation of learning information, and as a result, pedagogical design tools appear."

Based on this logic, we defined pedagogical design tools as pedagogical tools created using information and digital technologies based on the principles of pedagogical design. Pedagogical design tools include video, audio, multimedia - animation, games and other digital resources. As for the basic principles of pedagogical design, the concept of pedagogical design has only recently emerged. And it is coming to the region of Kazakhstan only now, but the main principles have already been formed. Based on them, the teacher can create a quality course plan:

Table 2. *Steps to create a plan*

Stimulate attention	It is known that attention always precedes the communication of meanings
Taking into account the socio-cultural environment	The learner cannot be considered as a closed system
Ability to set goals and objectives	Students should be shown in advance and periodically reminded why they are participating in this course.
Contextualization of theory	Dry academic facts on the Internet fade from memory faster than in a typical classroom. Therefore, the proposed new material should be based on existing knowledge and be related to life
Variety of content forms	If it was enough for everyone to read a textbook, there would be no need for pedagogical designers. A modern course should include not only text, but also infographics, interactive tasks, videos, and podcasts
Keeping active	Knowledge is well absorbed if it is acquired during active service. Even if the student is sitting in front of the monitor screen
Feedback	It should be constant and constant. It is more difficult to assess how the material is perceived by the audience from a distance. Therefore, it is necessary to provide conditions for current analysis of the effectiveness of the course

Another important principle that is invisible to the audience is the final assessment of effectiveness. Its criteria should be clear and transparent both to you and to your colleagues. [Lebow D., 2022]. Consider the theory and model of pedagogical design. First, let's define the difference between a theory and a model. A theory provides a common definition for observation and explanation, while a model is a mental representation (mental picture) that cannot be seen or directly experienced.

Instructional design theory provides clear and precise guidance on how to support people's learning and development. Learning is divided into the following types: cognitive/understanding, emotional, social, physical and spiritual. There are several theories and models of pedagogical design developed by different authors. Reigeluth identified three main characteristics that correspond to all the principles of pedagogical design theory:

- orientation/direction of design,
- definition of teaching method and learning situation,
- Pedagogical methods that can be classified into separate methods.

The design of the learning environment allows choosing the tools and methods that can make it accessible, friendly and understandable for every student. In this case, the peculiarity of the pedagogical design is that not only the structure of the future educational object is being developed, but also the direction of its research, including the individual direction, is being thought out and created. The design is intended to consider what kind of experience the learner will have when working with the interface of the created course, resource, content, how easily he can achieve his goal and implement it. So, what color the learning object will have, whether it will be convenient for the student with the proposed navigation, whether the text will be read, etc. these features allow you to consider the basic laws of UX/UI design. UX-design (User Experience) - user experience design, UI-design (User Interface) - interface design. The result is a ready-made electronic information and educational environment. As a pedagogical designer, a teacher should not only provide a methodological basis for the process of designing learning materials, but also implement a well-thought-out strategy to deal with the creation and creation of a real electronic educational environment.

It may be necessary to use elements of different models of pedagogical design. In this case, the teacher is required to develop a balanced approach to the development of educational materials and to be able to choose a model for the situation and not vice versa. Mastering pedagogical design tools demonstrated by the ability to electronically create quality learning objects, video objects of learning content, control-measurement materials allows the future teacher to choose suitable strategies for successful and attractive teaching, immersing the student in a more effective learning environment. Methodological support of pedagogical design strengthens professional motivation; ensures the solution of cognitive, professional-oriented and communicative-developmental tasks; equips with specific methods and work skills.

Design theories are important because they affect the preparation of observation and observation of the pedagogical process at the initial stages of design. It is about looking at outcomes (how learners change) and means (how to effect those changes). These theories are important because they provide guidance on three levels, namely:

- methods of teaching in different situations.

- teaching tools that provide many accessible teaching methods

-systems that ensure the possibility of creating quality teaching tools.

All models of pedagogical design have some common characteristics:

- definition and examination of the purpose of training,

- planning and design of methods to achieve educational goals,

- implementation of the planned action,

- review and evaluation of goals and strategies, etc.

When creating more complex programs, using traditional methods leads to loss of time and resources. As a result, the concept of pedagogical design emerged - a discipline used by development teams in the design, creation and evaluation of learning materials. It is based on

systematic application of knowledge about effective work, creation of learning process with "open architecture" and creation of this learning environment.

Pedagogical design technology is relatively simple. Learners' needs must be understood, learning objectives must be determined, and knowledge and information must be delivered as quickly, accurately, and efficiently as possible. But this requires an understanding of all the prerequisites and a clear indication of the final properties of the product. This, in turn, requires planned and well-structured work, not just one person, but a well-chosen team of developers. In addition, the tasks of a pedagogical designer are wide and very difficult: Analysis of the needs of the target audience, its competencies and expected learning outcomes.

Determining the goals and objectives of the educational material.

Analysis and structuring of materials according to the purpose.

Selection of tools and methods of educational work.

Create course elements, style and visual design.

Development of tests and assignments, monitoring and information gathering tools.

Create a course using appropriate tools or assign tasks to team members to develop specific elements.

Uploading the course to the learning management system (Learning Management System, LMS).

Development of methods for evaluating the results and effectiveness of materials.

Development of solutions for further improvement of educational content.

Such a clear sequence ensures the qualitative growth of the educational material during the work and specifies the forms of its delivery.

The main task of the quality and planned development of the educational course is to provide the necessary information to the student as fully as possible. It's not just the fact of giving it that matters - simple methods will do it well. The main task is to clearly accept the acquired knowledge and then apply it in practice. To achieve this, pedagogical design is based on 8 principles of the American psychologist Robert Gagne (Robert Mills Gagne), one of the founders of pedagogical design and the author of books on learning theory.

Attract students' attention, encourage learning, arouse interest in topics and methods. Explain the goals and objectives of education. Here, "why?" and also a certain level of expectation from the process itself is formed.

Presentation of new material. The most difficult part of the process, because the selection of accepting any new material is characteristic of the human psyche. This means that it is necessary to provide in advance certain elements that will keep the student's attention at important moments and allow him to convey the main idea of the project as accessible as possible. You can assemble the material using the iSpring Suite online course designer.

Accompanying teaching. It is mainly a guide for students and a semantic formation of the attitude to store the acquired material in long-term memory.

Experience. When new knowledge is still new, it needs to be tested in a real situation or confirmed by an appropriate experiment, which links theory and knowledge application in a clear and very effective way.

Feedback. It is impossible to evaluate the chosen teaching method and its effectiveness without a quick analysis. Therefore, even at the stage of course development, a flexible feedback system should be built as much as possible (here the results of the analysis of the target audience and its capabilities will be useful).

Assessment of learning progress and overall evaluation of the effectiveness of the training course. Moving to the practical plane, helping students to retain knowledge and use it correctly. Unlike the fifth principle, it is important to transfer practical skills to new situations that are not defined by the initial framework of the course. This allows to assess the depth of knowledge acquisition.

5 stages of development of educational materials

The process of designing instructional materials is similar in many parameters to disciplines such as programming, logistics, design, and applied psychology. It is a series of well-defined procedures, grouped into several stages and with specific tasks and methods of solving them. The well-established ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, which divides the entire process into 5 stages, is often used during the development of the pedagogical design of the lesson.

Analysis

The most important stage of development: the main elements are distinguished, the needs of students and the tasks of the teacher are studied, measurable and understandable learning goals are formulated, the target audience and forms of working with it are evaluated, and a list of expected results is drawn up. To increase efficiency, this stage is divided into several stages, which allows for a clear formulation of tasks by gradually defining key points. Carefully thought-out objectives help determine the tools of the training course, the extent to which it will be filled with interactive elements, and the use of already existing materials and methods.

Here you can clearly determine the methods of evaluating the effectiveness of the learning process. Clear and accurate expected results allow for a clear formulation of the content and form of exercises, control questions, final tasks and forms of their delivery. Also, it allows you to compare the materials and methods of different authors with each other, choosing only the most suitable. This helps the student in the learning process, focuses on the meaning of the presented material and directs efforts to achieve the goals. After the analysis, the learning objectives can be clarified, which allows to start the development of learning materials.

Projecting

The most extensive and unpredictable phase of the project. At this time, it is necessary to take into account all the conclusions of the analysis stage, to develop a general plan and structure of the material, to design an exercise and evaluation scheme, a visual series, an interface and a general design, and sometimes to connect different components with each other. In fact, in the first stage, a certain prototype, a scenario of the entire project, is created, which defines the effect of each element on the defined tasks. It should also be divided into several steps, because trying to solve all the tasks without a planned approach will often fail.

Selection of educational tools. Here, it all starts with the analysis and research of the target audience, the expected conditions and forms of learning, the content of the materials and the

application of certain TEACHING methods to them. Then you can begin to specify the learning tasks in detail and the tools, as well as to determine the necessary knowledge and skills that will allow you to complete all the tasks of the course.

Create a script or outline of future training materials, design and approve the appearance of typical screens, develop working layouts of various fragments and expert evaluation of each element. The most important thing at this stage is to clarify the technical requirements for the future course. Preparing trial version of educational materials, selecting or creating illustrations, animation effects and interactive elements, audio or video sequences. At this stage, it is possible to identify personal shortcomings, quickly correct them and make prompt changes to the work scenario.

Evaluation and processing of materials in terms of full compliance with tasks. Here, third-party expertise and all kinds of modeling are most effective: from a pedagogical experiment with the training of a test group to brainstorming to identify the strengths and weaknesses of a developed product. Support and development of educational materials. In this step, you can focus on solving small technical problems that already arise during the development and testing process, supplementing and expanding successful modules, defining logical connections, preparing the release of new versions or creating new training courses using existing developments.

Development

The main "technical" stage of any project, all created materials take their place in the general structure, are supplemented with new elements and logical connections, are corrected and "rubbed" with each other. Here, based on the goals of the entire project and the characteristics of the audience, you can very precisely adjust the choice of methods of presentation of material, tone of presentation, style, form of presentation of individual elements.

At this stage, general content elements are finalized, the most effective exercises are selected, feedback forms and material mastery checks (tasks and control methods) are created, connections between the interface and individual topics or questions (transition rules) are improved. Particular attention should be paid to clearly defining the means for summarizing the examination or practical work, which will allow the evaluation of the effectiveness of the entire course. The development stage is a very careful, but creative work, which requires maximum flexibility from the creators while fulfilling the strict initial settings.

Implementation

At this stage, the course is uploaded to the appropriate Learning Management System (LMS) or resource where students can access the materials. Despite the fact that the importance of this period seems to be small, it allows to evaluate the practical application of educational materials. It is here that you can check whether a lesson or course is suitable for your chosen audience, get first-hand information about its implementation and effectiveness, connect with the community of learners, find guides, accompanying documents and more. provides additional material for preparation.

Assessment

After collecting the first information about the implementation of the training course, it is necessary to evaluate its effectiveness. It is necessary to connect the tasks set at the analysis stage with the results obtained in practice. The learning materials themselves, the achievement of learning goals, the appropriateness of certain types of tasks and their relevance to the overall task are evaluated. Based on this, the course as a whole or individual lessons are developed, the results of the study work are evaluated, and ways of correcting the study materials are determined. This phase should end with a review of the requirements for individual units and an updated version

of the entire course. Now let's explain the typical model "ADDIE" of this pedagogical design (according to Figure 2).

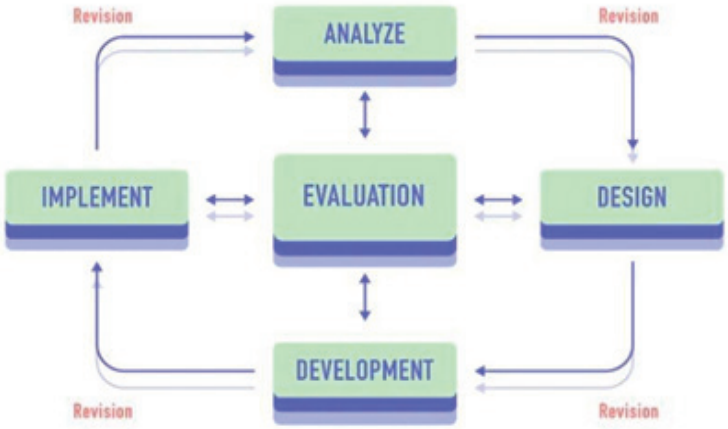

Figure 2. "ADDIE" models

– Analysis– learners and the learning environment of learning issues;

– Design- drawing up a plan for the creation of pedagogical activities;

– Development - creation of pedagogical activities;

– Implementation - embedding design;

– Evaluation– evaluation of students and the effectiveness of the given project (Uvarov, 2003).

"ADDIE" phases work according to the principle of a closed chain and they must always be repeated to improve the performance of the process. It is possible to reduce the phase of pedagogical design purposefully, but it is implemented only after the examination of the needs of learners. The "ADDIE" process is especially important in distance learning technology, where there is little, if any, personal interaction between the teacher and the student.

Preparation of modern educational materials, i.e. electronic textbooks, is a collective work. Specialists of various fields, for example, planners, artists, technicians, programmers, etc., work hand in hand. If one person prepares the educational material, he will be responsible for planning, drawing, and programming. However, there is almost no such comprehensive specialist. Currently, e-textbooks are prepared by specialists of each field as a team. The artist creates illustrations and decorates the program, screenwriters (professionals) write the script text and prepare tasks for model creation, cameraman shoots video clips, programmers create computer models and assemble the final product. All of these are combined by a pedagogical designer (or technician) who is responsible for the meaning and pedagogical effectiveness of the work.

In general, it can be concluded that only a methodologically competent teacher is capable of performing the function of a pedagogical designer, because the software teaching tool pedagogical design includes psychological and pedagogical principles of teaching.

Table 3. *Important characteristics of pedagogical design*

Scientific foundations of pedagogical design	based on pedagogical and cognitive-psychological point of view; based on the concept of education and training of a competent specialist for the future profession; focused not on description, but on form (gestalt) and the goal of perception, which is important and necessary for practical work
Purpose of pedagogical design	aimed at empirically substantiating theoretical rules and proving the effectiveness of selected teaching strategies and methods
Pedagogical design methods	pedagogical design methods are probabilistic rather than deterministic, that is, they do not require causality; represents more or less possible relationships between "if" and "then" - components in design based on empirical data
Use of pedagogical design	interrelated with the use of information and communication technologies for educational and methodological purposes; can be considered as didactic principles and thus used in planning pedagogical situations

Pedagogical conditions for the formation of pedagogical design in the professional training system of future mathematics teachers in the context of digital education are determined, methodology is developed, experimental results, conclusions and recommendations are made.

Conclusion

The use of modern pedagogical design in the training of future mathematics teachers is one of the most important aspects of the modern education system. Pedagogical design is a comprehensive approach aimed at developing the skills necessary for teachers, allowing for effective organization and management of the educational process. It aims to adapt curricula, teaching methods and technologies to the individual needs and abilities of students. This is especially important when teaching a complex and abstract subject like mathematics.

The use of modern pedagogical design provides several advantages. First, it helps teachers structure the subject and effectively convey the material to students. The use of interactive tools, visualization and multimedia elements during teaching increases students' interest in the subject and contributes to deepening their knowledge. Secondly, pedagogical design takes into account the individual characteristics of students and creates conditions for organizing the learning process in a way that is convenient and accessible for each student.

In addition, modern pedagogical design is aimed at developing the professional competence of teachers. It is important for teachers to learn new technologies, innovative teaching methods. This will help future teachers show creativity and flexibility in explaining the subject and meet the requirements of modern education. Another important aspect of pedagogical design is the possibility of improving the quality of teaching through continuous evaluation and feedback.

In conclusion, the use of modern pedagogical design in the training of future mathematics teachers not only organizes the educational process qualitatively, but also creates conditions for the professional development of teachers, students' deep learning of the subject, and the increase of educational efficiency. This approach opens the way for future teachers to bring innovation and creativity to the field of education.

References

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2001). Recent advances in augmented reality. *Computer Graphics and Applications, IEEE*, 21(6), 34–47. https://doi.org/10.1109/38.963459

Caudell, T. P., & Mizell, D. W. (1992). Augmented reality: An application of heads-up display technology to manual manufacturing processes. *System Sciences, Proceedings of the Twenty-Fifth Hawaii International Conference on*, 2, 659–669. IEEE. https://doi.org/10.1109/HICSS.1992.183632

Dick, W., Carey, L., & Carey, J. O. (2005). *The Systematic Design of Instruction*. 5th ed. Boston, MA: 448 p.

Gagne, R. M., Briggs, L. J., & Wager, W. W. (1992). *Principles of Instructional Design* (4th ed.). Orlando: Harcourt Brace Jovanovich.

Gerlach, V. S., & Ely, D. P. (1980). *Teaching and Media: A Systematic Approach (2nd ed.).* Englewood Cliffs, NJ: Prentice Hall, Inc. 420 p.

Gretsova, A. P., Nedogreeva, N. G., & Pribilova, Y. V. (n.d.). Understanding the concept of "instructional design" through the history of its development. *Pandia.ru.* https://pandia.ru/text/77/283/90820.php (Accessed: August 21, 2022)

Janin, A. L., Mizell, D. W., & Caudell, T. P. (1993). Calibration of head-mounted displays for augmented reality applications. *Virtual Reality Annual International Symposium, IEEE*, 246–255. https://doi.org/10.1109/VR.1993.380804

Johari, A., Chen, C., & Toh, S. (2005). A feasible constructivist instructional development model for virtual reality (VR)-based learning environments: Its efficacy in the novice car driver instruction of Malaysia. *Educational Technology Research and Development, 53*(1), 111-123.

Klepikova, A. G. (2009). *Preparing a future teacher for the use of pedagogical design in professional activities: Abstract* (Doctoral dissertation, Belgorod). 24 p.

Lebow, D. G. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. *Educational Technology Research & Development*, 41(3), 4-16.

Lowyck, J. (2014). Handbook of research on educational communications and technology: Fourth edition (pp. 3–20). https://www.scopus.com/authid/detail.uri?authorId=6507081786 (Accessed: December 1, 2023).

McArdle, J. J., & Cohen, S. A. (1991). Quantitative topics in research on aging. *Experimental aging research, 17*(1), 3–5.

Merrill, M.D., Drake, L., Lacy, M.J. and Pratt, J. (1996. Reclaiming Instructional Design. *Educational Technology*, 36, 5-7.

Reigeluth, C. M. (Ed.). (1999). *Instructional-design Theories and Models*: *A New Paradigm of Instructional Theory* (Vol. II). Routledge. 728 p.

Richey, R. (1986). *Theoretical and conceptual bases of instructional design.* New York: Nichols

Publishing. 227 p.

Sin, A. K., & Zaman, H. B. (2010). Live Solar System (LSS): Evaluation of an augmented reality book-based educational tool. In *Information Technology (ITSim), IEEE International Symposium* (Vol. 1, pp. 1–6). IEEE. https://doi.org/10.1109/ITSIM.2010.5560493

Smith, P. L., & Ragan, T. J. (1999). *Instructional Design.* New York: John Wiley & Sons Inc.

Sutherland, I. (1968). A head-mounted three-dimensional display. *Proceedings of Fall Joint Computer Conference,* 757–764.

Uvarov, A. Y. (2003). Pedagogical design. *Informatics,* 3, 1–32.

Willis, J.W. (1995). A Recursive, Reflective Instructional Design Model Based on Constructivist-Interpretivist Theory. *Educational Technology archive*, 35, 5-23.

About the Authors

Gulzhamal Ussainova is studying at Korkyt Ata Kyzylorda University**.**

E-mail: gulzhamal.u@mail.ru, **ORCID:** 0000-0003-2620-9745

Angyssyn Seitmuratov is studying at Korkyt Ata Kyzylorda University.

Associate professor of the Department of "Physics and Mathematics", Korkyt Ata Kyzylorda University, Kyzylorda, Kazakhstan

E-mail: angisin_@mail.ru, **ORCID:**0000-0002-9622-9584

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 2%

To Cite This Chapter:

Ussainova, G. & Seitmuratov, A.(2024). Use of modern pedagogical design in the training of future mathematics teachers. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp.114-126). ISRES Publishing.

Section 5.

Educational Theories and Curriculums

Curriculum Development Approaches Around the World

Saim AKMAN

Ministry of National Education

Introduction

Curriculum development in education is an interdisciplinary field that systematically deals with the process of planning, implementing and evaluating learning experiences of individuals. This process is critical in determining both the content of education and the way in which that content is delivered. Looking at the historical development of curricula, it can be seen that social needs, pedagogical approaches and educational policies have shaped this field. The concept of curriculum development is based on the aim of providing effective, meaningful and sustainable content to meet the learning needs of individuals.

This study examines the different approaches and representatives of these approaches that have shaped the field of curriculum development. Bobbitt's systematic approach based on scientific methods, Dewey's emphasis on experience-based learning, Tyler's rational model and Taba's teacher-centred, grassroot curriculum development constitute the cornerstones of this field. In addition, Freire's critical pedagogical approach, Apple's ideological criticism and Pinar's understanding focusing on individual experiences have brought alternative and innovative perspectives to the field of curriculum development. These different approaches provide important clues about how curricula are shaped both in the historical process and in today's education systems.

In this context, this study first discusses each scholar's understanding of curriculum development, the basic principles of these understandings, and their effects on practice. The aim is to show readers how different perspectives in the field of curriculum development have shaped and how these approaches inspire today's education. At the end of the chapter, the importance of diversity in the field of curriculum development will be emphasized by analysing the similarities and differences between different approaches.

John Franklin Bobbitt's Views on Education and Curriculum

With the completion of industrialisation in the early twentieth century, the social structure underwent a great change. Education and schools were affected by this change in the social structure. With the increase in population and schooling, a new understanding of education was needed. In an environment where everything is changing rapidly, education has also entered a process of change by keeping up with it. In this fast life, there was no time to waste in education. For this reason, many educators tried to adapt the principles of the 'Scientific Management' theory, which Frederick Taylor (1911) introduced to increase efficiency in production environments, to education in order to increase effectiveness in education. Among these adaptations, Franklin Bobbitt was the most successful and the most popular one (Au, 2011; Kliebard, 1995).

According to Bobbitt, education is the work of shaping. Just as a worker shapes iron and brings it to the desired standards, teachers shape children and make them conform to certain standards (Callahan, 1962). Bobbitt (1918) argued that there are two dominant approaches to education. The first approach focuses on the mental, emotional and cultural development of the individual, while the second approach aims for the individual to acquire the necessary skills in professional life and social relations. Both approaches are correct when evaluated according to the

criterion of serving their own purposes. However, Bobbitt stated that the aim of education is not to prepare people for 15 years of childhood, but to prepare them for 50 years of adult life, and that the second approach is more in line with the realities of the era. Therefore, the goals of education should be determined by analysing the activities in adulthood (Bobbitt, 1918). As a result, Bobbitt believes that education should prepare people for life and provide them with the knowledge and skills they will use in their adult life.

Bobbitt defined the curriculum in two ways. A curriculum could be defined as (1) all the experiences, directed and undirected, which bring out the abilities of individuals, or (2) a consciously directed sequence of experiences which schools use to help individuals realise and improve their abilities. However, the latter of these definitions tends to be used. Bobbitt states that education includes both guided and unguided experiences and that education should deal with both of these. No matter how different human life may be, it involves certain activities and the curriculum should be developed by identifying these activities using scientific methods by curriculum developers (Bobbitt, 1918).

According to Bobbitt (1921; 1927), curriculum development starts with setting objectives. However, Bobbitt stated that there is no point in setting general and all-encompassing objectives such as 'culture', 'social efficiency', 'mental discipline', and 'character building'. These goals have no function in guiding the education to be provided. Objectives should be specific and detailed to guide education and scientific methods should be used in setting the objectives. However, scientific methods are rarely used in curriculum development in education. The use of scientific management principles in curriculum development and curriculum implementation will increase efficiency by bringing a certain standard to the development and implementation processes (Eisner, 1967). The 20th century society has imposed new tasks on educators. In this new era, education should provide more information to people and new methods should be found to teach this information (Bobbitt, 2006). At this point, scientific management principles developed by Frederick W. Taylor should be applied to education in order to ensure that education keeps pace with this rapid change in society by increasing productivity. Only in this way can education gain functionality and efficiency that even philosophy cannot offer. Bobbitt thinks that the application of scientific methods to education can be as successful as its application in the business world (Kliebard, 1975; 1995). The business world has been developing since the Middle Ages, but the developments in education are relatively new. For this reason, education should take its share of these developments in the business world and be influenced by it (Callahan, 1962).

Bobbitt analysed Taylor's scientific management approach in detail and listed the duties of management in all institutions, including schools, as follows (Bobbitt, 1918; Callahan, 1962):

- Each organisation should determine the point it wants to reach, i.e. its objectives.
- It should coordinate workers to achieve these goals.
- It should find the best method and have the workers apply this method.
- Determine the necessary qualifications for the workers and make them suitable for these qualifications.
- Managers should keep workers constantly informed about the work to be done, the objectives and standards to be achieved, the methods to be employed and the materials to be used.
- Provide workers with the necessary materials and resources.
- Give incentives to workers to achieve the desired performance.

- All of these tasks are the responsibility of managers.

Suggesting that these principles are universal and can be applied in all institutions with a certain organisational scheme, Bobbitt divided curriculum development studies into seven main parts (Bobbitt, 1918).

Defining standards: Before starting the training, Educators should define certain standards for the product to be obtained. Standards function as important criteria both in determining the method we will use in obtaining that product and in evaluating whether we have obtained the product we want. When setting standards, educators should get help from the business world to tell educators what kind of people they need.

Evaluation: In order to check whether the product obtained as a result of the training conforms to the standards or not, tests should be developed in accordance with these standards in the second stage. Through these tests, managers and teachers can evaluate their own performances. Thus, teachers and administrators who are considered insufficient in reaching the standards can be given the opportunity to improve themselves.

Implementing the Tests: By whom the developed tests will be applied is a key factor in the process. Bobbitt states that these tests should be conducted by independent inspectors.

Determination of teaching methods: The next stage is to find the right method to achieve the standards. Finding a method is too heavy a burden for teachers. In addition, trying to find the best method by trial and error will lead to a waste of time and resources and thus reduce productivity. At this point, Bobbitt advocated that the task of finding a method should be left to the supervisors. Supervisors find the best method as a result of observations and have the teacher apply it.

Selection and training of teachers: Teacher training includes not only in-service training but also pre-service training. Schools should inform universities about the qualities they want in teachers. Schools, in turn, should select their teachers according to the criteria they have set. After the selection phase, in-service training should be organised for teachers to ensure their continuous compliance with the standards.

Monitoring and evaluation of the whole process: Finally, the administration should continuously monitor teachers and inform them about the guidelines. The success of the processes up to this stage is the responsibility of the administrators. Administrators are responsible for all processes, from setting standards to developing testing tools, finding the most appropriate method to implement it, and selecting and training teachers.

In summary, Bobbitt planned to bring a certain systematic approach to curriculum development in education. Bobbitt was not the first person to use the definition of curriculum. However, he laid the foundation of curricula as we know them today. Bobbitt brought a certain standard to education and aimed to increase the efficiency in educational understanding. In addition, Bobbitt divided the responsibility among managers, supervisors and teachers and ensured that the process was carried out from a single source. All participants are responsible for the functioning of the curriculum in the institution, but the management has to monitor and supervise the whole process.

John Dewey's Views on Education and Curriculum

John Dewey, who lived between 1859 and 1952, was an American scientist who worked in the fields of philosophy and education. John Dewey is one of the pioneers of pragmatism philosophy. Dewey created the philosophy of progressive education based on pragmatism. According to Dewey (1997), all social movements contain contradictions reflected in intellectual debates. The task of an intelligent theory of education is to identify the precise causes of the

existing conflicts and then present the ideas and practices of the opposing sides without taking sides. Any movement to create a new order of thought and the activities guided by it sooner or later requires a return to the seemingly simpler and more basic ideas and practices of the past.

Dewey stated that it is necessary to think based on the concept of 'education' itself without depending on certain currents in education, including progressivism. He attributed this view to the fact that people who adhere to any movement exhibit reactionary behaviour against other movements and as a result, they begin to be governed by the movements they reject without even realising it (Dewey, 1966). Human beings tend to think in extreme contrasts with an either/or mentality. According to people, the acceptance of one idea requires the complete denial of the other. This is also true for educational philosophy. However, Dewey states that an educational philosophy alone will not solve all the problems encountered and that it can also utilise the principles of the old philosophy to solve problems where necessary (Dewey, 1997).

Dewey stated that the traditional understanding of education regards education as a result of external creation, independent of natural abilities. In the traditional understanding, education consists of knowledge and skills that have been useful in the past. Therefore, the main task of the school is to transfer these to new generations. The aim of education in the traditional understanding is to form the habit of obeying the rules and standards brought from the past.

Although Dewey does not completely criticise this understanding of education, he argues that the emergence of new movements is due to people's dissatisfaction with traditional education. Progressive education is different from traditional education. According to John Dewey, education is an internal development based on the natural abilities of the student. The progressive philosophy of education is (Dewey, 1997):

- the expression and development of individuality against the idea of top-down imposition.
- freedom of movement instead of discipline.
- learning through experiences instead of learning from texts and teachers.
- learning as a means to achieve a goal instead of learning isolated skills through repetition.
- the idea of making the most of today's opportunities instead of making preparations for a distant future.
- the idea of being familiar with the changing world instead of adhering to static goals.

One of the things that makes the progressivist understanding of education more preferable than others is that this understanding is in accordance with the principles of democracy. Another reason is that progressivism uses more humane methods (Dewey, 1997). These two basic principles have caused the progressive understanding of education to surpass the traditional understanding of education. People tend to prefer the democratic over the autocratic, and humanistic approaches over rigid and oppressive attitudes (Dewey, 2001). John Dewey's views on the characteristics that should be present in educational experiences can be explained in short as follows:

- Education should be life itself. For years, traditional approaches saw education as preparation for life and equipped students with knowledge that they would probably never use in real-life. The progressive understanding of education sees education not as a preparation for life but as life itself.

- Education should be in accordance with the nature of the individual and knowledge. An understanding of education that does not take into account individual characteristics and the needs

of the individual does not cause any behavioural change in the individual thought to be educated. The progressive education approach considers the needs of the individual and provides education accordingly.

- The curriculum should stimulate the child's natural curiosity. Every child who starts his/her education life has a natural curiosity. Children act in line with this natural curiosity and as a result of this natural curiosity, they learn the subjects they investigate better. In the progressive approach, education should stimulate the natural curiosity of the child.

- Real-life problems should be studied. In accordance with the principle that education is life itself, education to be provided with a progressive approach should include real-life problems that are appropriate to the child's level and arouse curiosity in him/her.

- Both individual and collaborative project development. Progressive education approach enables students to develop themselves both individually and to develop their ability to work in cooperation with the group.

- Information should be presented as meaningful units. Since problems in nature will not be found divided into subject-areas, the information presented to students should be integrated.

- There is an understanding of democracy for education and education for democracy. The progressive education approach adopts democratic education. Democracy is a structure, a method and a principle that provides freedom to human beings.

- The teacher is a guide. In a democratic educational environment, the teacher is a guide who leads students to the right knowledge and the nature of knowledge.

- Restricting movement is restricting the freedom of thinking. The traditional education model in which students stand still and listen to the teacher is one of the biggest obstacles to thinking. The progressive understanding of education advocates giving students freedom of movement for the development of thought.

- The aim of education is to develop the full potential of the individual. The ultimate aim of education is to allow people to self-actualise.

- Gaining experience in real-life conditions ensures the depth, breadth and continuity of experience. Experiences gained in the real environment are more permanent and meaningful than those gained at a desk or from a book.

- The interests of the individual and the needs of the society are important in planning education. In order for education to be successful, the interests and needs of the individual should be taken into consideration. In addition, one of the important tasks of education is to be intertwined with society, to plan activities that will contribute to the development of society and to develop the vision of society.

The items above constitute the basis of John Dewey's understanding of education. John Dewey constructed the progressive understanding by putting the child at the centre and argued that all the elements that make up the curriculum should be selected according to the child and the child's interests. According to him, objectives, content, educational experiences and evaluation approaches should be chosen according to the child and the child's nature.

Based on all these, Dewey argues that all stages of curricula should be determined according to the child (Simpson & Jackson, 2003). Goals that will stimulate the curiosity of the child, content

that will attract his/her interest and that is given in integrity in accordance with his/her nature, educational experiences determined by taking his/her pedagogical characteristics into account, and an evaluation approach that encourages children to work in cooperation rather than compete with others and that evaluates the product rather than the child himself should form the basis of a curriculum prepared according to the progressive understanding (Dewey, 1913; 1966).

On the other hand, Dewey's views on experience are in the same direction. Dewey states that there is an organic connection between education and personal experience. According to him, real education is formed through experiences, but not all experiences may be educational. Experience and education cannot always be matched because not every experience can be educational in the right direction. For this reason, what is in question is the quality of experience rather than its existence. In his book 'Experience and Education', Dewey explained the features that should not be present in experiences as follows (Dewey, 1997):

- Experiences should not educate students in the wrong direction.
- Experiences should not try to put students into a certain stereotype.
- Experiences should not be fun but ineffective.
- Experiences should not be disconnected from each other.

Education provided with traditional understanding also provides examples of the experiences (Dewey, 1913; 1997). In other words, there are experiences in traditional education, but these experiences either cause learning in the wrong direction or are ineffective in helping students achieve the necessary gains.

In summary, John Dewey's understanding of education and curriculum development is an experience and interaction-based, democratic approach that focuses on the interests and needs of the individual. This understanding aims to make education a part of the individual's life and to reveal the potential of the individual while preparing him/her for society. This education model proposed by Dewey is an approach that aims to contribute to the development of both the individual and society.

Ralph W. Tyler's Views on Education and Curriculum

Ralph Winfred Tyler is an educator who lived between 1902 and 1994. Tyler has many studies in the fields of curriculum development and curriculum evaluation and is one of the pioneers in this field. Tyler is an important figure in education with his book 'Basic Principles of Curriculum and Instruction', also called 'Tyler Rationale'. Tyler's approach to curriculum development is shaped around four basic questions.

- What educational purposes should the school seek to attain?
- What educational experiences can be provided that are likely to attain these purposes?
- How can these educational experiences be effectively organized?
- How can we determine whether these purposes are being attained?

Tyler's questions can be more simply staged as setting goals, selecting learning experiences, organising learning experiences and finally evaluating the results (Tyrrell, 1974) and evaluating the curriculum itself. According to Tyler, the first thing that should be done when starting to develop a curriculum for any kind of instruction is to determine the objectives. These objectives become a criterion for which materials will be selected, which content will be determined,

which teaching methods will be chosen and which test tools will be used (Tyler, 1957; 1969). The whole development process from the first step to the last step of the curriculum should be determined according to the objectives. So, the objectives that guide the whole curriculum should be determined carefully. According to Tyler, it is not enough to be guided by a single source of information in determining the objectives (Hlebowitsh, 1992). All of the sources of objectives provide valuable information about our objectives and all of these sources should be evaluated holistically to determine the objectives (Tyler, 1969). The first of these sources is learners.

Tyler states that learners are an important resource in setting objectives. While examining the learners, their current situation is compared with the desired standards. The difference obtained as a result of this comparison is called need. The second information we can obtain from learners in setting objectives is their interests. Learning is an active process and requires the active participation of the learner (Tyler, 1957; 1969). If the objectives are set according to learners' interests, learners will have a sense of curiosity and will actively participate in the teaching-learning process.

The second source for setting objectives is life outside the school. Objectives should be set by analysing the needs of society and life in society. Students perceive real situations and learning situations best when these two situations match. For this (1) real situations and learning situations should be similar in many respects, (2) students should have opportunities to practise the information which they have learnt at school in real-life (Tyler, 1969).

Tyler states that examining learners is an important resource in setting objectives. While examining the learners, their current situation is compared with the desired standards. The difference obtained as a result of this comparison is called need. The second information we can obtain from learners in setting objectives is their interests. Learning is an active process and requires the active participation of the learner (Tyler, 1957; 1969). If the objectives are set according to learners' interests, learners will have a sense of curiosity and will actively participate in the teaching-learning process.

The second source for setting objectives is life outside the school. Objectives should be set by analysing the needs of society and life in society. Students perceive real situations and learning situations best when these two situations match. For this (1) real situations and learning situations should be similar in many respects, (2) students should have opportunities to practise what they have learnt in real-life (Tyler, 1969).

A second definition of need is the innate needs of human beings. These are called physical needs. Educational objectives should also provide learners with the ability to meet these needs. While determining the needs of learners, the environment in which they live should be taken into consideration. What the learners will need while living in that region is also important in determining the objectives (Tyler, 1969). Observation, interviews, questionnaires, aptitude and knowledge tests, and records kept in the community (e.g. health records or school records) can be used to determine students' interests and needs (Tyler, 1969). These procedures will bring scientific rigour to the process of identifying interests and needs and will help to identify the most accurate needs.

Setting goals by examining life outside the school is criticised by some because (1) society is constantly changing, (2) common behaviours in society may not be appropriate to be taught at school, and (3) some problems in real-life may not be of interest to students. However, according to Tyler, these criticisms are valid only in cases where only society is identified as the target source. Almost all these objections disappear when the objectives are shaped with information from other sources (Tyler, 1969). In addition, when society is taken as the target source, factors that shape life in a particular community and area, such as natural resources, changes in population size and

migration, should also be taken into consideration (Tyler, 1969).

The third source for setting objectives is subject-area experts. Subject-area experts are seen as important sources of information and their contribution to objective setting is significant. Experts working on curriculum development should read everything written by subject-area experts meticulously and make inferences about the objectives (Tyler, 1969). Thus, the knowledge and skills required by the subject-area can be taken into account when setting objectives.

Once the goals have been set as a result of the information obtained from individual, society and subject-area sources, those that are not consistent with each other should be discarded. In this process, these candidate goals have to pass through a number of filters (Kliebard, 1970; Tyler, 1969; Tyrrell, 1974). The first of these filters is philosophy. The philosophy of education and society serves as the first screen for selecting objectives. Once the philosophy on which the education program will be based is chosen, objectives that are not consistent with this philosophy are eliminated. Another screen used in selecting objectives is educational psychology. Educational objectives are the points to be achieved through education and can be obtained as a result of learning. If these objectives are not suitable for the internal conditions of the learners, they cannot be valued as objectives and are eliminated (Tyler; 1969).

The next stage after determining, selecting and organizing the objectives is how to select the learning experiences that will be used to achieve these objectives. At this stage, it is decided which learning experiences students should go through in order to create the desired behavioural change in students and how these experiences will be selected and organized. Learning experience is the interaction between the learner and the external conditions to which the learner will respond (Tyler, 1969). Tyler recommended the use of the following general principles in the selection of learning experiences (Tyler, 1969):

- The learning experiences should be suitable for exhibiting the behavior indicated by the objective.
- The learning experience should satisfy the learner who exhibits the behavior indicated by the objective and create satisfaction in him/her.
- The learning experience should be appropriate to the level of the student. If the learning experience is of a kind that the student is not yet able to do, it cannot serve the goal.
- There should be more than one learning experience aimed at achieving the same educational objective.
- One learning experience should serve the acquisition of different objectives. In other words, each learning experience should produce more than one learning objective. This means that the learning experience is economical.

Since the number of possible objectives is quite large, it may not be possible to present the characteristics of the learning experiences that are useful in achieving each type of objective in a comprehensible way. Instead, the characteristics required by the learning experiences that will be effective in achieving the objectives can be discussed by drawing attention to some of the features. According to Tyler (1969), learning experiences should help improve thinking skills, acquire knowledge, develop social attitudes and arouse interest.

The next step after the identification and selection of learning experiences is how they should be organized for effective teaching. Learning experiences should be organized in such a way that they stimulate each other to produce a cumulative effect (Tyler, 1969). While organizing learning experiences, two types of relationships, vertical and horizontal organization (Tyler,

1969). For example, while the vertical organization is employed in the organization of learning experiences in 5th and 6th grade mathematics courses, the horizontal organization is employed in the organization of learning experiences in 5th grade mathematics and 5th grade science courses.

The last stage of Tyler's curriculum development approach is the evaluation stage. After the objectives are set and learning experiences are selected and organized, the curriculum development process may seem to be over, but evaluation is necessary to determine how successful all stages are (Tyler, 1966; 1969; 1983).

The evaluation phase can be carried out in order to assess the success of the student, obtain information about the difficulties experienced in learning experiences in the classroom, determine the effectiveness of the curriculum, examine the educational process, identify the defects in the society and develop a more appropriate curriculum for the society (Smith & Tyler, 1942; Tyler, 1969; 1983).

The concept of evaluation has two important aspects. First, since education aims to change student behaviour, evaluation should be directed towards student behavior. Secondly, evaluation should be done more than once to see whether there is a change or not. Because the assessment made by measuring students only at the end without knowing where they were at the beginning does not give information about the behavioural changes of the students (Tyler, 1983). The second stage in planning the assessment process is to determine the situations in which students will exhibit the behaviours defined in the objectives. Situations that give students the chance to exhibit the behaviour should be created and observed.

Assessment results provide information about the strengths and weaknesses of the curriculum. In fact, the results obtained with an objective, valid and reliable measurement tool can even indicate the sources of these strengths and weaknesses (Tyler, 1942). The results of curriculum evaluation also provide information about whether the materials are appropriate for student attainment (Tyler, 1969).

Curriculum development is a continuous process. The curriculum is developed, the curriculum is tested, the results are evaluated, inadequacies are identified, necessary improvements are recommended, the curriculum is reorganized in line with these improvements, it is tested again, it is evaluated again (Tyler, 1966; 1969; 1983) and this process continues in this way consistently.

To summarize, Tyler presented a systematic approach to curriculum development that influenced both the era in which it emerged and its aftermath. This approach basically consists of four stages: determining goals by selecting them from multiple sources and filtering them through philosophy and psychology, selecting experiences to achieve these goals, organizing the selected experiences in line with certain principles, and evaluating the learning outcomes and the curriculum itself. Tyler emphasized the alignment of objectives and learning experiences and suggested that the educational process should be evaluated through measurable outcomes. This approach enabled education to be carried out in a planned, measurable and objective-oriented manner and has become one of the cornerstones of contemporary education programs.

Hilda Taba's Views on Education and Curriculum

Hilda Taba (1902-1967), an Estonian-born American educator, is an important scholar who contributed to the field of curriculum and instruction. Taba argued that it is more appropriate to start the curriculum development process with the planning of teaching-learning processes rather than developing a general plan for a school curriculum. In such a procedure, which starts with the planning of teaching-learning processes, these processes form the basis of curriculum design (Lunenburg, 2011).

According to Taba, curriculum development is a complex process that requires many different decisions, such as deciding on the general objectives to be pursued by schools and the specific objectives of instruction. The core areas and topics of the curriculum should be selected as well as the content. While developing the curriculum educators should decide The types of learning experiences in which the content and objectives are to be implemented, how to evaluate what students have learned and to what extent the curriculum achieves its objectives, and finally, they should decide the overall design of the program should. All of these decisions must be made on a valid and consistent basis if curriculum development is to be complete and comprehensive (Taba, 1962).

Regardless of the specific design, all curricula contain certain elements. They involve the formulation of aims and specific objectives, the selection and organization of content, the selection and organization of learning experiences, and finally the evaluation of outcomes. Curricula differ according to which of these is emphasized more (Taba, 1962). In order for curriculum development to be more planned and dynamic, a certain sequence should be followed (Taba, 1962). For this reason, Taba summarized the process of curriculum development in seven steps.

- Needs Analysis
- Identifying objectives
- Selecting the content
- Organizing the content
- Selecting learning experiences
- Organizing learning experiences
- Determine what to evaluate and how to do it

Needs Analysis: The program is developed for students to learn. Since students' backgrounds are different, it is important to identify gaps, deficiencies and variations within them (Taba, 2013; Taba, 1962). In order to create a theory of curriculum development and a way of thinking about it, it is necessary to ask what the needs of the culture and society are and will be, both now and in the future. The curriculum is first and foremost a way of bringing young people into society as productive individuals. Not all cultures need the same knowledge and skills. For this reason, the needs specific to that society and culture must first be determined (Taba, 1962). The needs analysis of the culture and society serves as a guide for setting the main goals of education, choosing the content and what to emphasize in learning activities

Setting objectives: Formulating clear and understandable objectives is the second stage. The objectives decide the selection and organization of content, the selection and organization of learning experiences and finally the assessment process. Taba, like Tyler, also stated that objectives can be taken from different sources and suggested almost similar sources of objectives as Tyler.

- *Society and culture*: what are the problems, needs and requirements of society and culture? What expectations does it have of the people who live in it? An analysis of society reveals what kind of skills and characteristics the people living in it need in order to survive.
- *The individual*: The aim of education is to raise free-thinking, spiritually and physically healthy individuals. For this purpose, the objectives of education should be set in a way that enables the individual to develop and realize himself/herself.

- *Subject*: Education should provide individuals with the necessary knowledge to master subject-areas.

Selection and organization of content: In order for the program to serve its purpose, it is necessary to select the content that is consistent with the objectives and that will enable the objectives to be achieved. The selection and organization of content have criteria other than the objectives, such as validity and relevance, the differences between various levels of content, and the level of development. Moreover, the selection and organization of content requires continuity and sequentiality (Taba, 1962). Compared to Tyler, who considered content within learning experiences, Taba considered content under a separate heading in the curriculum development process.

Selection and organization of learning experiences: Since the curriculum is a learning plan, what is known about learning processes and individual development plays a role in shaping the curriculum. However, the selection and organization of learning experiences require more than the application of learning principles. Learning experiences are the implementation of objectives. The planning of learning experiences is not a decision made by the teacher at the moment of teaching, but constitutes the basic strategy of curriculum development (Taba, 1962). When developing a curriculum, the selection of experiences should be based on the questions "(I) are the criteria for selecting experiences clearly defined, (II) are the learning experiences psychologically and pedagogically appropriate, (III) are they of interest to students, and finally (IV) how should the learning experiences be organized?" (Fraenkel, 1994).

Deciding what to evaluate and how to evaluate it: Finally, plans need to be evaluated. What should the quality of education be in order to achieve the educational objectives? How can we make sure that there is consistency between the aims, objectives and what students actually gain? Does the curriculum provide opportunities for learners at all levels to achieve their goals? Evaluation should seek to answer questions such as these. Evaluation also fulfils the following functions (Taba, 1962).

- Determine whether the hypothesis underlying the curriculum is valid
- Identify the strengths and weaknesses of the curriculum by looking at the strengths and weaknesses in student attainment
- The assessment provides evidence for better grading and reporting.

To summarize, Hilda Taba proposed a comprehensive and systematic approach to curriculum development and suggested that this process should be managed in a planned manner. According to her, curriculum development is a process that starts with needs analysis and consists of setting goals, selecting and organizing content, planning learning experiences and evaluation. In this process, every decision should be made in line with social and individual needs and educational goals. Taba emphasizes the importance of criteria such as continuity, validity and sequentially in the selection and organization of content while emphasizing the planning of learning experiences in line with the objectives. Evaluation is seen as a critical tool to understand whether the curriculum is effective and to make improvements. This approach aims to structure curriculum development in a framework that is compatible with cultural, social and individual needs.

Paulo Freire's Views on Education and Curriculum

Born in 1921 in Brazil, Paulo Freire spent his childhood in poverty. This poverty inspired him to help others in poverty like himself and he began teaching literacy to people living in poor areas. In 1959, Freire completed his doctorate and became a professor of education and worked as an administrator and educational consultant in various institutions. Freire is a pioneer in the

field of critical pedagogy. He devoted his life to the liberation of education. Freire believes that students are not passive recipients of knowledge as they are treated, but that every student has a critical thinking style. For him, the duty of the educator is to liberate the thinking power available to students and to enable them to use their existing knowledge to act constructively.

According to Freire, there is no such thing as neutral education (Giroux, 1979). For him, education is either an attempt to conform the younger generations to the logic of the existing system, or it is an "enforcer of freedom", a means by which people critically and creatively engage with reality and discover how they can contribute to the world in which they live. The latter definition is more in line with Freire's liberating and critical understanding of education, as Freire argues that education should liberate both the teacher and the learner (Freire, 2005b). Moreover, Freire believes that people should look at the world they live in with a critical perspective and interpret what is happening around them with their own thinking systems.

According to Freire, if the relationship between teacher and student is defined as one of telling and listening, this understanding of education is wrong, and he defines this understanding as a disease. In this understanding, students are seen as empty vessels to be filled by teachers. The more a teacher fills the container, the better the teacher, and the more a student passively stands by and lets it be filled, the better the student (Freire, 2005a). This understanding leads students to mechanically memorize what is being taught without understanding its content. However, people who memorize everything and read to the end are captives of texts. These people are afraid to take risks because they cannot make a connection between what they read and real-life, and they speak as if they are reciting from memory (Freire, 2001).

In an educational approach where students are seen as empty vessels to be filled or as passive recipients, education becomes an "investment". Students are investment objects and teachers are investors. In this view, the object of investment, the student, must accept the investment made by the investor, the teacher. Freire calls this model the "banking system" (Freire, 2005a). Just as a banker sees everything that happens around him as an investment and acts accordingly, teachers see students as instruments to be invested in. In the banking model of education, knowledge is a gift given to students who are assumed to know nothing, and the continuation of teaching by a teacher with this understanding depends on the absolute ignorance of the students (Freire, 2005a). In other words, the more ignorant the students remain, the more they need knowledge and the teacher who will provide this knowledge. In this ignorance, the teacher continues to do his/her job and to be appreciated for the information he/she gives them, which is actually useless to them.

The aim of the banking model of education is to prevent people's ability to think critically and to keep them indifferent to what is going on around them. Freire argues that such an understanding can be overcome with libertarian education. The libertarian understanding of education develops the already existing ability to think in students and sensitizes them to their environment. Students raised with this kind of education can act with a "revolutionary" consciousness to fulfil their responsibilities towards their communities.

According to Freire, there is no communication without dialog and no education without communication (Freire, 2005a). In other words, education requires a dialog between teacher and student based on love, willingness to receive, faith and mutual trust. For the dialogic, problem-identifying teacher and student, the content of the curriculum is neither a gift nor a burden. The content in such a curriculum is an organized and systematic re-presentation to the students of what they want to learn. The content of the dialogue between teacher and student actually gives the content of the curriculum.

According to Freire (2005a), the starting point for determining the content of the curriculum should be the concrete situations of the present and should reflect the aspirations of the people.

These concrete situations should be presented to the people as a problem to be solved. The educator's task is to establish a dialog with the public about their views and to understand their view of the world (Freire, 1999). Freire explains the concept and stages of program development with the following example (Freire, 2005a):

Suppose a group of researchers is assigned to develop a curriculum for adult education in an agricultural town with a high illiteracy rate. This program includes a literacy mobilization and a post-literacy phase. In the first phase, problem-defining education explores "production-related vocabulary". The second phase explores production-related topics. The researchers then visit the area where they will work after researching the area from secondary sources. During this visit, the researchers must convince the people to attend a meeting where they will explain what will be done. Researchers explain that there should be an atmosphere of mutual trust. During these visits, the researchers observe their surroundings very well. They record everything they see in their notebooks, even if it is insignificant. They then analyze this recorded information. Researchers take care to focus on issues that affect residents. These issues determine the content of the curriculum.

According to Freire, when preparing curricula, the characteristics of the society in which the curriculum will be prepared should be taken into account (Freire, 1999). Content should be determined by observing these characteristics very well. Program content should be prepared together with the public by explaining the whole process to them. Curricula prepared behind closed doors and only in line with the wishes of the ruling class are doomed to fail.

Freire believes that the purpose of education is to liberate people. According to him, education should enable people to think and have a critical view of their environment and events. With the skills they develop as a result of their education, people make sense of their environment and believe that they can change it. Educated and independent people try to change the society they live in like revolutionaries. Since this situation is not liked by the groups that hold political and economic power in society, these groups try to put obstacles in front of people's thinking. By using education, these groups try to minimize or even destroy the power of thinking, being critical and being creative. In this way, they guarantee the continuation of their domination.

In sum, according to Freire, education is not neutral; it either supports the existing system or liberates individuals by encouraging them to think critically. Freire criticizes the traditional "banking" model and argues that this model makes individuals rote memorizers and incapable of critical thinking. In the liberating understanding of education, on the other hand, teachers and students shape the content of the curriculum together through dialogue, and this process is based on concrete problems and social needs. Education should encourage individuals to critically understand their environment and take action for social transformation.

Michael Apple's Views on Education and Curriculum

Michael Apple, who described himself as a "critical scholar", is one of the pioneers of the critical education movement. He emphasized how schools reproduce social inequalities by examining the link between education systems and power relations. In his works such as Ideology and Curriculum, he criticized the role of hidden curricula and the mechanisms of ideological control in education. Apple argues that a more just and inclusive understanding of education is possible through critical pedagogy.

The critical pedagogy, pioneered by scholars such as Freire and Apple, challenges the dominant traditional understanding of education. In the traditional understanding of schools, they are institutions used by those in power to direct and align society (Apple, 2004). Instead of asking what subjects students master or what results they get on tests, it is necessary to ask challenging

questions about education in schools (Apple, 2000). Whose knowledge is this? How has this knowledge been formalized? What is the relationship between this knowledge and how it is taught and those who hold social and economic power in society? Who do these legal definitions of knowledge benefit and who do not? What are the explicit and implicit effects of educational reforms on actual society? What can we do as critical educators and activists to challenge educational and social inequalities and develop a socially just curriculum (Apple, 2004)? By seeking answers to questions like these, Apple argues, we can question our understanding of education and create a free educational environment.

However, in addition to these questions, according to Apple (2018), the real question that needs to be asked and that forms the basis of critical education is "Can education change society?". Dominant groups have a say over education and the economy, but this must be challenged in order for schools to create a more democratic society. A less racist, sexist and classist curriculum, more critically-based teaching practices and a closer relationship between the school and the community require less political influence both within the school and in society, otherwise, advocates of democratic education will have little chance of success (Apple, 2000).

Moreover, teachers are increasingly dissatisfied with current politics because so much of what they do is determined by people who have little idea about the state of schools and classrooms (Apple & Beane, 1995). That is, teachers are uncomfortable with not having a voice in what they teach and having "official" knowledge imposed on them. In this case, curricula should give teachers more freedom about the knowledge they teach and the methods they employ.

There are debates about what knowledge should be taught in education, what is "official" according to whom, who has the right to decide, and how teaching and learning should be evaluated (Apple, 1995). Apple states that those who hold economic, political and cultural power in society have a say in education. It should also be noted that schools have an implicit program to impose the dominant ideology (Apple, 2004).

According to Apple, education should be seen as a political act (Apple, 2012). Education is deeply influenced by political culture. The curriculum is not a neutral accumulation of knowledge. They have always been part of a "selective tradition" whereby choices are made according to someone's or some group's opinion of the approved knowledge. Curricula are produced from the cultural political and economic conflicts and compromises that organize and confuse the public. Whether we like it or not, discriminatory forces permeate the heart of educational programs, teaching and assessment (Apple, 1993). The fact, then, that there is an official information policy in every case, a policy that some call neutral and others call biased, should not be ignored.

Apple is not completely opposed to a national curriculum or national testing. However, he argues that there is something to be aware of and that the creation of a national curriculum and the national testing of students is entirely under the influence of the ruling class. According to him, the national curriculum currently being implemented in the UK and the US is a politically tailored curriculum shaped by state books and the book publication market (Apple, 1993).

Apple argues that critical education can provide a better and more meaningful education by going beyond the standards. According to him, national curricula are prepared by people behind closed doors and do not take into account the characteristics of the school and its region. Moreover, these curricula only allow state-approved information to be included in textbooks. He gives the following example from his own teaching years.

From my earlier years of teaching in very poor schools in impoverished slums, I had already gained a good deal of experience in more critically democratic models of curriculum and teaching and had sought to go beyond such standardized textbooks as often as possible. In many ways, what

I did was similar to the kinds of things that the social and educational activists in Porto Alegre and other places have attempted here. I again sought to do the same in this more conservative environment.

The state curriculum guidelines for the sixth grade level provided space for such action. One of the major goals was community study. I did not want to use the textbook that had been used before, one that talked generally about communities of various kinds and ignored the history and current struggles over poverty, racism, and immigrant lives and cultures. Instead, I wanted my students to understand their community close-up. We went to the local museum and historical archives to do research on the history of the town and its surrounding areas. What we discovered was powerful. There had been active Ku Klux Klan chapters in the area—and one in the town itself. (This is a very violent racist group with a long history in the United States.) There had also been repeated instances of racist violence and overt efforts to keep the town "white and ultra-conservative" in religious beliefs. While less powerful, there also had been conflict over this and resistance to such practices by a small group of people in the community.

The discussions among the students about all of this, about the public face of the town and about what was missing in the "facts" that the students usually learned about this community and its surrounding area, were powerful and very thoughtful. These kinds of racist things were "not supposed to happen in the North of the United States." The students published a class newspaper about what they had found and about the questions that it raised. The newspaper was sent home—and then the explosion occurred. The leaders of a number of the most conservative groups were outraged. This was "un-American". How dare I have my 12-14-year-old students learn such things and raise such questions? There were attempts to have me fired. In the end, the other teachers, the school principal, and many community members refused to allow the conservatives to destroy the possibility of building a more critically democratic education (Apple, 2017: p.903-904).

As we can understand from this story, which Apple gives as an example from his own life, curricula that are prepared from a centralized system teach only the information approved by the ruling class, disregard the information the ruling class does not want to be learned, always have a hidden mission, and constitute an obstacle to a critical and democratic understanding of education. According to Apple, the task of teachers is to go beyond this understanding whenever possible and show their students everything that needs to be taught about a subject in its environment and away from all kinds of hate speech. In this way, students will develop a system of thought on their own and form their own value judgments in a democratic environment.

William F. Pinar's Views on Education and Curriculum

William Pinar, an American educator, is known as one of the pioneers of the reconceptualization movement. Reconceptualizers argue that the old way of curriculum development ended in the late 1960s, that the conventional understanding of curriculum is political, and that it is important to understand the curriculum rather than to develop it. According to Pinar (1978; 2010), the future of curriculum studies is uncertain. Curriculum development has lost its influence with the recent reforms in America. This situation caused a change in the curriculum field and studies shifted from curriculum development to understanding the curriculum.

At the end of the 1960s, the field of curriculum development entered a crisis. Tyler's theory came to the end of its intellectual legitimacy for both conceptual and historical reasons. Criticisms that Tyler's conception of program development was too technical increased. Historically, the Kennedy administration excluded the national education program from the reform movement. Furthermore, the decline in the number of students enrolling to study in the field, the politicization of the field, and the replacement of retiring education programmers by field specialists accelerated the decline. Moreover, with the acceleration of social changes, the field of education has also had

its share (Pinar, 1978; 2010).

In addition, curricula have become increasingly dependent on standardized tests and many teachers have begun to think that they have to teach for tests or have been forced to do so by their administrators. This has led to general curriculum development no longer being a primary concern (Pinar, 2004). Another phenomenon that has undermined the teaching profession has been the placement of technology at the centre of the educational experience for the sake of testing. A study conducted by economists revealed that the teaching profession has been reduced to increasing student achievement on standardized tests. However, according to Pinar (2013), not all teachers accept this nonsense.

In the light of these circumstances, the academic field of curriculum studies has been reconceptualized from bureaucratized school-cantered curriculum development to a scientific understanding of it. Those who formulate theory need to know that practitioners will no longer accept their recommendations or impositions (Pinar, 2004).

Pinar thinks that the current situation has turned into a nightmare for teachers and the academics who work with them. Schools have become factories of knowledge and skills, and the education profession has been reduced to counselling. Millions of people are having nightmares in schools and very few of them realize that they are asleep. Because there is so much dissatisfaction in the classroom, where curricula are implemented, many teachers retreat into their own safe subjectivity. In doing so, however, they abandon their professional authority and ethical responsibility for the curriculum they teach (Pinar, 2004).

The concept of curriculum is many things to many people. Curriculum is a complex phenomenon. It is structured by rigid rules, focused on objectives and over-reliance on products. The curriculum is perceived as conversations between teachers and students in a certain place on certain dates that are at the same time both private and public (Pinar, 2004).

Before the reconceptualization, the program was understood as what the district office wanted teachers to teach. After the reconceptualization, the concept of curriculum still gives this lexical and institutional definition, but it is no longer limited to these and is now understood not only as an institutional but also as a symbolic concept. In the broader view, curriculum is what older generations choose to teach or not to teach to younger generations. The curriculum must then be understood as historical, political, racial, gendered, phenomenological, autobiographical, aesthetic, religious, and international. These concepts have become the main research topics of post-reconceptualizers (Pinar, 2010).

However, changes such as these have by their very nature stimulated opposing views. Firstly, the term “reconceptualization” was controversial, and then it was debated whether it was a paradigm shift or an extension and restatement of the old. Pinar acknowledged that much of this was similar to what progressivists such as John Dewey were saying. What is clear here is that reconceptualization repeats the old statements, but its function is not to improve or change the program but to understand it politically. Since the goal is to understand the curriculum, not to improve it, this new movement served the function of reconceptualizing the curriculum field in the United States, both conceptually and methodologically. However, in the early 1980s, the reconceptualization movement lost the momentum of its early years. The success of reconceptualization also brought its end (Pinar, 2010).

In summary, William Pinar is one of the pioneers of the reconceptualization movement that emphasizes understanding rather than developing curricula. According to him, since the late 1960s and early 70s, traditional curriculum development methods have lost their effectiveness and the field has turned more towards understanding the political and symbolic aspects of curriculum.

Pinar states that education systems have become mechanized, and teachers and students have become distanced from their professional responsibilities in this process. Reconceptualization provided a broad perspective by examining curriculum in historical, political, aesthetic, and phenomenological contexts, but this movement lost momentum in the 1980s.

References

Apple, M. W. (1993). The Politics of Official Knowledge: Does a National Curriculum Make Sense? *Teachers College Record, 95*(2), 222-241.

Apple, M. W. (1995). *Education and power.* Routledge.

Apple, M. W. (2000). *Official Knowledge: Democratic Education in a Conservative Age.* New York: Routledge.

Apple, M. W. (2004). *Ideology and Curriculum.* New York: Routledge.

Apple, M. W. (2012). Education, Politics, and Social Transformation. S. Totten, & J. E. Pedersen içinde, *Researching and teaching social issues: The personal stories and pedagogical efforts of professors of education* (s. 7-28). New York: Lexington Book.

Apple, M. W. (2017). The Struggle for Democracy in Critical Education. *Revista e-Curriculum, 15*(4), 894-924.

Apple, M. W. (2018). Critical Curriculum Studies and the Concrete Problems of Curriculum Policy and Practice. *Journal of Curriculum Studies, 50*(6), 685–690.

Apple, M. W., & Beane, J. A. (1995). *Democratic Schools.* Virginia: Alexandria, Va. Assoc. for Supervision and Curriculum Development.

Au, W. (2011). Teaching under the new Taylorism: high-stakestesting and the standardization of the 21st century curriculum. *Journal of Curriculum Studies*(43), 2545.

Bobbitt, F. (1918). *The Curriculum.* Boston: Houghton Mifflin.

Bobbitt, F. (1921). A Significant Tendency in Curriculum-Making. *The Elementary School Journal, 21*(8), 607-6015.

Bobbitt, F. (1927). The Orientation of the Curriculum-Maker. *Teachers College Record, 28*(12), 41-55. doi:https://doi.org/10.1177/016146812702801203

Bobbitt, F. (2006). Scientific Method in Curriculum-Making. D. J. Flinders, & S. J. Thornton içinde, *The Curriculum Studies* (s. 9-16). New York: Routledge.

Callahan, R. E. (1962). *Education and Cult of Efficiency.* Chicago: The University of Chicago Press.

Dewey, J. (1913). *Interest and effort in education.* Hougton Mifflin Company.

Dewey, J. (1966). *The Child and Curriculum and The School and Society.* Chicago: The University of Chicago Press.

Dewey, J. (1997). *Experience and Education.* Newyork: Touchstone.

Dewey, J. (2001). *Democracy and Education.* Pennsylvania: The Pennsylvania State University.

Eisner, E. W. (1967). Franklin Bobbitt and the "Science" of Curriculum Making. *The School Review, 75*(1), 29-47.

Fraenkel, J. R. (1994). The evolution of the Taba curriculum development project. *The Social Studies, 85*(4), 149-159. doi:10.1080/00377996.1994.9956294

Freire, P. (1999). Education and community involvement. M. Castells, R. Flecha, P. Freiré, H. A. Giroux, & D. Macedo içinde, *Critical education in the new information age* (s. 83-91). Rowman & Littlefield Publishers.

Freire, P. (2001). *Pedagogy of Freedom: ethics, democracy and civic courage.* Lanham: Rowman & Littlefield Publishers.

Freire, P. (2005a). *Pedagogy of the Oppressed.* Newyork: Continuum.

Freire, P. (2005b). *Education for Critical Consciousness.* London: Continuum.

Giroux, H. A. (1979). Paulo Freire's approach toradical educational reform. *Curriculum Inquiry, 9*(3), 257-272. doi:https://doi.org/10.2307/3202124

Hlebowitsh, P. (1992). Amid behavioural and behavioristic objectives: reappraising. *appraisals of the Tyler Rationale. Journal of Curriculum Studies, 24*(6), 533-547. doi:https://doi.org/10.1093/acrefore/9780190264093.013.1036

Kliebard, H. M. (1970). Reappraisal: The Tyler Rationale. *The School Review, 78*(2), 259-272.

Kliebard, H. M. (1975). The Rise of Scientific Curriculum Making and Its Aftermath. *Curriculum Theory Network, 5*(1), 27-38.

Kliebard, H. M. (1995). *The struggle for the American curriculum.* Routledge.

Lunenburg, F. C. (2011). Curriculum development: Inductive models. *Schooling, 2*(1), 1-8.

Pinar, W. F. (1978). The Reconceptualisation of Curriculum Studies. *Journal of Curriculum Studies, 10*(3), 205-214.

Pinar, W. F. (2004). *What Is Curriculum Theory?* Mahvah: Lawrence Erlbaum.

Pinar, W. F. (2010). Reconceptualization. In C. Kridel, *Encyclopedia of Curriculum Studies* (s. 735-736). California: SAGE Publications.

Pinar, W. F. (2013). *Curriculum Studies in the United States: Present Circumstances, Intellectual Histories.* New York: Palgrave Macmillan.

Simpson, D. J., & Jackson, M. J. (2003). John Dewey's view of the curriculum in the child and the curriculum. *Education and Culture, 20*(2), 23-27.

Smith, E. R., & Tyler, R. W. (1942). *Appraising and Recording Student Progress.* New York: Harper & Brothers.

Taba, H. (2013). *The dynamics of education : A methodology of progressive educational thought.* Routledge.

Taba, H. (1962). *Curriculum development: Theory and Practice.* Harcourt, Brace & World.

Taylor, F. W. (1911). *The Principles of Scientific Management.* San Francisco: Harper and Brothers

Publishers.

Tyler, R. W. (1942). General statement on evaluation. *The Journal of Educational Research, 35*(7), 492-501. doi:10.1080/00220671.1942.10881106

Tyler, R. W. (1957). The curriculum-then and now. *The Elementary School Journal, 57*(7).

Tyler, R. W. (1966). The Objectives and Plans for a National Assessment of Educational Progress. *Journal of Educational Measurement, 3*(1), 1-4.

Tyler, R. W. (1969). *Basic Prenciples of Curriculum and Instruction.* Chicago: The University of Chicago Press.

Tyler, R. W. (1983). A rationale for program evaluation. In G. F. Madaus, M. S. Scriven, & D. L. Stufflebeam, *Evaluation models: Viewpoints on educational and human services evaluation* (s. 67-78). Kluwer-Nijhoff Publishing.

Tyrrell, R. W. (1974). An appraisal of the Tyler Rationale. *The School Review,* (83), 151-162.

About the Authors

Dr. Saim Akman is an English Teacher at Konya Anadolu İmam Hatip High School in Konya. He is currently working for General Directorate of Secondary Education Department of Instructional Materials and Content Development. He has completed his PhD in the Curriculum and Instruction department at Hacettepe University. His main areas of interest are Curriculum development, curriculum evaluation, teaching-learning processes, and foreign language teaching.

E-mail: saimakman@gmail.com, **ORCID:** 0000-0002-9768-663X

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 9 %.

To Cite This Chapter:

Akman, S. (2024). Curriculum development approaches around the world. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp.127-14). ISRES Publishing.

Theory of Mind and Its Development in Preschool Children

Canan KELEŞ-ERTÜRK

KTO Karatay University Health Services Vocational School

Kezban TEPELİ

Selcuk University Faculty of Health Sciences

Introduction

Theory of mind is a skill related to the individual's understanding that his/her thoughts and other individuals' thoughts are different. The development of theory of mind is influenced by both hereditary and environmental processes. In this section, the conceptual and theoretical aspects of theory of mind and its developmental stages in preschool period are discussed.

Theory of Mind

Theory of mind is the ability of individuals to understand their own mental states as well as the mental states of others. These states can include, but are not limited to, beliefs, desires, tensions and emotions (Bjorklund et al., 2005). Theory of mind represents the ability of people to understand and predict their own and others' actions by considering their mental states. This ability forms the basis of understanding human behavior. Because most behaviors of individuals depend on the processes that take place in their minds. Such mental analysis and predictions constitute the basic elements of social interactions (Astington & Dack, 2008).

Theory of mind refers to the capacity to understand, predict and explain the behavior of others by taking into account the mental states underlying these behaviors. This ability is present in typically developing individuals and usually emerges in early childhood (Scholl & Leslie, 1999). The ability to understand the mental states of others varies across individuals (Welsh, 2021). Children begin to better comprehend the social world by considering the perspectives of others. Understanding a speaker's intentions in communication helps children go beyond the surface meaning of messages. Children also begin to use these skills to achieve social goals, such as peer acceptance. This depends on the child's progress in theory of mind and how they use this knowledge in everyday life (Keenan, 2003).

Although there is general agreement on the critical milestones in the development of theory of mind, there are different theories about how this process takes place. While some researchers consider theory of mind to be a product of learning processes, others argue that it is based on a more complex module of mental states. This module is activated early in life and takes into account factors such as language development and increases in cognitive capacity. Moreover, experts agree on the importance of developmental differences and developmental data in understanding this process (Wellman, 2011). Various theories and views on theory of mind have been developed. Theory theory suggests that individuals' beliefs can have biasing effects on their perceptual processes. It also emphasizes that experiences play a critical role in the development of children's theory of mind. In this framework, when children encounter new information that cannot be explained by their existing theory of mind, they evaluate this information and revise their theory of mind. As a result, experience stands out as an important mechanism that improves children's social interactions and their ability to understand others' thoughts (Flavell, 1999). Modular theory argues that children's concepts such as belief, imitation and desire play a critical role in the processes of predicting and explaining behavior. While the modular theory suggests

that these basic concepts are determined by innate modules, it states that these modules are shaped over time by the developmental process and evolutionary factors. It also emphasizes that some components of the theory of mind are endogenous and are activated by appropriate neural maturation and environmental stimuli (Doherty, 2009). Simulation theory explains the ability of individuals to transform their own mental states into the predicted mental states of others. This process starts with the individual perceiving the other person's current mental state and supporting it with his/her own thinking mechanism. He then uses this mental state to understand the behavior of others instead of his own behavior. At the heart of the theory is the understanding of environmental psychological characteristics and the process of acquiring knowledge about the emergence of different mental states. In addition, there are procedures such as generalization, concept formation and inference making in the background of this theory (Ratcliffe, 2007). The innatist approach considers the theory of mind as a basic evolutionary adaptation. In contrast, constructivists argue that theory of mind is a product of early social learning. This approach also emphasizes that theory of mind is shaped through individuals' social interactions and experiences (Westra & Carruthers, 2021).

Theory of mind refers to the ability of individuals to understand the thoughts and beliefs of others, and in this context, the false belief task is used as an important tool. This task tests a person's ability to interpret or predict another person's behavior by comprehending their false beliefs. In the example false belief task, children are presented with two different stories about cooperation and competition. Through these stories, the aim is to assess children's understanding of the characters' beliefs and how these beliefs affect their behavior. Such practices play a critical role especially in the development of children's social skills and empathy levels, and provide important findings on how social cognition is shaped (Wimmer & Perner, 1983).

Development of Theory of Mind

In its most basic forms, theory of mind develops during infancy and early childhood, within the first four to five years of life. The most basic form of theory of mind, perception-goal psychology, begins to develop at around 9 months of age. At this stage, children are able to understand that others have different perceptual perspectives and goals about the world and can adjust their behavior accordingly. Later, around the age of 4 years, metatheory emerges in the form of belief-desire psychology. This stage involves recognizing that others may represent the world in detailed ways that are incompatible with the individual's own view and may be inaccurate. Important developmental milestones in this process are shown in Figure 1 (Rakoczy, 2022).

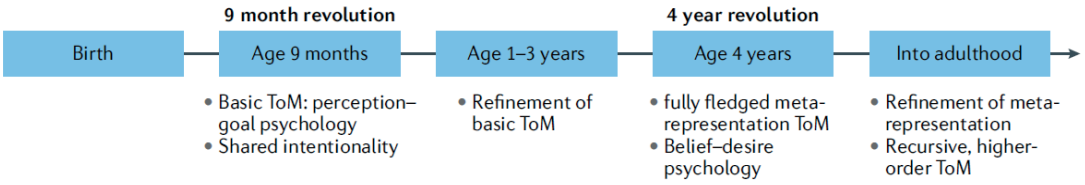

Figure 1. Milestones in the development of theory of mind (Rakoczy, 2022)

The most well-known developmental sequence related to the development of theory of mind deals with the skills that emerge between the ages of 3-5, that is, in preschool years. This progressive developmental sequence is presented in Table 1 (Peterson, & Wellman, 2009 and Wellman & Liu, 2004 as cited in Tucci, 2016):

Table 1. *Developmental sequence of theory of mind*

Stage	Age of Mastery	Task Description
Diverse Desires	**3.0 – 4.0 yrs**	Child is given a choice of two snacks (e.g., carrots and cookies). Child picks favorite snack. Another character (e.g., doll) chooses the opposing snack as her favorite. Child is asked what the character will choose to eat. Child must inhibit his desire and choose the opposing snack to score correctly.
Diverse Beliefs	**3.0 – 4.0 yrs**	Child is given a choice of two locations for a missing cat. Child picks the location where he thinks the cat is hiding. Another character chooses the opposing location. Child is asked where the character will look for the cat. Child must inhibit his desire and choose the opposing location to score correctly.
Social Pretend	**4.0 – 4.5 yrs**	Child and assessor pretend to paint a blue cup green. Another character not involved in the pretend play enters the situation. Child is asked what color the character thinks the cup is. Child should say the initial color of the cup (i.e., blue) to score correctly.
Knowledge Access	**4.6 yrs**	Child is shown a nondescript box with a random object inside (e.g., toy dog). Toy is concealed inside the box, and another character (who has not seen inside the box) enters the situation. Child is asked what the character thinks is inside the box. Child must say the character doesn't know to score correctly.
False Belief – Unexpected Contents	**5 yrs**	Child is shown a recognizable box (e.g., M&M box) and asked what they think is inside. Child should say candy. Contents of the box are revealed. It is something other than what the outside of the box would suggest. (e.g., toy fish). Object is placed into the box and another character enters the situation. Child is asked what the character thinks is inside the box. Child should say candy to score correctly.

Theory of mind refers to the ability of individuals to understand the thoughts and feelings of others and is usually acquired rapidly in typically developing children based on specific abilities in infancy (Wellman, 2014). During typical development, children show a specific developmental sequence of acquiring ToM between the ages of 2.5 and 5 years. Therefore, tasks related to ToM are usually aimed at children in this age group. Preschool children's capacity to understand mental states in these tasks helps to assess individual differences in mindreading (Slaughter & Repacholi, 2003).

In children's development, the ability to reason about desires appears about a year and a half earlier than reasoning about beliefs. Infants at 18 months have a limited ability to think non-self-centeredly about people's desires. By 2.5 years of age, children begin to understand the relationship between desires and emotional outcomes; for example, they recognize that a person is happy when he or she achieves something he or she wants (Bartsch & Wellman, 1995). However, understanding of false beliefs usually develops by age 4. Children aged 3 years and younger have difficulty understanding that the mental representation of a person may differ from reality. These conceptual distinctions are related to other understandings such as appearance reality and the ability to perceive the same object from different visual perspectives, and these skills are also acquired around the age of 4. From the age of 4, children begin to use beliefs systematically in their daily lives (Flavell & Miller, 1998, as cited in Sodian & Kristen, 2010).

Theory of mind is a process that starts with intuitive social skills developed in infancy and progresses with reflective social cognition in toddlerhood and preschool years (Astington & Edward, 2010). Babies gain the ability to distinguish between the movements of animate and inanimate objects at around six months, while their joint attention skills begin to develop at twelve months. At eighteen months, the first signs of the development of theory of mind are seen, along with the ability for joint attention. At the age of three, children have difficulty distinguishing the beliefs of others from their own beliefs, while by the age of four, their ability to understand these beliefs is significantly improved (Şahin et al. 2019). 3-year-old children understand that different individuals can have different desires, loves and feelings. Between the ages of 4 and 5, they understand that people can have different thoughts and realize that a person can have a false belief. Theory of mind enables individuals to understand others by recognizing their own mental

states (thoughts, desires, motives and emotions). Individuals use theory of mind to explain their behavior by expressing their own feelings and thoughts and interpret other people's speech and behavior by considering their thoughts and desires (Astington & Edward, 2010).

The rate of development of ToM abilities varies across individuals. While the general age of success in the classical version of the false belief task is set at 4 years, some typically developing children successfully complete this task at age 3, while others do not succeed until age 5. Therefore, it is important to investigate whether individual differences are genetic or environmental (Zufferey, 2010). Hughes et al. (2005) conducted studies on identical and fraternal twins and found that the main factors affecting the development of ToM are environmental, not genetic. Ruffman et al. (1998) emphasize the important role of the presence of older siblings in the development of belief understanding. They also emphasize the importance of social interactions in both facilitating and providing these interactions.

Research reveals that the child's environment plays a critical role in the development of ToM abilities. However, this does not mean that ToM does not have a genetic basis. While ToM is supported by genetic factors, environmental influences also significantly shape this development. Therefore, innate ToM abilities are determined by the developmental process and environmental factors (Zufferey, 2010).

References

Astington, J. W. & Edward, M.J. (2010). The Development Of Theory Of Mind In Early Childhood. *Social Cognition.*

Astington, J.W. & Dack, L.A. (2008). Theory of Mind (Ed. Marshall M. Haith, Janette B. Benson). *Encyclopedia od Infant and Early Childhood Development Volume 1,* Elsevier Inc., 343-356.

Bartsch, K. ve Wellman, H.M. (1995). *Children Talk About The Mind,* Oxford University Press, New York.

Bjorklund, D. F., Cormier, C. A., & Rosenberg, J. S. (2005). The Evolution Of Theory Of Mind: Big Brains, Social Complexity, And Inhibition (Ed.: Wolfgang Schneider, Ruth Schumann-Hengsteler, Beate Sodian). *Young Children's Cognitive Development Interrelationships Among Executive Functioning, Working Memory, Verbal Ability And Theory Of Mind,* 147-174.

Doherty, J. M. (2009). *Theories Of Theory Of Mind. Theory Of Mind. How Children Understand Other's Thoughts And Feelings*. Psychology Press.

Flavell, J.H. (1999). Cognitive Development: Children's Knowledge About The Mind. *Annual Reviews Psychology*, 50, 21-45.

Hughes, C., Jaffee, S. R., Happé, F., Taylor, A., Caspi, A. & Moffitt, T. E. (2005). Origins Of İndividual Differences In Theory Of Mind: From Nature To Nurture?. *Child Development*, *76*(2), 356-370.

Keenan, T. (2003). Individual Differences In Theory Of Mind The Preschool Years And Beyond (Ed.: Betty Repacholi, Virginia Slaughter) *Individual Differences In Theory Of Mind: Implications For Typical And Atypical Development*. New York And Hove: Psychology Press, 122-143.

Rakoczy, H. (2022). Foundations of theory of mind and its development in early childhood. *Nature*

Reviews Psychology, 1(4), 223-235. https://doi.org/10.1038/s44159-022-00037-z

Ratcliffe, M. (2007). *Rethinking Commonsense Psychology: A Critique Of Folk Psychology, Theory Of Mind And Simulation.* London: Palgrave Macmillan.

Ruffman, T., Perner, J., Naito, M., Parkin, L. & Clements, W. A. (1998). Older (But Not Younger) Siblings Facilitate False Belief Understanding. *Developmental Psychology, 34(1)*, 161-174.

Scholl, B. J. & Leslie A.M. (1999). *Modularity, Development And 'Theory Of Mind. Mind & Language*, 14(1), 131-153.

Slaughter, V. & Repacholi, B. (2003). Introduction: Individual Differences In Theory Of Mind What Are We Investigating? (Ed.: Betty Repacholi, Virginia Slaughter) *Individual Differences In Theory Of Mind: Implications For Typical And Atypical Development*. New York And Hove: Psychology Press, 1-13.

Sodian, B. & Kristen, S. (2010). *Theory Of Mind* (Ed.: Britt M. Glatzeder, Vinod Goel, Albrecht Von Müller). Towards A Theory Of Thinking Building Blocks For A Conceptual Framework, Springer, 189-202.

Şahin, B., Bozkurt, A., Usta, M. B., Aydın, M., Çobanoğlu, C. & Karabekiroğlu, K. (2019). Theory of Mind: Development, Neurobiology, Related Areas and Neurodevelopmental Disorders. *Current Approaches in Psychiatry, 11*(1), 24-41.

Tucci, S. (2016). Theory of mind development and children who are deaf and hard of hearing. Victorian Deaf Education Institute. (Access Date: 26.10.2024). chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.deafeducation.vic.edu.au/Resource/fact-sheets/Theory%20of%20Mind%20Summary.pdf

Wellman, H.M. (2011). *Developing A Theory Of Mind* (Ed.: Usha Goswami). The Wiley-Blackwell Handbook Of Childhood Cognitive Development (Second Edition). United Kingdom: A John Wiley & Sons, Ltd. Publication, 258-284.

Wellman, H.M. (2014). *Making Minds How Theory Of Mind Develops*, Oxford University Press.

Welsh, C. (2021). *Theory Of Mind And Evidence Of Brain Modularity* (Ed.: T.K. Shackelford, V.A. Weekes-Shackelford). Encyclopedia Of Evolutionary Psychological Science, Springer International Publishing, 8143-8144.

Westra, E. & Carruthers, P. (2021). *Theory Of Mind* (Ed.: T.K. Shackelford, V.A. Weekes-Shackelford). Encyclopedia Of Evolutionary Psychological Science, Springer International Publishing, 8136-8142.

Wimmer, H. & Perner, J. (1983). Beliefs About Beliefs: Representation And Constraining Function Of Wrong Beliefs In Young Children's Understanding Of Deception. *Cognition*, 13: 103–114.

Zufferey, S. (2010). Lexical Pragmatics And Theory Of Mind: The Acquisition Of Connectives. *John Benjamins Publishing Company.*

About the Authors

Canan KELEŞ-ERTÜRK works as an Assistant Professor at KTO Karatay University, Faculty of Health Sciences, Department of Child Development. She completed her undergraduate, graduate and doctorate in child development and education program. She has books, papers and articles on child development and education.

E-mail: canan.erturk@karatay.edu.tr, **ORCID:** 0000-0001-6247-0073

Kezban TEPELİ is Prof. Dr. She works as a professor in the Department of Child Development, Faculty of Health Sciences, Selcuk University. She completed her undergraduate, graduate and doctorate in child development and education program. She has many books, papers, articles and projects on child development and education.

E-mail: ktepeli@selcuk.edu.tr, **ORCID:** 0000-0003-3403-3890

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 7%.

To Cite This Chapter

Keleş-Ertürk, C. & Tepeli, K. (2024). Theory of mind and its development in preschool children. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024* (pp. 146-151). ISRES Publishing.

Biomimicry in Science Education

Ayşegül TONGAL

Akdeniz University

Fatih Serdar YILDIRIM

Akdeniz University

The Concept of Biomimicry

It is known that design is not only an action specific to humans, but many living things realize it unconsciously by changing or adapting to their environment and conditions (Çakır, 2019). The main purpose of design is to ensure the safety of living things, solve problems and improve life. Living things participate in designing by recognizing their environment and using the possibilities they have by considering their benefits. In this process, living things need to have technological abilities such as perception, analysis, reasoning and sensory memory. Design allows living things to adapt and survive in situations where change is not possible (Kuday, 2009). Thus, design also functions as an adaptation strategy and emerges as an important process that supports the survival abilities of living things.

Since prehistoric times, humans have developed various designs to meet their basic needs and find solutions to environmental challenges. Most of these designs were created by observing nature or inspired by the natural environment. For example, in Ancient Egypt, dams and canal systems were built to control the flooding of the Nile River and to use water resources more efficiently. During this construction, engineering studies were inspired by the water cycle in nature and developed as a water management strategy. This shows that long before the concept of biomimicry was scientifically defined, people were studying the natural systems around them and producing engineering solutions by utilizing the working principles of these systems. The observation and imitation of natural processes or the application of their adaptations in man-made systems have formed the basis of the engineering and architectural practices of many civilizations throughout history (Aydın, 2023).

Nature has managed to survive by developing adaptation mechanisms against changing environmental conditions. As a result of this process, the solutions offered by nature are highly efficient and sustainable or functional in terms of resource utilization. Biomimicry is an interdisciplinary science that examines nature and the adaptations that living organisms have developed over millions of years of evolution and aims to be inspired by these processes or to imitate them in engineering, design and technology (Benyus, 1997). Biomimicry is defined as the transformation of these processes into design with qualified techniques and the development of new products by imitating the features that enable living things that have existed in nature for billions of years to be successful in fulfilling their tasks (Karabetça, 2018). The conceptual foundations of the term biomimicry were laid by Janine Benyus. Benyus first discussed the concept of biomimicry in her book "Biomimicry: Innovation Inspired by Nature" published in 1997 and assumed a pioneering role in this field. Benyus stated that the basic functioning principles of nature can be applied in the fields of engineering, design and technology (Canbazoğlu Bilici et al., 2021; Avcı, 2019). This term is a combination of the concepts of "biology" (life science) and "mimicry" (imitation) (Volstad & Boks, 2012).

The basis of biomimicry is the use of nature as a source of inspiration in engineering and design processes. In the literature, the concept of biomimicry is defined on three main components. First, imitating the form or function of structures in nature. Second, modeling the processes occurring in nature. The third is to copy the functioning of systems in nature (Benyus, 1997). These three components are used in the development of innovative designs to serve sustainability, which is the basic principle of biomimicry. Biomimicry enables the design of sustainable products and processes that do not harm the environment by taking inspiration from nature. Therefore, biomimicry can be considered as an "innovative design approach" and "sustainable development ethics" (Tavşan, 2022). Therefore, integrating these qualities into the fields of engineering and design enables achieving sustainable development goals in the long term (Karabetça, 2018).

Biomimicry applications are basically handled with two different approaches (Çakır, 2019). Reductive-shallow biomimicry generally aims to make wider use of biology-based technologies in engineering and design and is based on the simple imitation of forms in nature. This approach allows to increase and diversify knowledge in certain areas (Benyus, 1997). However, this method does not take into account the deeper systemic processes of nature. Therefore, it does not focus on ecological sustainability. On the other hand, holistic biomimicry advocates adopting an ecologically sustainable and environmentally benign approach. In this approach, it is essential to fully mimic nature's ecosystems and processes, thus creating "eco-design". Holistic biomimicry aims to ensure that man-made products and processes work in harmony with nature and use the most efficient production methods without harming the environment. In between these two approaches is the imitation of natural processes. In nature, production processes work in the most energy-efficient way without harming the environment. For example, the development of self-opening and self-closing water bottle designs for cyclists inspired by the opening and closing mechanism of heart valves is an example of this intermediate level (Volstad and Boks, 2012). This intermediate level focuses on the design of environmentally friendly and efficient processes while producing practical solutions based on the workings of nature.

As Kennedy (2004) notes, environmentally friendly and sustainable designs can be developed by mimicking the way organisms and ecosystems in nature function. Nature uses only the energy that is necessary and prevents waste by optimizing this energy use. This provides an excellent model for energy efficiency. Nature develops form-fitting designs for functionality. Natural systems maintain ecological balance by developing mechanisms to control excesses within themselves. Organisms that tend to overgrow or spread are often controlled by limiting factors such as food, space or competition. For example, when a population grows excessively, it is stabilized by mechanisms such as reduced food resources, increased disease or predator pressure. Such internal regulation mechanisms help natural systems to persist sustainably, and biomimicry practices offer strategies to prevent excessive resource consumption or system imbalance.

Biomimicry is a scientific approach that examines the biological functions and strategies that living things in nature have developed to survive and applies this knowledge to the design of man-made products and processes (Biomimicry Institute, 2017). Biomimicry involves students directly in the making and engineering processes by using nature as a source of inspiration. In this context, by observing and analyzing nature, students have the opportunity to find solutions to environmental and technical problems facing humanity. The interdisciplinary nature of biomimicry enables students to integrate different scientific fields such as life sciences, chemistry, physics and engineering (Williams et al., 2019). Thus, they can not only learn about existing problems, but also actively participate in scientific thought processes in these fields by developing original solution strategies inspired by nature.

What is not Biomimicry?

Biomimicry, “bioinspired”, “biomimetic”, “biomimetic” or more rarely “bionic” (Aydın, 2023; Sharma and Sarkar, 2019). Although there is no functional difference between these terms, the term biomimicry is generally preferred in sustainable design solutions, while the term biomimetic is more frequently used in fields such as military technology (Badini et al., 2023). In order to better understand what biomimicry is, it is important to consider what is not biomimicry. Although many designs and visual examples inspired by nature are nature-based, they cannot be considered as biomimicry (Aydın, 2023). For example, brand logos, aesthetic designs that mimic nature, drones that look like insects, or nature-themed decorations on smartphone screens only use nature as a superficial source of inspiration rather than mimicking biological functions or processes. Biomimicry aims to deeply understand the principles of nature’s functioning and adaptation processes and integrate them into innovative solutions. In this context, biomimicry is a scientific approach that provides sustainable solutions to real-world problems by replicating functional and systematic processes in nature.

Although biomorphism and biomimicry refer to designs inspired by nature, they are different concepts. Biomorphism is the use of the form and aesthetic characteristics of living organisms in nature in design processes. In other words, the shape of a design may resemble a living creature in nature. However, this is only a visual similarity (Hanzad, 2019). Biomimicry is the development of man-made products by imitating the functional and structural characteristics of organisms in nature. This involves adapting the functional solutions developed by nature through evolutionary processes to engineering and technology. Biomorphism can be an inspiration for biomimicry. However, they are not the same thing. For example, the use of a bird’s aerodynamic wing structure in aircraft design is an example of biomimicry. Because here, an engineering solution is produced by taking into account its functionality and aerodynamic properties. In biomorphism, on the other hand, only formal similarity is taken as basis (Aydın, 2023).

Biophilic design is an approach based on the deep human connection to nature and the psychological and physical benefits of this connection. Biophilic refers to the innate human desire to connect with nature, which is internalized through evolutionary processes (Blair, 2009). This intrinsic need triggers people’s desire to be close to the natural environment. In this context, biophilic design tries to strengthen people’s connection with nature by incorporating the colors, patterns and materials of nature into architecture and interiors. The human desire to be close to natural stimuli such as animals, plants, water elements and seasonal changes is one of the basic principles of biophilic design. For example, the tranquility we feel when walking in a forest or our tendency to keep plants and animals in our homes is an indication of the ancient human connection with nature (Ernst, 2014). Biophilic design aims to support both the physical and mental health of individuals by integrating such natural elements into people’s living spaces. Thus, it is aimed to create healthier living spaces that are more integrated with nature instead of built environments isolated from nature (Aydın, 2023).

Bio-assisted technologies are a technological approach to the development of man-made products using biological systems, organisms and processes (Öztoprak, 2020). These technologies aim to optimize product design and manufacturing processes by taking advantage of the structural or functional properties of living organisms. In bio-assisted technologies, components derived from molecules, cells, tissues or biological processes are integrated to improve the performance, sustainability or function of products (Naveira et al., 2023). This approach can be extended to many areas of biotechnology. For example, products such as biosensors, biomaterials or biofuels are concrete applications of bioassisted technologies (Aydın, 2023).

Biorobotics is an interdisciplinary field that aims to design and develop robotic systems by mimicking the functional properties of biological systems (Erden et al., 2011). In this field, biological properties of living organisms, especially their movement and perception abilities, are used in the development of robots and robot-like devices. Examples of biorobotic applications include unmanned aerial vehicles (drones) that resemble the structural and movement characteristics of insects or birds. These drones mimic the efficient and aerodynamic designs of biological models (Aydın, 2023). Biorobotics has a similar approach to biomimicry, examining the functional mechanisms of organisms in nature and integrating them into engineering designs. However, unlike biomimicry, biorobotics does not attempt to produce an exact copy of a form found in nature. Instead, it models the basic functionality of biological systems for robotic solutions and develops these systems by adapting them for more advanced technological purposes.

Uses and Examples of Biomimicry

In the historical process, it has been documented that people have developed various tools and equipment by adapting the natural structures and living things they observe in their environment. This process shows that before the formal emergence of the biomimetic phenomenon, it was a common practice inspired by nature (Çakır, 2019). For example, the Romans developed defense mechanisms inspired by the durable outer shell of an animal called Armadillo. These defense systems were adapted to military equipment by imitating the flexible standard of the animal's shell. These examples show that sciences throughout history have been able to analyze biological forms and continuity in nature and adapt them to their own technological and rechargeable form. Thus, these early applications based on biomimetic principles guided their own innovations by observing the structures of organisms in human nature (Yılmaz, 2021).

Sevencan (2020) emphasizes that the main purpose of the tools and equipment that people have developed inspired by nature is to protect themselves from the threats they face in the natural environment and to maintain their way of life. In order to survive, humans have developed various defense and shelter systems to protect themselves from both animals and weather conditions (for example, cold and rain). Observing natural adaptation mechanisms, humans have aimed to make life more sustainable and safe by integrating this center in nature into technology and architecture.

Inspired by snails, the robotic swarm system offers a revolutionary innovation in terrestrial robotics thanks to its bimodal coupling mechanisms that mimic the biological characteristics of land snails. This system increases the adaptability and robustness of robots, enabling them to operate smoothly in different and challenging environments. The system uses two main modes. The first mode is the free motion mode in which the robots are equipped with magnet embedded rails. This mode allows the robots to quickly adapt to their environment and move freely. It is optimized for tasks that require high maneuverability. In more challenging conditions, for example on rough terrain or in bad weather, the robots switch to strong mode. This mode provides more robust connections using polymerized vacuum absorbers that mimic the sticky properties of snail feet. This creates a strong bond between robots in a swarm and increases the stability and durability of the overall system. The dual-mode capability allows robots to switch between fast and agile movements and strong and stable configurations as needed. This adaptive structure offers great advantages for a variety of applications in many fields such as environmental monitoring, agriculture, search and rescue (Figure 1).

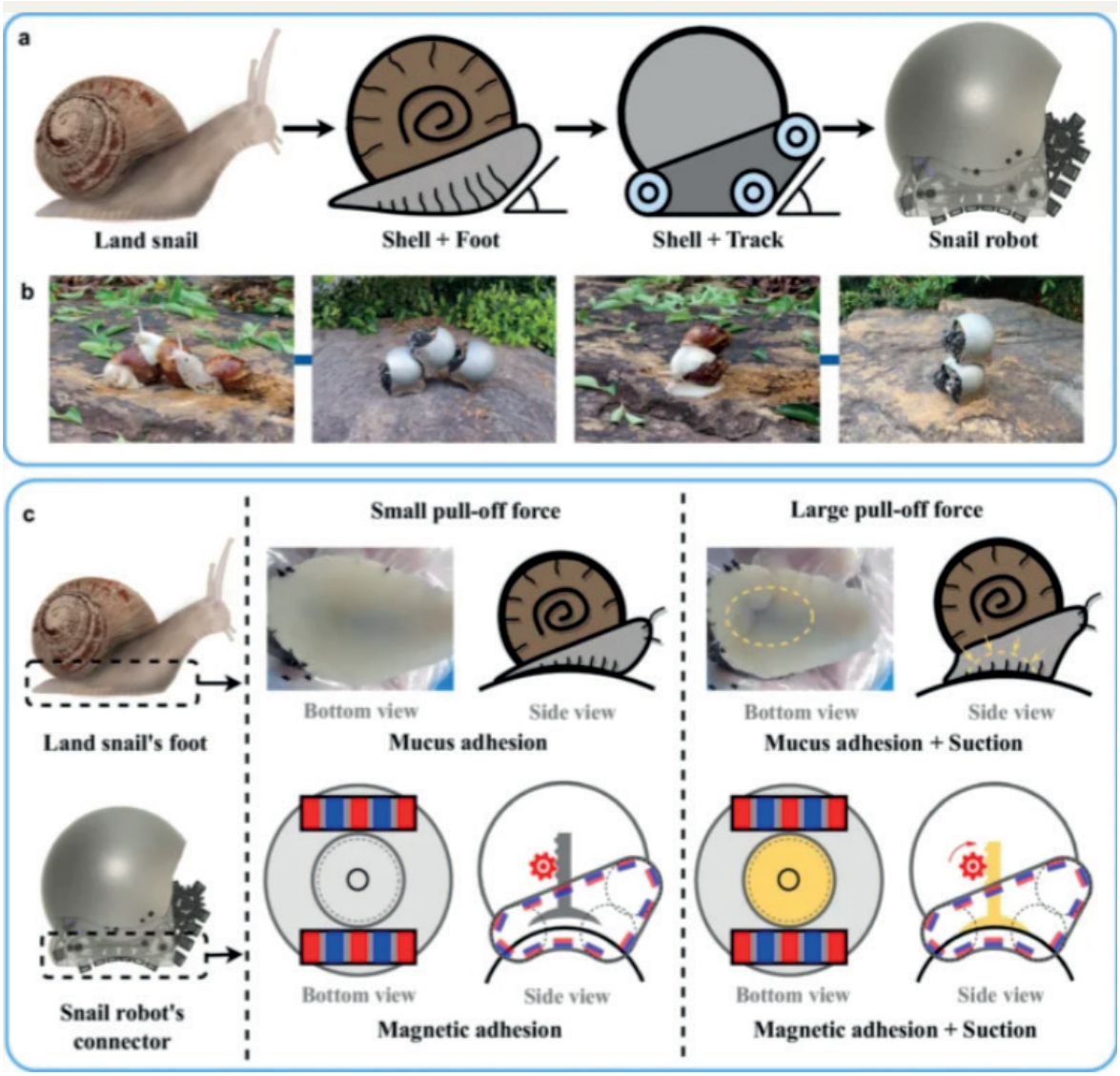

Figure 1. *Example of nature and Innovation*

Figure 2. *Ask nature (2021d)*

Plant reproduction is also a natural process that inspires biomimicry. Maple seeds, in particular, create a tornado-like vortex as they spin in the wind, and this aerodynamic structure allows them to generate more buoyancy than other seeds. Such natural mechanisms allow plants to spread their seeds over larger areas. While wind turbines play an important role in the production of environmentally friendly energy, their efficiency can be limited and costs can increase due to

shortcomings in their aerodynamic design. Biome Renewables has developed a device called "PowerCone" inspired by the aerodynamic structure of maple seeds. PowerCone is designed to improve the aeroacoustics of turbine blades and reduce turbulence. Placed in the center of the turbine, this device provides additional torque by directing the airflow more smoothly to the blades, thereby increasing the turbines' efficiency and electricity generation capacity. This biomimicry-based design aims to achieve sustainability and cost-effectiveness in energy production (Figure 2).

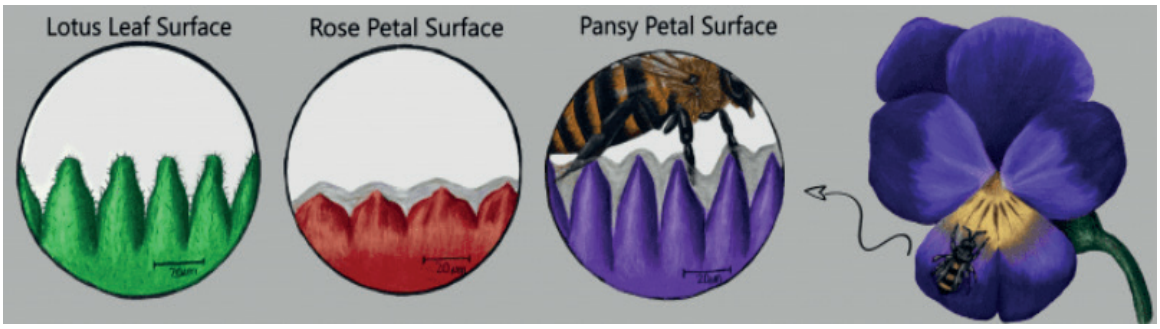

Figure 3. *Ask nature (2021d)*

The microscopic ridges on the surface of violet petals are unusually long and pointed, reaching a height of about 45 microns. This is about three times the height of rose petals with similar ridges. The ridges on both violet and rose petals have a wrinkled surface. In rose petals, these wrinkles allow water to penetrate these areas by capillary action, keeping the droplets stable on the surface and preventing them from rolling. On violet petals, the wrinkles are much narrower, which prevents water from entering these surfaces. In addition, the ridges on violet leaves have smaller tips and are located closer together than on rose and lotus leaves. This structure minimizes the contact area between the leaf and the water droplet and prevents water from settling on the surface, creating air bubbles. As a result, violet leaves are characterized by both enhanced hydrophobic properties and self-cleaning ability. This allows the leaf surface to remain clean without retaining water and dirt. However, it also provides a surface on which insects can attach (Figure 3).

Figure 4.*Ask nature (2021d)*

In the field of biomimicry, the similarity between the teeth and jaw structure of the American lion (Panthera atrox) can be considered as an important example of biomimicry in terms of biomechanics. The teeth and jaw structure of the American lion, especially the front teeth are

longer and sharper than the back teeth, providing a strong biting ability. These morphological features are important for the function of catching and tearing prey. The jaw joint supports the mobility of both the upper and lower jaws, giving the American lion a wide biting angle and helping it to hold the prey firmly. The staple remover mimics this mechanical structure. The two ends of the staple remover are designed to resemble the American lion's pointed and long front teeth. These ends grasp the staple and hold it firmly as the teeth do, and the upper and lower parts move with a mechanism similar to a jaw joint to remove the staple. This structure effectively combines both strength and mobility. Kuday (2009) states that this similarity is an important example of how biomimicry works. The functional features of the jaws and teeth of the American lion inspired the design of a simple engineering tool such as a staple remover.

Biomimicry and Science Education

Research on the integration of biomimicry in science education programs is limited (Fried et al., 2020; Canbazoğlu Bilici et al., 2021; Yao et al., 2020; Gencer et al., 2020). However, biomimicry is considered as an important approach in the context of STEM (Science, Technology, Engineering and Mathematics) education. Biomimicry is a natural fit with STEM education as it involves thinking and design processes inspired by nature. STEM education brings together disciplines such as science, technology, engineering and mathematics through engineering design processes. This process aims to develop students' understanding of fundamental concepts as well as 21st century skills such as critical thinking, problem solving, creativity and collaboration. Biomimicry contributes to enriching these processes in science education. Because by examining the structures and processes in nature, students can make innovative designs and produce sustainable solutions to engineering problems. This understanding was defined as a core component of STEM education in the Next Generation Science Standards (NGSS) adopted in the United States in 2012 (Bybee, 2019). The NGSS provide a framework that promotes interdisciplinary learning while developing students' scientific knowledge and skills. Within this framework, biomimicry is seen as a powerful tool that combines science and engineering education with nature-based innovative thinking (Kaya, 2022).

In the 21st century, revising curricula to adapt to rapid changes in science and technology has become an important field of study (Başar & Demiral, 2019). Biomimicry is also defined as biotechnology applications and these two terms are often used interchangeably during studies. Biomimicry is based on the process of developing products by observing and imitating the structures and processes of organisms. This process consists of two basic stages. The first is the careful observation of nature and the second is the transformation of the information obtained from these observations into design (Yıldırım, 2019). Since natural sciences are accepted as a reflection of the functioning of nature, integrating the biomimicry approach into science education should include design studies inspired by nature. Understanding science necessitates understanding nature. Therefore, designing new products inspired by nature has a critical role in providing students with science and technology literacy. In this context, solving technology-based problems in the 21st century requires an interdisciplinary approach such as biomimicry.

The 2005 science and technology curriculum was prepared based on the constructivist approach, but practical difficulties such as lack of time were encountered during the implementation process. While this program aimed to ensure students' active participation in knowledge, it could not be fully efficient due to time constraints in classroom practices (Bakaç, 2019). In the program updates made in 2013, 2018 and 2024, a research and inquiry-based approach was adopted. These new approaches focused on learning processes that would enable students to understand and explain the natural and physical world. The 2018 science curriculum aims to emphasize applications of scientific knowledge. The program aims to provide students with the ability to use scientific knowledge in practice rather than theoretical knowledge. In addition, students are encouraged to integrate their scientific studies with engineering processes and to address the economic aspects

of these studies. At the end of the academic year, students are expected to exhibit what they have learned and the projects they have developed in this process at events such as science festivals (Bakaç, 2019). This approach aims to enable students to produce creative solutions with scientific knowledge and to understand the relationship between science and engineering.

In the 2013 science curriculum, goals such as understanding nature, developing scientific process skills, gaining awareness of sustainable development, understanding and exploring the nature of science were prioritized (Başar & Demiral, 2019). These objectives are also included in the 2018 science curriculum. However, the 2018 program focused more on scientific and technological developments and added new fields such as engineering and entrepreneurship to science. In the 2013 curriculum, there was no emphasis on the STEM approach, while in the 2017 curriculum, a "Science and Engineering Practices" section was added. In 2018, this section was expanded and an area called "Science, Engineering and Entrepreneurship Practices" was created. These developments aim to help students relate the subjects they learn in science courses to daily life, improve their problem-solving skills and design creative products for the problems they face. These changes add engineering and entrepreneurship dimensions to science education and aim to provide students with a more hands-on, interdisciplinary and solution-oriented learning experience (Başar & Demiral, 2019).

Starting in 2004, the vision of science and technology literacy continued with the 2013 Science curriculum and was updated in 2024. The 2018 and 2024 Science curricula aimed to develop students' interdisciplinary thinking skills by emphasizing science, engineering and entrepreneurship practices in the context of STEM (MoNE, 2018). With this curriculum, it is aimed for students to be able to produce solutions to the problems they face, organize information and apply the knowledge they have acquired across different disciplines. STEM applications based on biomimicry in "Physical Phenomena," "The World and the Universe," "Living Things and Life," and "Matter and its Nature," which are included in the knowledge stages of the science curriculum, enable students to develop problem-solving skills by imitating the processes and functions in nature. Integrating biomimicry into science teaching in this way allowed students to be inspired by nature for problems they may encounter in daily life or problems they may encounter in the future. The combination of STEM and biomimicry makes science education more applied, innovative and oriented towards producing sustainable solutions (Aydın, 2023).

The Place of Biomimicry in Science Education

Integrating biomimicry into education requires an inquiry into how nature solves the problems faced by humans. In order to improve students' problem solving skills, it is important to take nature's solutions to challenges in areas such as energy, nutrition, shelter and social interaction as a model (Aydın, 2023). Seeing nature as a "teacher" and integrating this perspective into science education is possible through a planned and structured biomimicry education. This educational approach allows students to produce innovative solutions inspired by nature (Rowland, 2017).

Biomimicry provides students with different perspectives as an educational approach that develops sustainability and creative thinking skills. Students seek answers to the question "how would nature find a solution to this problem?" by examining the solutions that exist in nature (Aydın, 2023). Thus, they learn the mechanisms in nature and use them in problem solving. In this process, they understand how nature inspires innovative and sustainable designs (Biomimicry Instute, 2006a). Students obtain scientific findings as a result of these observations and reinforce their scientific thinking skills by questioning these findings in a cause-effect relationship (Boga & Timur, 2016).

Biomimicry is a concept related to the discovery of wonders in nature and teaching this concept to students in primary school years can help them recognize nature, increase their awareness

and develop their creativity (Aydın, 2023). At the high school level, teaching biomimicry through integrated projects through biology, environmental science and art courses can help students better understand nature, improve their design skills and produce sustainable solutions. In this way, biomimicry education can be integrated into education programs at primary and high school levels and contribute to students' better understanding of both nature and the design process (Silveira & Mburu, 2023).

Science Education Activities Based on Biomimicry

Today, rapidly advancing science and technology require individuals to develop the skills to adapt to and contribute to these innovations. In this context, various teaching methods and techniques are used in schools to effectively transfer increasing information density to individuals. The science of biomimicry is an approach that aims to develop man-made products inspired by living and non-living things in nature. There are two basic steps in the implementation of this process (Avcı, 2019). The first is the observation of nature and the second is the integration of the information obtained from these observations into design processes (Alawad & Mahgoup, 2014). This approach can be applied in schools with various methods and adapted to different fields. The systematic process used in biomimicry design studies consists of the following steps:

1. Exploring Models in Nature (Exploration Phase): Students discover patterns in nature by examining the structures and behaviors of organisms in nature. At this stage, the functioning of natural systems is observed.
2. Abstraction of Biological Principles: The biological functions of these models observed in nature are abstracted through different disciplines and their scientific foundations are revealed. At this stage, it is aimed to understand how biological principles work and to transfer these principles to design.
3. Determining Which Problems the Solution Responds to: It is detailed in which areas the designed solution will bring innovation and which problems it can solve. This stage is critical in terms of determining the functionality and application areas of the design.
4. Imitating Nature's Strategy: The solutions reached are developed within the framework of sustainability principles, taking into account the strategies of nature. By imitating the solutions found by living creatures in nature to the problems they face, an environmentally compatible and sustainable product design is realized.
5. Evaluating the Solution with the Principles of Life: Finally, the solutions developed are evaluated according to the basic principles of life. At this stage, the long-term effects of the solution are examined by taking into account the sustainability, efficiency and adaptation strategies offered by nature (Avcı, 2019).

The biomimicry design process does not end after the completion of the stages listed. On the contrary, an important process of questioning and thinking awaits students after this point. At this stage, the rough version of the solution developed for the current problem should be reflected upon and further improvements should be made. This refinement process involves elaborating the solution and identifying more specific questions. The process cannot be completed without considering sustainability aspects such as environmental compatibility of the design, material and energy conservation. Students should focus on these aspects of the design and try to develop more efficient and environmentally friendly solutions. Successful completion of the design process is possible by producing detailed and feasible solutions that are compatible with sustainability principles.

In the study conducted by Velioğlu and Yakışan (2019), it was examined that 4th grade primary school students developed biomimicry designs inspired by the characteristics of animals. This process involves students creating innovative technological product designs by utilizing the different characteristics of various animal species during a lesson period. The researchers analyzed

the drawings created by the students to determine how these designs were influenced by the geographical environment and socialization environments. In particular, it was found that the war-themed content that students were exposed to through computer games and media had a significant impact on the design process. According to the results of the research, the technological products designed by the students are mostly for war and defense technologies. This draws attention to the importance of integrating the biomimicry design process into education. Biomimicry is an approach that encourages the process of learning from nature in order to understand the functioning of nature and use this knowledge to develop innovative designs. As emphasized by Arhon (2017), this process requires learning and interpretation by expanding the perspective on nature. This study provides a concrete example of how the concept of biomimicry can be applied in education and is an important sign for the development of educational programs in this context.

The study conducted by Sumrall, Sumrall, and Robinson (2018) focused on a classroom practice for first-year students' understanding of the concept of biomimicry. This study was carried out by using cooperative learning methods in groups of four. First, students were introduced to various specific examples of biomimicry. This process encouraged students to create creative camouflage designs inspired by nature. The research aimed to increase group interaction and communication by having students present their designs to their classmates. The results show the importance of integrating biomimicry designs into education by emphasizing the inspirational role of nature in student learning processes.

Çoban (2019) aimed to integrate the concept of biomimicry in the context of science education for fifth grade students and to examine the results of this application. At the beginning of the research process, it was aimed to improve students› ability to observe organisms. These observation activities contributed to the development of scientific thinking and analytical skills by providing students with the opportunity to make connections between the structures and functions of organisms. In the later stages of the study, students were asked to design creative products inspired by various organisms through drawing and modeling. The results revealed that students adopted different approaches in the modeling process. While some students tended to design by directly imitating the structures of organisms, other students developed more functional and innovative designs by focusing on their functional features. These findings emphasize the role of biomimicry practices in education and show how students can be inspired by natural organisms to produce creative and functional solutions. It also provides an important contribution to the effectiveness of biomimicry-themed teaching methods in science education by examining the interaction of students› scientific observation skills and creative thinking skills.

Sanne et al. (2019) aimed to teach middle school students how the concept of biomimicry can bridge the disciplines of biology and engineering and encourage mathematical thinking in this context. The researchers designed an instructional activity to develop students' understanding of biomimicry and used the pretest control group model in this activity. The activities developed in the implementation phase of the study were carried out in a modular manner in the laboratory environment. This modular structure allowed students to grasp the relationships between various disciplines and gain hands-on learning experiences. The results of the study show that students were able to effectively learn the intersection of engineering, mathematics and biomimicry concepts. In conclusion, this study reveals that biomimicry-themed teaching activities can contribute to students' development of a deeper understanding of STEM fields through an interdisciplinary approach. This emphasizes the importance of integrating biomimicry into the education curriculum and provides students with the skills to make connections between concepts in various fields.

The study by Han et al. (2020) aims to examine the effectiveness of a teacher professional development program using the STEAM (Science, Technology, Engineering, Arts and Mathematics) education model for science teachers with two years of experience. The study was conducted using case study methodology and teachers were provided with an overview of

pedagogical approaches to science and engineering technologies. The study focused on science and technology teaching competencies and beliefs to examine changes in teachers' self-efficacy. At the end of the training program, science teachers became more active in science practices such as data collection and observation during the implementation process. In this process, teachers were able to better recognize the problems in their environment and increase their competence in solving these problems with the knowledge they gained. These findings reveal the positive effects of the STEAM model on teacher professional development and show that teachers' pedagogical competencies as well as their problem solving skills have improved. By emphasizing the impact of applications in education, the study reveals the contributions of science teachers to the educational processes and the importance of such programs. They provided teachers with an overview of pedagogical approaches to science and engineering technology in education. They also tried to focus on science and technology teaching competence and beliefs to investigate the change in teachers' self-efficacy. As a result of the study, science teachers reported that with this program, they were now able to recognize problems around them and solve problems with the knowledge they gained while engaging in science practices, including data collection and observation in the field.

Biomimicry-based design studies provide versatile gains in educational environments by increasing students' interest in nature (Yıldırım, 2019). Such studies support engineering process skills and enable the emergence of original and innovative products. Students are expected to consider criteria such as realism, economic efficiency, functionality and durability while developing their designs in the process of biomimicry applications (Aydın, 2023). This contributes to the development of multidimensional thinking, planning and problem solving skills in design processes. Biomimicry studies enable students to interact directly with nature by taking the learning environment beyond the classroom walls and to produce creative solutions to solve the problems they encounter in the concrete world (Alemdar et al., 2021). This process supports project-based learning approaches by allowing students to use their innate creativity potential and develop visionary perspectives. Students who learn to develop environmentally friendly technologies inspired by nature also increase their sensitivity to social and environmental problems and adopt an understanding of sustainability. Eryılmaz (2015) emphasized the importance of ergonomics and user-friendly features in biomimicry-based designs. As a result, biomimicry studies stand out as an important educational method that develops students' design and engineering skills at both individual and social levels with a holistic approach. Incorporating biomimicry into the science education curriculum can provide multifaceted benefits to students.

References

Alawad, A. A., & Mahgoub, Y. M. (2014, April). The impact of teaching biomimicry to enhance thinking skills for students of art education in higher education. In *International Teacher Education Conference* (pp. 263-268).

Alemdar, M., Ehsan, H., Cappelli, C., Kim, E., Moore, R., Helms, M., ... & Weissburg, M. (2021, July). Biologically inspired design for engineering education: Online teacher professional learning (Evaluation). In *American Society of Engineering Education*.

Arhon, Z. (2017). Biyomimikri: Sürdürülebilirlik için doğadan gelen inovasyon. Erişim Adresi: https://www.calik.com/Home/DownloadMagazine?id=8038 (25 10 2024).

Ask nature. (2021b). Retrofit for Wind Turbines Inspired by the Kingfisher and Maple Seeds. Retrieved 18.10.2024 from https://asknature.org/innovation/energy-saving-retrofitfor-wind-turbines-inspired-by-the-kingfisher-and-maple-seeds/

Avcı, F. (2019). Nature and innovation: Biomimicry in schools, Anadolu Öğretmen Dergisi, 3(2),

214-233, DOI: 10.35346/aod.604872

Aydın, B., (2023). "The effect of biomimicry teaching approach in science education on students' 21st century skills and creativity". Unpublished Doctoral Thesis. Hacettepe University. Ankara

Badini, S., Regondi, S., & Pugliese, R. (2023). Unleashing the power of artificial intelligence in materials design. *Materials*, *16*(17), 5927.

Bakaç, E. (2019). Comparison of 2005 science and technology curriculum, 2013 and 2018 science course curriculums: 2005 fen ve teknoloji dersi öğretim programı, 2013 ve 2018 fen bilimleri dersi öğretim programlarının karşılaştırılması. *Journal of Human Sciences*, *16*(3), 857-870.

Başar, T., & Demiral, Ü. (2019). Comparison of 2013, 2017 and 2018 science curricula. Journal of Uludağ University Faculty of Education, 33(1), 261-292.

Benyus, J. (1997). *Innovation inspired by nature: biomimicry*. New York: William Morrow & Co.

Biomimicry Institute. (2017). Sharing biomimicry with young people an orientation for k-12 teachers. Biomimicry.or

Biomimicry Instute. (2006a). MIMIC Instructional Framework. E.T. 15.10.2024 https://biomimicry.org/

Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school gardening. *The journal of environmental education*, *40*(2), 15-38.

Boga, M. A., & Timur, S. O. (2016). Exploring Biomimicry in the Students' Design Process. Design and Technology Education: An International Journal, 21-31.

Bybee, R. W. (2019). Using the BSCS 5E instructional model to introduce STEM disciplines. *Science and Children*, *56*(6), 8-12.

Canbazoğlu Bilici, S., Küpeli, M. A., & Guzey, S. S. (2021). Inspired by nature: An engineering design-based biomimicry activity. *Science Activities*, *58*(2), 77-88.

Çakır. A., (2019). Biology teacher candidates› awareness of biomimicry. Published Master›s Thesis. Gazi University Ankara

Çoban, M. (2019). Integration of biomimicry into science education. Unpublished Master›s Thesis, Yıldız Technical University, Science Education, Istanbul, Turkey, 146 pp.

Erden, Z., Eroğlu, A. K., & Erden, A. (2011). Behavior-based modeling approach in conceptual mechatronic design and its application to biosimulation robot design. Engineer & the Machinery Magazine, (618).

Ernst, J. (2014). Early childhood educators' use of natural outdoor settings as learning environments: an exploratory study of beliefs, practices, and barriers. *Environmental Education Research*, *20*(6), 735-752.

Eryılmaz, H. (2015). Biomimicry and Ergonomics: Innovative Inspiration from Nature in Design. Journal of Engineering Sciences and Design, 3(3), 469-474.

Fried, E., Martin, A., Esler, A., Tran, A., & Corwin, L. (2020). Design-based learning for a

sustainable future: student outcomes resulting from a biomimicry curriculum in an evolution course. Evolution: *Education and Outreach,* 13(1), 22. https://doi.org/10.1186/s12052-020-00136-6.

Gencer, A. S., Doğan, H., & Bilen, K. (2020). Developing Biomimicry STEM Activity By Querying The Relationship Between Structure And Function In Organisms. *Turkish Journal of Education*, 9(1), 64-105. https://doi.org/10.19128/turje.643785.

Han, J., Holland, J., Kelley, T. and Konowles, J. G. (2020). Increasing high school teachers' self-efficardy for integrated STEM instruction through a collaborative community of practice. *Internetional Journal of STEM Education*, 7(14), 2–13.

Hanzad, M. (2019). Bio Design Method; Learning Nature In Line With Technology. *JENAS Journal of Environmental and Natural Studies*, 1(1), 11-18.

Karabetça, A. R. (2018). Creating innovative spaces with biomimicry-supported design criteria. Turkish Online Journal of Design Art and Communication, 8(1), 104-111.

Kaya, Ş., (2022). Investigation of the effect of activities prepared for stem education using biomimicry applications on the environmental literacy skills of prospective science teachers. Unpublished Master's Thesis. Cukurova University. Adana.

Kennedy, S. (2004). Biomimicry/biomimetics: General Principles and Practical Examples. The Science Creative Quarterly. http://www.scq.ubc.ca/biomimicrybimimeticsgeneral-principles-and-practicalexamples/ adresinden erişilmiştir. E.T. 24.10.2024

Kuday, I. (2009). *Examination of the term biomimicry as a supporting factor in design process.* Master's Thesis, Mimar Sinan Fine Arts University, Institute of Natural and Applied Sciences, Istanbul.

MONE. (2018). Science curriculum (Primary and Secondary School Grades 3, 4, 5, 6, 7, and 8). Ankara.

Naveira, P. E., Lorite, I. M. C., Robles, D. C., Garrido, A. C., Ramos, E. E., García, F. J. G., & López, Á. B. (2023). Controversy mapping approach to address socially live issues from science and technology education. Eureka Journal on Science Education and Outreach, 20(3), 1-19.

Öztoprak, Z. (2020). Rethinking the city with the principles of life: A biomimicry-based approach. Idealkent, 11(Special Issue on Urbanization and Economy), 1180-1204.

Rowland, R. (2017). Biomimicry step-by-step. *Bioinspired, Biomimetic and Nanobiomaterials*, *6*(2), 102-112.

Sanne, F., Risheim, I., & Impelluso, T. J. (2019, November). Inspiring Engineering in the K12: Biomimicry as a Bridge between Math and Biology. In *ASME international mechanical engineering congress and exposition* (Vol. 59421, p. V005T07A015). American Society of Mechanical Engineers.

Sevencan, H. (2020). Tekstil ve giysi tasariminda biyomimetik uygulamalari. *Uluslararası Disiplinlerarası ve Kültürlerarası Sanat*, *5*(10), 101-118.

Sharma, S., & Sarkar, P. (2019). Biomimicry: Exploring Research, Challenges, Gaps, and Tools. Research into Design for a Connected World, Singapore

Silveira, V., & Mburu, P. K. (2023, October). Promoting Creativity in the Secondary Design and Technology Classroom in England. In *The 40th International Pupils' Attitudes Towards Technology Conference Proceedings 2023* (Vol. 1, No. October).

Sumrall, W. J., Sumrall, K. M., & Robinson, H. A. (2018). Using biomimicry to meet NGSS in the lower grades. *Science Activities*, *55*(3-4), 115-126.

Rabbit. G., (2022). Awareness of prospective science teachers about the concept of biomimicry. Unpublished Master's Thesis. Recep Tayyip Erdoğan University. Rize

Velioğlu, D., & Yakışan, M. (2019). Analysis of primary school 4th grade students' drawings about their perceptions of biomimicry. Gazi University Journal of Faculty of Education, 39(2), 727-753.

Volstad, N. L., & Boks, C. (2012). On the use of Biomimicry as a Useful Tool for the Industrial Designer. 20(3), 189-199. https://doi.org/https://doi.org/10.1002/sd.1535

Williams, D., Barber, A., & Sheppard, P. (2019, March). Making Inspired by Nature: Engaging preservice elementary teachers and children in maker-centered learning and biomimicry. In *Society for Information Technology & Teacher Education International Conference* (pp. 1660-1665). Association for the Advancement of Computing in Education (AACE).

Yao, Y., Zhao, T. Y., Machado, C., Feldman, E., Patankar, N. A., & Park, K.C. (2020). Frostfree zone on macrotextured surfaces. 117(12), 6323-6329. https://doi.org/doi:10.1073/pnas.1915959117.

Yıldırım, B. (2019). Pre-service science teachers' views on biomimicry applications in STEM education. Gazi University Gazi Faculty of Education Journal, 39(1), 63-90.

Yılmaz, T. Ş. (2021). Investigation of biomimicry approach in the process of producing form in architecture (Master's thesis, Konya Technical University).

About the Authors

Ayşegül TONGAL is a PhD in Science Education from Akdeniz University. Her main areas of interest are artificial intelligence and science education applications.

E-mail: tongalaysegul@gmail.com, **ORCID:** 0000-0002-4340-8423.

Fatih Serdar YILDIRIM is an Associate Professor at Akdeniz University, Faculty of Education, Department of Mathematics and Science Education, Department of Science Education. She holds a PhD degree in Biology Education from Gazi University. His main areas of interest are artificial intelligence, social sciences and humanities, education, science education, life sciences, environmental biology, environmental pollution, basic sciences and augmented reality applications.

E-mail: fsyildirim@akdeniz.edu.tr, **ORCID:** 0000-0003-4080-8488.

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 5%.

To Cite This Chapter:

Tongal, A., & Yıldırım, F. S. (2024). Biomimicry in science education. In S.A. Kiray & O. Cardak (Eds), *Current Studies in Social Sciences 2024* (pp152-166). ISRES Publishing

Section 6.

Language and Literature

Active Learning in English Language Teaching: Bridging Theory and Practice

Cavide DEMİRCİ

Eskişehir Osmangazi University

Kamil YAR

Eskişehir Osmangazi University

Introduction

Learning is the process through which individuals acquire new understanding, knowledge, behaviours, skills, values, and preferences. Brown (2000) posits that learning encompasses the acquisition of information pertaining to a subject or skill through various means, including study, experience, or instruction. Thus, learning can be defined functionally as behavioural changes that result from experience or, mechanistically, as alterations in an organism attributable to experiential factors and can be conceptualized as the process of acquiring knowledge, enhancing that knowledge, and personally engaging with it.

Language serves as our principal mode of communication, enabling us to convey our ideas, emotions, opinions, and thoughts to others. It is a fundamental aspect that distinguishes humans from animals and defines our humanity. Globally, there are thousands of languages, with each nation typically having its own official language, alongside numerous regional languages. Some languages are spoken by millions, while others have a speaker base of only a few thousand. In today's globalized context, the significance of English is undeniable, as it stands as the most widely spoken universal language, with approximately 1.5 billion speakers (Zeidan, 2023). While this study accounts for total speakers rather than exclusively native speakers, it underscores the critical importance of English proficiency for effective communication.

Many students struggle to achieve fluency or mastery in English, which impedes their overall learning progress. Frequently, students study English primarily to pass examinations, resulting in difficulties in constructing grammatically correct sentences. Additionally, they often lack sufficient practice to learn the language effectively. However, proficiency in English is crucial for success in contemporary society, serving as an essential gateway to numerous opportunities, particularly in developed nations that seek technically skilled individuals and favour candidates who demonstrate English proficiency (Nishanthi, 2018). The primary objective of language teaching and learning must be to cultivate the four essential language skills alongside a comprehensive understanding of grammar and a wide memorization of lexical items. Ultimately, the primary objective is to enable learners to use the language effectively and communicatively across diverse contexts. Throughout the history of language teaching, numerous approaches have been proposed by linguists and educators to address the needs of students, let them master on essential language skills and adapt to the demands of their respective eras. However, only a select few have demonstrated sustained continuity and effectiveness within the English education process. These approaches evolve over time, often transforming into new forms or being entirely replaced in response to the shortcomings of their predecessors. Instead of examining each of these notable approaches individually, it is more beneficial to categorize them according to distinct stages. Before exploring active learning strategies, it is essential for educators to be familiar with the various approaches utilized in English language education over time.

The first phase of English Language Teaching (ELT) was marked by a diverse array of instructional approaches and methods, including the Grammar-Translation Method (GTM), the Direct Method (DM), the Audio-Lingual Method (ALM), the Community Language Teaching Approach (CLT), and the Total Physical Response Approach (TPR). Among these approaches, the Grammar-Translation Method (GTM) emerged in Germany in the late 1700s and maintained its dominance until the 1940s, despite later criticism for its primary focus on grammar and translation models. In addition to the Audio-Lingual Method (ALM), which is rooted in behaviourism and emphasizes the mechanical repetition of everyday language, various other methods continue to be employed, either individually or in an integrated manner.

The second phase introduced a modern approach tailored to contemporary ELT demands, equipping language learners with the skills necessary to effectively apply classroom language in real-world contexts. This approach is termed the Communicative Approach, being divided into two sub-categories: Content-Based Language Teaching and Task-Based Language Teaching (Larsen-Freeman & Anderson, 2011). This method has facilitated a transition in the teaching process from a model of absolute teacher authority to one that is more innovative and centred on student engagement. While it is not entirely accurate to characterize earlier approaches as wholly teacher-centred, subsequent discussions will demonstrate that no singular method has proven fully adequate or fully embraced a student-centred paradigm. This evolution has led to the emergence of a third phase of educational approaches. The third phase, known as the post-method period, emerged from the critique that no single method can be perfect on its own, and that each may offer advantages in specific contexts. Prabhu (1990), a noted expert in second language teaching, contended that different teaching environments necessitate different methods, that each method possesses some degree of validity, and that no method can be universally adequate.

Applying methods and strategies in a versatile manner and fostering a learning environment that addresses both the academic and social needs of students has become increasingly important in contemporary education. In response to the demands of contemporary society, students today are more proactive, innovative, and self-directed in their academic and social decision-making than those educated in traditional systems. This societal shift has inevitably influenced the educational process. Consequently, we can explore the concept of active learning, including its components, strategies, and application areas, which advocate for the integration of diverse methods and the active participation of students in the educational experience. Integrating these approaches with active learning strategies when appropriate can enhance the effectiveness of instruction and support student engagement. Khamwan (2007) discovered that following utilization of interactional strategies as mechanisms for initiating dialogue, students' responses to the teacher's inquiries became longer and more substantive. Additionally, the average frequency of interaction turns was approximately two turns every three minutes. This training appeared to enhance students' comprehension of the lesson, enabling them to seek clarification from the teacher when faced with difficulties. Furthermore, a greater number of students were able to engage in responding to the teacher's questions.

In contemporary educational discourse, there is a consensus among many educators that students achieve more effective learning outcomes within an interactive and active learning environment. The roots of utilizing active learning to enhance critical thinking can be traced back to Socratic methods, which emphasized reflective thinking using provocative questioning. Socratic questioning serves as a strategic approach to engage students in active learning and to nurture critical thinking abilities.

This chapter aims to address the active learning methodology, its applications in both in-class and online educational settings, as well as the potential challenges that may arise during the implementation of active learning practices.

Active Learning

Active learning is often defined in opposition to passive learning. Perspectives in the field assert that mere participation in class and rote memorization do not foster meaningful learning. Instead, they advocate that students should engage in discussions, write about their learning, and connect new knowledge to their personal experiences, which forms the foundation of active learning (Chickering & Gamson, 1991). Effective teaching involves actively involving students in the learning process by encouraging them to think critically, pose questions, share their experiences, analyse information, and conduct research (Park, 2003). Such active learner participation fosters a collaborative educational environment among students. Employing various educational strategies, such as collaborative learning and problem-solving-oriented learning, enhances student involvement and creates an optimal environment for effective learning (Prince & Felder, 2007). Active learning encompasses a range of methodologies, including experiential learning, hands-on activities, service learning, peer education, laboratory experiments, role-playing, and case studies. It embodies concepts such as "dynamic," "student-centred," and "participatory learning," wherein students actively engage with content to develop understanding (O'loughlin, 1992; Chi, 2009). These methodologies align with the principles of active learning and represent a significant component of contemporary pedagogical frameworks.

Various studies characterize active learning as any educational activity that necessitates student participation, extending beyond passive observation, listening, or note-taking to include interactive elements such as discussions and problem-solving (Felder & Brent, 2009). This broad definition highlights that active learning is not merely a theoretical construct, but a practical pedagogical approach designed to enhance the learning process. Active learning methodologies emphasize activities such as reflective writing, group discussions, and collaborative problem-solving, all of which are integral to cultivating critical thinking skills among students. By focusing on skill development rather than merely the transfer of knowledge, active learning techniques provide a comprehensive educational experience. This approach encourages students to engage deeply with the material, fostering an environment where they can reflect on their own attitudes and values. By prioritizing participation and engagement, active learning transforms the classroom dynamic into a collaborative space where students are motivated to take ownership of their learning. This shift not only enhances their understanding of the subject matter but also equips them with essential skills that are applicable beyond the classroom, preparing them for real-world challenges and promoting lifelong learning.

Educational activities transcend the mere transmission of knowledge to students; they are viewed as a complex process that enables learners to effectively synthesize information, understand concepts, guide their thinking, and develop their own cognitive frameworks. Within this pedagogical context, teachers adopt diverse roles, including that of educator, facilitator, communicator, and manager, thereby moving away from the traditional role of mere knowledge transmitter (Dirsa et al., 2022). This transformative approach necessitates heightened student participation and engagement. 'Active engagement' can be defined as participating in activities that often involve physical movement during the learning process. For instance, in a virtual environment, if students navigate the space by pedalling a stationary bike while exploring, this would be classified as an active learning activity (Tong, et al., 1995).

The term 'passive engagement', in contrast, refers to a learning approach where students adopt a primarily receptive role in the classroom. For instance, when students are not encouraged by the teacher to explore topics independently, and engage in the learning process without questioning, applying, or producing knowledge within a teacher-centred framework, these can be identified as examples of passive learning styles.

Active learning is conceptually grounded in constructivist learning theories. Constructivism posits that individuals construct knowledge by integrating new ideas and experiences with their prior understandings, thereby fostering the development of deeper comprehension (Bransford et al., 2000). This theoretical framework emphasizes the importance of achieving profound understanding among students rather than focusing solely on rote memorization. However, delineating the components of effective constructivist teaching presents challenges, as constructivism is primarily a theory of learning rather than a prescriptive theory of instruction (Richardson, 2003). While active learning serves as an instructional strategy designed to facilitate constructivist learning by promoting self-directed knowledge construction and encouraging student responsibility for learning outcomes, interventions aligned with constructivist principles may still fall short. They might not adequately elicit and utilize prior knowledge, integrate existing and new knowledge, or stimulate reflective processes, making active learning not only transcend a mere student participation; but also necessitate structured guidance and oversight from educators to fulfil its objectives effectively and enhance student engagement.

The learning outcomes associated with constructive activities should ideally exceed those of merely active activities, as constructive tasks engage learners more deeply and promote higher-order thinking skills. A relevant example illustrating this distinction comes from a study by Kastens and Liben (2007), which compared two conditions involving fourth-grade students. In the explanatory condition, students were tasked with writing down and articulating the clues they used during a field-based map skills activity. In contrast, the baseline condition involved students merely placing flag stickers on a model map, corresponding to pre-placed flags, without any explanatory component. The results indicated that students engaged in the explanatory task demonstrated significantly better performance in map skills assessments compared to those who only placed flags without providing explanations. This finding underscores the importance of incorporating constructive activities into educational practices, as they not only facilitate knowledge acquisition but also foster critical thinking and problem-solving skills. By requiring students to articulate their reasoning, constructive activities lead to a more meaningful understanding of the material. These findings suggest that educators should design learning experiences that promote reflection and explanation rather than merely participation. Integrating constructive tasks can enhance learning outcomes and equip students with essential cognitive skills necessary for success in both academic and personal contexts.

In her study, Chi (2009) studied on numerous examples of overt constructive activities that have been investigated in addition to self-explaining. These include drawing concept maps (Biswas et al., 2005), asking questions (Graesser & Person, 1994), posing problems (Mestre, 2001), and comparing and contrasting cases (Schwartz & Bransford, 1998). Other activities encompass integrating text and diagrams or multimedia resources (Bodemer et al., 2004), inducing hypotheses (Suthers & Hundhausen, 2003), drawing analogies (Chinn & Malhotra, 2002), generating predictions (Klahr & Nigam, 2004), and engaging in reflection and self-monitoring of one's understanding, along with other self-regulatory activities (Azevedo et al., 2006). In her study, Chi (2009) categorized student activities into three distinct groups based on their perspectives: active, constructivist, and interactional activities.

Table 1. *Characteristics, overt activities, and cognitive processes, for active, constructive, and interactive activities, from the learner's perspective*

	Active	**Constructive**	**Interactive**
Characteristics	Doing something physically	Producing outputs that contain ideas that go beyond the presented information	Dialoguing substantively on the same topic, and not ignoring a partner's contributions
Overt Activities	Engaging Activities Look, gaze, or fixate Underline or highlight, Gesture or point, Paraphrase, Manipulate objects or tapes, Select, Repeat	Self-construction Activities Explain or elaborate Justify or provide reasons Connect or link Construct a concept map, Reflect, or self-monitor, Plan and predict outcomes, Generate hypotheses	Guided construction Activities in Instructional Dialogue: Respond to scaffoldings Revise errors from feedback Sequential or Co-construction Activities in Joint Dialogue: Build on partner's contra-argument, Argue, defend Confront or challenge
Cognitive Processes	Attending Processes Activate existing, knowledge, Assimilate, encode, or store new information, Search existing knowledge	Creating Processes Infer new knowledge, Integrate new information with existing knowledge, Organize own knowledge for coherence, Repair own faulty knowledge, Restructure own knowledge	Jointly Creating Processes Creating processes that incorporate a partner's contributions

Active learning methods frequently incorporate cooperative learning groups, aligning with constructivist principles that highlight the significance of social interaction in the learning process. Lev Vygotsky's foundational contributions highlighted the interplay between cognitive functions and social interactions, culminating in the development of a sociocultural theory of development. According to Vygotsky, learning occurs when individuals engage in problem-solving tasks that surpass their current developmental capabilities, with guidance from teachers or peers. Therefore, active learning approaches that leverage group dynamics benefit from this sociocultural constructivist framework, promoting increased peer interaction and facilitating cognitive advancement through collaborative learning experiences (Vygotsky, 1930).

Research highlights that academic performance is significantly enhanced in environments that implement active learning strategies, as these approaches bolster both teaching effectiveness and student motivation. Compared to traditional instructional methods, active learning classrooms are associated with higher levels of productivity, improved student grades, and increased educational enthusiasm (Nurbavliyev et al., 2022). Active learning strategies foster a more engaging and interactive learning atmosphere, which encourages students to participate actively in their education. This shift from passive to active participation not only enhances comprehension but also cultivates a sense of ownership over the learning process. As students become more involved, their intrinsic motivation to learn increases, leading to better academic outcomes. Moreover, the benefits of active learning extend beyond mere grades; they also contribute to the overall educational experience. Students in active learning environments report feeling more connected to the material and their peers, which can further enhance motivation and engagement.

Consequently, implementing active learning strategies in educational settings is crucial for optimizing both teaching effectiveness and student success.Top of Form

Active Learning Strategies

Learning that lacks meaning is often quickly forgotten, as genuine understanding is vital for applying knowledge in future scenarios. While teaching aims to facilitate learning, it doesn't guarantee that students will absorb the material simply because it is presented. Educators' views on learning greatly affect their teaching strategies and, consequently, student outcomes. It is crucial for teachers to transition from a focus on rote memorization to one that emphasizes meaningful knowledge construction and skill application. This broader perspective on learning requires a significant shift in how educators perceive and engage in the teaching-learning process. This transformation involves moving away from a teacher-centred, lecture-driven approach to one that is learner-centred, fostering discussion and practical applications. As educators grow in their roles, their comprehension of teaching and learning evolves along this trajectory. Past studies indicate that students view active learning as beneficial to their educational experience (Machemer & Crawford, 2007; Patrick, Howell, & Wischusen, 2016) and report an increase in their self-efficacy as a result (Stump, et al., 2014). From this perspective, active learning strategies can be categorized into three main areas: explanation, facilitation, and planning strategies.

Explanation strategies aim to provide students with a clear understanding of the rationale behind active learning practices. These strategies can be subdivided into two main components: establishing student expectations regarding the subject matter and articulating the overarching purpose of the instruction. Setting expectations involves establishing a tone and routine for active learning at both the course and classroom activity levels. Instructors can address these expectations at the start of the semester, during the initial class session, or just prior to specific activities. To effectively set expectations at the beginning of the semester, research suggests implementing strategies that familiarize students with active learning as early as possible. This includes ensuring that project instructions and relevant materials are made available early in the semester and clearly communicating that the project constitutes a significant component of their overall assessment (Krishnan & Nalim, 2009). Explaining the purpose of activities involves providing students with reasons for engaging in certain tasks and emphasizing the importance of their participation. One effective approach identified in studies is the use of assessment data related to active learning to demonstrate its value. Intermittently reiterating the learning objectives in the initial weeks after establishing expectations can positively influence student motivation.

Facilitation strategies are designed to maintain student participation in classroom activities once they have commenced, with many of these strategies focusing on direct engagement with students. This category can be further divided into two key areas: involving the teacher in activities and encouraging student participation. Involving the teacher in classroom activities not only aids in facilitating the activity but also fosters closer interactions with students and allows for immediate feedback. When instructors actively move around the classroom, they promote engagement among both students and them. Encouraging students entails creating a supportive classroom atmosphere that motivates them to engage in activities. This involves establishing respect and rapport, demonstrating genuine concern, and maintaining a positive attitude toward student success. Much of students' achievement is rooted in the negotiation process and the cultivation of mutual respect within the classroom, which requires the instructor to exhibit motivation, energy, and enthusiasm. Negotiation plays a crucial role in fostering a sense of community. For instance, while learning students' names can be challenging, it is an essential aspect of building rapport and motivating them. Additionally, listening to students' needs and preferences regarding assessment deadlines, projects, and activities is particularly effective in establishing the relationships necessary to sustain and enhance student performance.

The planning category, in contrast to the explanation and facilitation categories, encompasses strategies that extend beyond classroom time. This category includes four sub-strategies: designing appropriate activities, creating group policies, aligning the course, and reviewing student feedback (Nguyen et al., 2021). First, the design of activities involves ensuring that the tasks are suitable in terms of time constraints, difficulty levels, and course requirements. Activities should strike a balance between being too challenging and too simplistic, while also being engaging and providing ample opportunities for student participation. Creating group policies addresses the rules and structures governing group activities. This strategy focuses specifically on collaborative work, considering aspects such as determining optimal team sizes and assigning specific roles to group members. Aligning the course highlights the importance of deliberately connecting various components of the curriculum. This strategy involves planning assessments that reflect student participation in activities and timing these activities in relation to other course elements to ensure coherence. Reviewing student feedback entails both gathering insights on the effectiveness of activities and utilizing that feedback to enhance the course structure. Research has shown that incorporating student feedback into ongoing course improvement is vital for fostering effective learning.

Strategies for active learning should not be chosen solely to facilitate the transfer of knowledge from the external world to the learner's cognitive framework; rather, they are intended to provide learners with the tools necessary to construct their own understanding and meaning. As illustrated in previous examples, it is crucial to take students' needs into account when selecting active learning strategies, aiming to integrate them effectively into an interactive learning process. At this point, it is essential to recognize that implementing strategies in a strictly student-centred manner, while excluding the teacher from the equation, can be counterproductive. The teacher's role is pivotal; they must actively engage students during lessons, facilitate meaningful discussions, organize content in an accessible manner, and share outcomes that invite student feedback and commentary. In this collaborative framework, the teacher should participate as a co-learner, actively contributing to the learning experience rather than functioning merely as a passive administrator. This active involvement not only enhances the learning environment but also models the kind of engagement and critical thinking that active learning seeks to foster among students. A balanced approach that recognizes the roles of both teachers and students can lead to richer educational experiences and more effective learning outcomes.

Active Learning in English Language Teaching

English language instructors primarily serve as guides and facilitators within the language classroom, aiming to motivate and support students in recognizing effective learning strategies and styles. Research indicates that instructors are committed to identifying and addressing students' learning challenges (Suleiman, 2022). As previously discussed, active learning emerges as an invaluable strategy that has demonstrated effectiveness for teachers of English as a foreign language. This approach offers numerous advantages over traditional methods, such as lectures; it enhances students' learning, improves information retention, and increases overall enjoyment of the lessons. Active learning promotes a collaborative environment, encouraging interaction among students, instructors, and peers rather than reliance on solitary study. This interaction helps to facilitate the zone of proximal development (ZPD), enabling students to achieve their full potential with appropriate support from peers or teachers. Furthermore, active learning encompasses a diverse range of practical activities and teaching methodologies that motivate students to reflect on their learning experiences and apply their knowledge to problem-solving situations.

Effective language acquisition necessitates genuine interaction between instructors and students. However, advancements in technology and the impact of global pandemics have compelled many educational institutions to shift from distance education to online learning formats.

These abrupt transitions, often executed without adequate preparation, have posed challenges for instructors attempting to implement active learning strategies swiftly. While live interactions in virtual classrooms may be somewhat limited, effective online platforms facilitate the exchange of ideas, sharing of instructional materials, and engagement with instructors, thereby enhancing participation. The integration of interactive multimedia components with active learning activities in these settings significantly improves learning outcomes.

Researchers assert that virtual classrooms should prioritize the development of students' language skills over mere information transfer, aligning with the fundamental goals of language education. Multimedia applications afford students opportunities for meaningful engagement through conversation, listening, writing, reading, and critical thinking about course content, as well as discussing relevant academic topics. By fostering direct participation in learning activities, interactive multimedia tools yield exceptional results, particularly in enhancing language skills. The incorporation of e-learning technologies in virtual English language teaching environments transforms the teaching and learning process from passive reception to active engagement (Suleiman, 2022).

Analyses within the field indicate that students typically hold a strong appreciation for active learning, recognizing its positive impact on their educational experience in online courses. These components should focus on maintaining continuous student engagement through interactive activities and assignments that promote collaborative knowledge construction and discussion. Additionally, it is essential to integrate regular feedback and evaluation mechanisms within these activities to monitor and support ongoing student progress. Observations of individual learning activities also indicate a distinct preference among students for active and interactive tasks, such as self-assessment questions, interactive exercises, and external video links. In contrast, passive activities, including short lectures that present key concepts and readings, are perceived as less effective. This suggests that active, student-centred tools are essential for supporting learners in achieving their educational objectives while also fostering a deeper understanding of the curriculum and expanding their academic knowledge base (Granmo & Bengtsson, 2015).

Many active learning strategies are adaptable and can be effectively implemented in both face-to-face and online teaching environments. Educational institutions are increasingly encouraged to adopt teaching methods that prioritize a student-centred approach, utilizing innovative technologies to promote active participation through various internet applications. Online platforms commonly used by students include tools that facilitate interaction with peers and instructors, as well as those that support online discussions and collaborative learning activities. Given the diverse range of active learning strategies available, it is reasonable to categorize these approaches under three overarching theories: cognitive, constructivist, and connectionist.

According to Flavell (1979), cognitive theorists conceptualize learning as a multifaceted internal process that includes various mental activities such as memory, thinking, reflection, abstraction, motivation, and metacognition. This perspective highlights that learning is not merely about absorbing information but involves the active engagement of mental faculties. Individuals exhibiting metacognitive awareness are particularly attuned to their cognitive processes; they actively evaluate their understanding and strategies for learning, which enables them to adapt and refine their approaches based on self-reflection and self-regulation. This level of awareness empowers learners to monitor their progress, recognize when they are struggling, and make informed decisions about how to approach new material or challenges.

In addition to cognitive theories, constructivist theory asserts that students are not passive recipients of knowledge but active participants in their educational journeys. This perspective emphasizes that knowledge is constructed through students' interpretations of their experiences and the sensory information they encounter in their environment (Piaget, 1973). As learners

engage with new concepts, they build connections with their prior knowledge, leading to deeper understanding and retention. In this model, students occupy a central role in the learning process, while the instructor transitions to the role of facilitator, guiding and supporting learners as they navigate their individual paths of discovery. This shift encourages a more collaborative and interactive classroom dynamic, where dialogue and exploration are key components of the learning experience.

Furthermore, the connectionist approach emerges as a particularly relevant learning theory in the digital age. In this context, individuals leverage networks -whether social, academic, or technological- as environments for learning and collaboration. The inherent dynamism of these networks means that learners often encounter a vast and ever-changing landscape of information. As a result, individuals may find themselves with limited control over the flow of information, necessitating a commitment to continuous learning. This approach requires not only the ability to acquire new knowledge but also the capacity to forget outdated information that no longer serves their learning objectives (Siemens, 2005). In this case, learners must cultivate the skill to relearn current knowledge, adapting to new contexts and innovations in an increasingly complex world.

The interplay of cognitive, constructivist, and connectionist theories illustrates the evolving landscape of learning in contemporary education. By understanding learning as an internal process influenced by metacognitive awareness, recognizing students as active constructors of knowledge, and adapting to the dynamic nature of digital networks, educators can better support their students in navigating the complexities of modern learning environments. This holistic understanding of learning processes equips both learners and instructors with the tools needed to thrive in an interconnected and rapidly changing world.

Subsequent sections of this topic will concentrate on various applications and implementations of active learning, both within classroom settings and in online learning contexts.

Classroom Applications

Listed below are some active learning practices that can be used in teaching English. Many studies indicate that the implementation of specific active learning activities in the classroom is likely to enhance students' learning outcomes (Adler, 1982; Keyser, 2000; Charalambos, 2000; Walker, 2003; Bell & Kahrhoff, 2006; Tedesco, 2013).

Academic Portfolio:

Portfolios provide students with a sense of ownership over their work, which significantly boosts their interest in the subject matter. By encouraging students to take pride in their achievements, portfolios also serve as reflective tools that allow learners to track their progress over time. As students compile their work, they engage in ongoing self-assessment and reflection, enhancing their comprehension of the material. This portfolio approach integrates both "Explanation" and "Planning" components, which are vital for enriching the learning experience. The "Explanation" aspect encourages students to express their reasoning and the thought processes behind their choices, thereby fostering metacognitive awareness and critical thinking. Conversely, the "Planning" element motivates students to establish learning objectives and strategize on how to reach them. This combination not only aids in language development but also promotes a proactive approach to education.

Portfolios encourage active involvement during evaluations, transforming assessment into a more interactive and collaborative experience. Instead of merely serving as a summary of grades, portfolio assessments facilitate conversations between students and teachers, allowing for constructive feedback that guides future learning. This method actively engages students in their evaluations, further strengthening their dedication to their educational path. The implementation

of portfolios is an effective strategy that deepens students' connections to the material while enhancing vital skills in self-regulation and reflection.

Role and Drama:

While games and drama activities can be easily implemented in classroom settings for small groups or individual students, they can also be effectively utilized in online English teaching. This approach promotes language use in an enjoyable and engaging manner, making learning more interactive. By assigning roles, students can concentrate on specific elements of a movie or lesson while simultaneously gathering information from their peers regarding other aspects. This collaborative strategy not only encourages active participation but also enhances communication skills as students discuss and share insights with one another. Furthermore, the integration of these activities in online environments can help create a dynamic and immersive learning experience, allowing students to practice language skills in a supportive and motivating context. Incorporating games and drama into online English teaching fosters a richer learning environment that captivates students and enhances their language proficiency.

Argument:

Creating a discussion environment in English language teaching encourages students to engage with opposing viewpoints, which is essential for developing critical thinking skills. This practice not only enhances their listening abilities but also emphasizes the importance of supporting evidence in discussions. By requiring students to substantiate their arguments with research and inquiry, educators promote a deeper understanding of the subject matter. Furthermore, this approach discourages oversimplified perspectives on complex issues, encouraging students to explore nuances and consider multiple angles. Engaging in such discussions cultivates an atmosphere of intellectual curiosity, where students learn to respect differing opinions and articulate their own viewpoints more effectively.

Fishbowl Activity:

To foster active engagement in the classroom, students are encouraged to formulate questions related to the course content and submit them anonymously into a designated box. During the class session, the instructor randomly selects several questions from this pool and either addresses them on behalf of the entire class or facilitates a group discussion to elicit collective responses. This strategy not only empowers students to voice their inquiries but also stimulates critical thinking and collaborative learning. Moreover, this approach can be seamlessly adapted for online language education by utilizing interactive applications, messaging platforms, or text messaging systems. Such digital tools enable students to participate in the same questioning process, maintaining anonymity while fostering a sense of community. By engaging students in this way, educators can create a dynamic learning environment that encourages exploration and dialogue, regardless of the delivery method. This technique enhances student involvement and enriches the learning experience, making it applicable in both traditional and online settings.

Treasure Hunt Activity:

This instructional strategy focuses on locating and analysing web pages that contain critical information -such as text, images, audio, or video- pertaining to the topic of study. Engaging in this activity is particularly advantageous for gathering relevant factual data and providing essential background information that enhances students' understanding of the subject matter.

By encouraging students to explore various multimedia resources, this approach promotes active engagement and critical thinking as they evaluate the credibility and relevance of different sources. Furthermore, the integration of diverse media formats caters to various learning styles, making the content more accessible and engaging. This strategy not only aids in the acquisition

of knowledge but also fosters skills in information literacy and analysis, preparing students to navigate the vast array of resources available in today's digital landscape.

Think, Match, Share Activity:

This pedagogical strategy promotes collaboration among students, allowing them to exchange ideas before presenting their findings to the entire class. It enhances focus, cultivates problem-solving skills both individually and in groups, boosts the confidence of more reserved students, broadens the array of materials available for responses, and supports auditory and tactile learning experiences. In online English education, students can be randomly assigned to small groups and utilize private messaging to facilitate their collaboration.

The strategy also broadens the range of materials available for responses, enriching the learning experience while accommodating various learning styles. It supports auditory and tactile learning experiences, ensuring that students engage with the material in multiple ways. In the context of online English education, this approach can be effectively implemented by randomly assigning students to small groups, where they can utilize private messaging platforms to facilitate their collaboration. This use of digital tools allows for seamless communication, enabling students to brainstorm, share insights, and develop their ideas collectively before presenting to the larger class.

Dictionary Games:

In this activity, each group is assigned the task of identifying an obscure word from the dictionary and generating three distinct definitions for it. This method not only fosters students' dictionary skills but also promotes autonomy, empowering them to independently navigate and comprehend language. By engaging in this exercise, students enhance their ability to analyse and interpret various meanings of a single word, encouraging deeper linguistic exploration. This approach also cultivates critical thinking, as students must consider context and usage in formulating their definitions. Moreover, working collaboratively in groups encourages communication and teamwork, allowing students to share insights and learn from one another. This activity serves as an effective means of developing language skills while promoting independent learning and cooperative engagement.

Time for Clarification:

This technique serves as a brainstorming exercise aimed at generating definitions or explanations for various concepts. In this activity, students are instructed to spend 3-5 minutes compiling words or phrases that encapsulate a specific topic. This focused effort not only stimulates individual thinking but also prepares students for deeper engagement with the subject matter.

The activity can effectively initiate discussions in an online classroom setting, where students can share their ideas and insights. Following this initial brainstorming phase, students can transition into group work, where they compare their lists and collaboratively refine their definitions. This process encourages collaboration and critical discussion, allowing students to synthesize their ideas and arrive at a more comprehensive understanding of the topic. By working together to refine their definitions, students enhance their communication skills and deepen their comprehension of the subject. This technique not only fosters a sense of community among learners but also empowers them to take an active role in their learning journey, making it a valuable addition to both in-person and online educational environments.

Tool Fault Detection Activity:

In this activity, students are organized into small groups of 3 to 4 individuals and presented with a specific question or problem to address. Each team is tasked with brainstorming potential

solutions and identifying related issues over a duration of five minutes, during which they document their ideas on paper. This collaborative brainstorming session encourages active participation and fosters critical thinking as students explore various perspectives.

At the conclusion of the brainstorming period, the written responses are collected by the instructor, who then utilizes these submissions to facilitate a class discussion. By reviewing the teams' ideas, the instructor can guide a collective analysis of the topic, highlighting key points and encouraging further dialogue among students. This method not only enhances engagement but also provides an opportunity for students to refine their ideas through discussion, as they consider their peers' viewpoints and solutions. This activity promotes a deeper understanding of the subject matter and cultivates essential skills in teamwork, communication, and problem-solving, making it an effective strategy in both classroom and online learning environments.

Discussion Map Activity:

To stimulate discussion on a particular subject, the topic is prominently displayed on a visual medium, such as a whiteboard or poster. Students are encouraged to engage actively by posing and answering questions related to the topic. This approach not only sparks conversation but also fosters a collaborative atmosphere where ideas can be freely exchanged. By prompting students to consider various aspects of the topic, including both its advantages and disadvantages, this exercise encourages comprehensive research and critical analysis. Students are motivated to delve deeper into the subject matter, exploring its broader context and implications. This holistic examination enhances their understanding and encourages them to consider multiple perspectives.

Discussion map activities serve to enrich the learning experience, as students engage in meaningful dialogue that deepens their insights and promotes critical thinking. The visual medium acts as a focal point for discussion, facilitating a more dynamic and interactive learning environment that can be effectively utilized in both traditional and online educational settings.

One Minute Article Activity:

The One Minute Article technique offers an inclusive platform for all students to contribute, allowing even those who may be less inclined to participate in oral discourse to express their thoughts effectively. This method acts as a catalyst for discussion, drawing attention to specific points of interest while facilitating a quick assessment of students' understanding and enabling targeted feedback. In this activity, the instructor distributes slips of paper containing a specific topic, granting students one minute to write their reflections. This structured approach encourages concise expression of ideas, promoting clarity and focus on their written responses. Moreover, it aids in the development of daily spoken English skills, as students can later use their reflections as prompts for verbal discussion.

By engaging in this exercise, students not only enhance their writing abilities but also build confidence in sharing their thoughts in a group setting. The rapid nature of the task encourages spontaneity and creativity, making it an effective tool for fostering engagement and dialogue within the classroom. One Minute Article technique enriches the learning experience by promoting inclusivity, enhancing communication skills, and providing valuable insights into students' comprehension of the subject matter.

Mini Cases Activity:

Mini cases are succinct collections of information that are meticulously curated to encourage students to analyse specific sets of facts or scenarios. These cases prompt students to interpret the information, make judgments, and reach decisions based on relevant concepts and principles within their discipline. By engaging with mini cases, students are invited to critically evaluate the information presented, fostering a deeper understanding of the subject matter. Predominantly

utilized in small group settings, particularly in online English education, this approach significantly enhances students' academic language skills. Through collaborative discussions around the mini cases, students develop their ability to articulate thoughts clearly and engage in Socratic thinking. This form of inquiry-based learning encourages them to ask probing questions, challenge assumptions, and explore multiple perspectives.

Active Learning in Online English Classes

Educators must distinguish active learning methodologies from traditional classroom paradigms and adapt them effectively to the online learning environment. It is essential for them to recognize and address the distractions inherent in online settings to ensure sustained student engagement. Several key factors are vital for facilitating a robust online learning experience.

First, educators should aim to foster an inclusive virtual environment where students feel connected and valued. Second, it is important to employ a diverse range of educational tools and techniques that cater to various learning styles and preferences. Providing clear instructions and supportive resources can further enhance student comprehension and retention of knowledge. Additionally, integrating evaluation mechanisms is crucial for assessing learning outcomes and informing necessary adjustments to the curriculum. Moreover, educational activities must be thoughtfully designed to promote active participation, taking into consideration the limitations of the online context. In this regard, it is imperative to ground educational strategies within a structured educational design model while adhering to the pedagogical principles established by the institution.

As outlined by Ragan (2023), there are ten fundamental principles that contribute to the effectiveness of online teaching, which are *Active participation of the instructor, Implementing Proactive Course Management Strategies, Creating Course Activities, Being Prepared for Unplanned Situations, Providing Timely Feedback, Thinking Before Providing Feedback, Supporting Continuous Progress, Utilizing Secure Communication Tools, Enhancing Course Material and Quality and Strengthening Technological Connectivity.*

The instructor plays a pivotal role in overseeing an online course from its initiation to conclusion. Failing to engage in live sessions or relying solely on pre-recorded lectures can detrimentally affect student motivation. In a traditional classroom setting, a structured environment is established for both instructors and students, encompassing specific parameters such as time and location. Similarly, the online classroom can create an environment conducive to effective learning through the clear communication and management of essential parameters. Since course content is often developed and stored within a learning management system, some educators may mistakenly assume that their responsibilities in delivering course materials are fulfilled, thereby diminishing their active role in the online learning experience. However, akin to expectations in a face-to-face setting, instructors in online courses must maintain a visible and engaged presence to effectively guide and enhance the learning process. An online course instructor must also facilitate a successful learning experience by employing proactive course management strategies. These strategies encompass various practices, including, but not limited to, monitoring assignment submissions, notifying and reminding students about missed or impending deadlines, and adjusting course progress as needed. The concept of "course management" can encompass multiple facets of the educational experience. For instance, it includes managing student rosters, organizing team structures, grading assignments, disseminating grades, and implementing disciplinary measures, all of which contribute to effective online course management.

While the online classroom environment offers significant flexibility regarding study time and location, establishing and communicating a consistent course tempo and study pattern can benefit both instructors and students, thereby reducing confusion in course delivery. For students, a

clearly defined model of course activities facilitate the planning and management of extracurricular commitments alongside e-learning tasks. For instructors, providing a syllabus and study model helps delineate the boundaries between online classroom activities and other aspects of life.

Students enrolled in online courses often rely on their instructors as the primary source of knowledge and guidance regarding course progress. If an instructor anticipates being unable to actively engage in the course for more than a few business days, it is advisable to notify students at least one week in advance. In emergency situations, instructors should communicate with students as promptly as possible regarding their absence and provide information on when they will resume updates about course progress.

Timely and effective feedback from instructors is essential for online learners to effectively manage their educational experience. Instructors are expected to respond to students' inquiries on the same day. If an instructor is unable to provide a comprehensive response within one business day, they should still communicate with the student within that timeframe and indicate when a more detailed reply will be available. Feedback on assignments is most beneficial to students when it is articulated using clear and concise language that effectively conveys the extent to which relevant course outcomes are being achieved. In instances where student inquiries may be ambiguous, instructors are encouraged to engage in dialogue that fosters understanding and helps students articulate their needs. Instructors play a vital role in keeping students informed about their progress on assignments, quizzes, and exams. A turnaround time of one to two days for feedback ensures that students receive timely information necessary for maintaining positive progress. Following the electronic submission of an assignment, it is essential for instructors to review the submission and respond within a reasonable timeframe. In some educational institutions, this timeframe may be dictated by specific policies or cultural norms. Regardless of the established timeframe, informing students about when they can expect a response enables them to monitor course activities effectively, plan accordingly, and make any necessary adjustments.

In online learning environments, interaction between instructors and students is a vital component of the teaching and learning process. Immediate and reliable access to class participants is essential for instructors to effectively guide the course to completion. As students engage with course assignments, discussion posts, and online assessments, the ability to communicate with the instructor becomes integral to their success. Student-instructor communication is often necessary to address problems, inquiries, or disputes regarding various course elements. In certain situations, it may be beneficial for all class participants to view these communications. For instance, a student may post a question in a discussion area that is relevant to others, allowing the instructor to address it collectively. Conversely, some topics may be more personal and inappropriate for public discussion, such as matters relating to student performance, course adjustments, or grade disputes. In these instances, employing secure and appropriate communication tools is crucial for ensuring confidentiality and effective resolution for both parties.

The provision of high-quality course content is critical to fostering a successful learning experience. Instructors are responsible for monitoring and addressing elements of the course that may compromise its integrity, such as inaccuracies in course content, editing errors, unclear information and instructions, broken links, and other design issues. If the educational institution aims to deliver a high-quality online educational experience, it is essential to emphasize strategies and methods for effective quality assurance. Many online programs recognize that students whose learning experiences do not meet acceptable quality standards are likely to withdraw, as it may negatively impact their perception of the program and their degree. Instructors of online courses require immediate and reliable access to the necessary technology to facilitate student engagement. Effective online course delivery depends on high-speed Internet access (e.g., DSL, cable modem, or satellite). Instructors must familiarize themselves with the full technical requirements of their program to ensure compliance. Additionally, online instructors are expected to navigate and

experience all functional aspects of the online course to assess the system's functionality and performance adequately.

Challenges in Applying Active Learning Strategies in English Language Teaching

Teaching English presents significant challenges for both students and educators). Despite the critical importance of English in our society, it is essential to investigate the underlying reasons for our collective difficulty in acquiring a second language (Arslan, 2009; cited in Altın & Saraçoğlu, 2018). Educators encounter various obstacles in English instruction, which are influenced by the nature of the teaching process, the materials and textbooks available, and students' attitudes towards the language. These challenges include the extensive content of the English curriculum, inadequate teaching resources, a lack of facilities such as speaking laboratories, and the difficulty of translating curriculum requirements into practical application. Additional issues comprise overcrowded English exam papers, the reliance on profile dimensions for assessing student knowledge, students' perception of English as complex, an emphasis on exam-oriented topics, and insufficient preparation for English lessons (Özmat & Senemoğlu, 2020).

In addition to the challenges that may arise in teaching English, various issues can occur when implementing active learning strategies, both in traditional classroom settings and in online English education. Addressing these challenges requires not only the initiative of the teacher but also the provision of a systematic and forward-thinking educational framework by the institution, thus ensuring that students remain motivated and are not discouraged by external factors. The transition to online learning exacerbates these difficulties. Notably, many students struggle to maintain focus on digital screens for extended periods, a challenge that may be intensified by the pervasive presence of social media and other distracting websites. Furthermore, online courses often feature lower levels of interaction compared to traditional classrooms, which undermines the effective implementation of active learning strategies that rely on face-to-face engagement, such as discussions, group work, and role-playing activities. The extent of participation and collaboration in an online teaching and learning environment is largely contingent upon the knowledge and skills that both educators and students possess, which are developed through training specific to the online platform being used. Without adequate training, it becomes challenging for both instructors and learners to meet their educational objectives. Additionally, having a conducive home environment and access to sufficient resources are crucial factors that significantly influence the success of online learning outcomes (Mazlan et al., 2021).

Challenges to language teaching within the school context include overcrowded classrooms, which impede effective interaction, as well as insufficient physical and technological resources. Additionally, classrooms equipped with technology frequently encounter maintenance issues. Compounding these difficulties are the lack of administrative support and deficiencies in supervision, which further complicate the educational environment (Taşçı, 2023). While the challenges associated with implementing active learning strategies in English language instruction largely mirror those found in online education, they can be categorized into four distinct areas: teacher-related issues, student-related issues, challenges related to the content and content and technological difficulties. The following topics will address these potential challenges encountered when implementing active learning techniques in both classroom settings and online English education.

Teacher-Related Challenges

While traditional educational approaches predominantly favoured teacher-centred models, progressive and reconstructive principles have shifted focus towards student roles. However, these significant changes have not diminished the importance of the teacher's role; rather, they have led to the emergence of a new teacher model that emphasizes skills such as guidance, facilitation, and classroom management. Therefore, teacher-related challenges within the educational environment

merit consideration alongside other areas of concern. These challenges can be categorized into aspects such as professional experience, competence, interest, and motivation.

Beyond fulfilling a teaching obligation, educators also engage in professional development aimed at enhancing their academic qualifications, teachers are not only required to identify the characteristics exhibited by students through various methods, including observation, interviews, and questionnaires, but also, they need to strive to foster positive traits in students while mitigating the development of negative traits. A professional teacher who wants to integrate students into the learning process in a more active way must expose them to the work of professionals by introducing diverse fields of expertise and skill sets, enabling students to make informed choices regarding their future paths. Moreover, teachers are responsible to offer guidance and counselling to assist students who encounter challenges in realizing their potential. The absence of one or more of these competencies in educators not only results in professional inadequacies but also adversely impacts students' active engagement in the learning process. For instance, if a teacher fails to monitor students' developmental progress and neglects necessary assessments, this can hinder the identification of students' strengths and weaknesses. Similarly, a teacher who does not emphasize students' positive attributes may stifle their growth in specific areas. Consequently, it is crucial for educators to actively observe and engage students in the learning process, alongside enhancing their pedagogical competencies.

Teacher competence can be evaluated from various perspectives. Research indicates that teachers with greater professional experience demonstrate significantly higher levels of engagement in educational activities related to relationships, as well as in planning and delivering lessons, compared to their less experienced counterparts (Makovec, 2018). Experienced educators provide students with a wider array of opportunities in several areas, including the establishment of classroom rules, participation in activities, in-class guidance, active involvement in lessons, and involvement in decision-making processes.

The teacher's motivation and willingness to engage in professional development are other critical components in the process of effective language teaching. Research shows that various external factors—such as students lacking the expected level of readiness and knowledge, an unsuitable school or teaching environment, extraneous responsibilities imposed on teachers, an inadequate or overly complex education system, and insufficient salary and compensation—contribute to a decline in teacher motivation (Mukminin et al., 2015). Additionally, the lack of adequate materials and infrastructure to facilitate the transition from theory to practice further undermines teacher motivation, particularly in the field of language education.

Problems arising from teachers can often begin prior to their entry into the profession, particularly at the university level or during their teaching internships. Examples of these issues include insufficient or ineffective practical courses in universities, an excess of language education faculties, the absence of standardized teaching criteria across institutions, and a predominance of theoretical content in language education courses. The role of teachers in education extends beyond merely providing information; contemporary educational frameworks require teachers to engage in more comprehensive roles.

When it comes to online education, teachers play a vital role in addressing the complexities inherent in distant education. In synchronous online learning environments, there is an expectation that educators will develop a diverse array of teaching strategies and effectively utilize appropriate tools to enhance the learning experience (Noviani, 2021). To successfully adapt active learning strategies to the digital landscape and address the unique challenges of virtual classrooms, teachers can foster student engagement and mitigate distractions. Essential considerations include creating an inclusive environment that promotes student connections, employing a variety of teaching methods that are suitable for online delivery, providing clear guidance and resources, assessing

learning outcomes effectively, and designing activities that facilitate active participation within the online context (Niktinat, 2021).

In online education, teacher-related issues also encompass time management, teaching style, and the transition from face-to-face to online learning environments. Notably, educators have reported considerable challenges in online English language teaching, particularly concerning speaking objectives. This perception underscores the need for further research to identify specific obstacles and to develop effective strategies for addressing them (Todd, 2020). In transitioning from face-to-face to online learning, English teachers must identify productive and effective methods for teaching the four language skills while adapting their materials to digital formats for online accessibility. It is crucial for teachers to select appropriate teaching and assessment strategies that consider the challenges faced by their students. With reduced direct interaction among students and between students and teachers in online settings, educators need to maintain students' motivation to learn, as disengagement can lead to boredom.

To achieve learning objectives, online instruction should be carefully planned, with provisions for course access. Additionally, teachers must become proficient in using new educational tools, and parents supporting younger students must also possess technological literacy. English teachers should focus on the four skills in language instruction, as each skill area has distinct characteristics (Ermawati et al., 2021). Significant challenges faced during the transition to online teaching and learning include insufficient skills and training among educators, inadequate internet access and infrastructure, a lack of supporting resources, and limited student engagement and feedback in online environments. Addressing these barriers is essential for the effective implementation of online education. Successfully overcoming these challenges not only facilitates the online teaching and learning process but also enriches the overall educational experience by fostering collaboration between teachers and students (Hamad, 2022)

The absence of timely and constructive feedback on students' written work represents a significant challenge in online learning environments. Constructive feedback is essential and serves as a cornerstone of active learning, enabling students to identify mistakes in their inquiries and providing detailed explanations to enhance their understanding. In online settings, assessments are frequently communicated through various platforms, including email, academic systems, and messaging applications such as WhatsApp. Consequently, feedback often consists merely of numerical scores on spreadsheets, lacking accompanying documentation that clarifies how students' work was assessed. In the field of English language instruction, as in many other disciplines, the need for detailed and prompt feedback is critical; without it, students are likely to repeat the same mistakes in future online assessments.

Information and communication technologies employed in traditional teaching can also enhance online education, allowing educators to present learning opportunities in diverse ways tailored to meet the evolving needs of students. These technologies facilitate individualized instruction, enabling students to learn at their own pace and in alignment with their unique learning styles. As a result, even conventional classroom teaching often incorporates insights gained from remote teaching methodologies (Nycz & Cohen, 2007).

Student-Related Challenges

The most significant student-related challenges in English language learning pertain to students' attitudes and concerns. Research indicates a negative correlation between students' self-efficacy in English and their anxiety levels, suggesting that higher self-efficacy is linked to lower anxiety (Doğan, 2016). It is crucial to highlight that teachers bear the responsibility of enhancing student motivation and play a vital role in fostering students' emotional and psychological well-being. Moreover, students in English classes often lack a common foundational knowledge, unlike

in other subject areas. For instance, some students receive instruction from unqualified English teachers in rural areas, while others benefit from urban settings that offer a variety of classroom resources. Additionally, while some students attend private language schools utilizing online programs, language applications, and interactive opportunities, many depend solely on textbooks for their English education. The absence of a placement test to appropriately group students by their language proficiency further complicates the situation for weaker students, who may resort to guidebooks for assistance (Akbari, 2015). In another study Wahyudin and Rido (2020) stated that student-related issues encompass various factors, including student expectations, readiness, participation, learning styles and engagement strategies.

Students may occasionally resist departing from traditional teaching methods and exhibit a preference for alternative learning techniques. This reluctance can pose challenges not only for the students themselves but also for the teacher, particularly in facilitating interaction among students. Furthermore, in such instances, even if student integration is successfully achieved, the effectiveness of active learning can differ markedly among students, with certain individuals demonstrating higher levels of engagement compared to their peers (Freeman et al., 2014).

Felder and Silverman (1988) highlight the importance of addressing different learning styles, suggesting that a one-size-fits-all approach in active learning may not meet the needs of all students. They argue that a uniform approach to active learning may fail to address the unique preferences and strengths of individual learners. By tailoring instructional strategies to align with various learning styles - such as visual, auditory, and kinaesthetic - educators can create a more inclusive and effective learning environment that fosters engagement and understanding for all students. This differentiation is crucial for maximizing the potential of active learning, as it ensures that each student could engage with the material in a manner that resonates with their personal learning preferences.

Prince (2004) emphasizes that students unfamiliar with active learning may struggle to adapt, suggesting the need for gradual implementation and support. In his study Prince advocates for a gradual implementation of active learning strategies, coupled with adequate support, to facilitate this transition. This gradual approach allows students to acclimate to new learning environments and expectations, thereby enhancing their ability to engage effectively. Providing the necessary guidance and resources during this transition period can help mitigate resistance and foster a more positive learning experience.

Active learning strategies often require more time for discussions, which can be challenging for students accustomed to a rigid structure (Michael, 2006). Active learning strategies frequently necessitate extended periods for discussions, presenting challenges for students who are accustomed to a more rigid and structured educational framework. This shift in expectations can create difficulties as students may struggle to adjust to the increased emphasis on collaborative dialogue and critical thinking. Educators must be mindful of these challenges and provide appropriate support to help students navigate this transition effectively.

A study conducted by Johnson and Johnson (1994) on cooperative learning underscores several challenges associated with group dynamics, such as unequal participation and interpersonal conflict among group members. These issues are especially relevant in active learning contexts, where collaboration and teamwork are fundamental to fostering student engagement and enhancing the overall learning experience. Unequal participation can lead to some students dominating discussions while others remain passive, which undermines the collective learning process. Additionally, conflicts may arise from differing opinions, communication styles, or work ethics, further complicating group interactions. Addressing these dynamics is crucial for educators, as it not only facilitates more effective teamwork but also ensures that all participants are encouraged to contribute meaningfully to the learning process. By implementing strategies to promote equitable

participation and resolve conflicts, instructors can create a more supportive and productive active learning environment.

Hattie and Timperley (2007) contend that providing clear feedback and establishing well-defined expectations are essential components for achieving student success in active learning environments. They emphasize that when students receive specific guidance regarding performance standards and learning objectives, they are better equipped to engage meaningfully in the learning process. Conversely, ambiguity in feedback or expectations can result in confusion, hindering students' ability to understand what is required of them and impeding their overall learning outcomes. Therefore, educators must prioritize clarity in communication to foster an environment where students feel confident in their roles and responsibilities, ultimately enhancing their engagement and performance in active learning activities.

Deci and Ryan (1985) discuss intrinsic and extrinsic motivation, noting that external factors can significantly influence a student's willingness to engage in active learning activities. While student motivation and flexibility are fundamental to active learning approaches, a prevalent issue in online English instruction is the tendency for students to exhibit overly relaxed behaviour, resulting in delayed responses during video conferencing or late participation in classes. This situation often compels teachers to wait for tardy students to engage, thereby diminishing the effectiveness of active learning strategies implemented throughout the lesson (Nartiningrum & Nugroho, 2021).

Students encounter significant challenges in online learning environments due to the absence of physical interaction, which restricts their ability to seek assistance from peers or instructors regarding academic difficulties. This sense of isolation can result in frustration, particularly when tangible support is necessary. Moreover, engagement levels in online platforms tend to be low, as students often favour passive listening instead of active participation, demonstrating reluctance to invest time in typing questions and responses. To address perceived deficiencies in the online learning experience, students should cultivate collaborative learning strategies, recognizing the critical role of peer interaction and support in enhancing their English learning both in virtual settings and traditional classroom environments. Research in this domain indicates that online learning, often a novel experience for many students, significantly influences study habits by enhancing awareness of individual learning styles relative to traditional face-to-face education. Furthermore, the propensity for procrastination within online learning environments compels students to modify their study practices to mitigate such tendencies. Moreover, students are required to cultivate autonomous learning behaviours, referred to as e-autonomy, in online courses. It has been observed that learners assume greater responsibility for their online education by utilizing various e-autonomous tools, paralleling their behaviours in conventional classroom settings (Erarslan & Arslan, 2020).

The absence of physical presence in online learning environments can lead to feelings of isolation among students. Without face-to-face interactions with peers and instructors, the sense of community and support typical in traditional educational settings may wane. To mitigate this challenge, educators can employ several strategies, such as establishing virtual workgroups, facilitating online discussion boards, and organizing live video conferencing sessions. These initiatives foster social interaction, enhance connections among students, and promote a greater sense of engagement and support throughout their learning experiences.

Another challenge students face is learning attention. The majority of students encountered difficulties in online learning environments related to concentration, motivation, enthusiasm, engagement, and expectation of achieving learning goals. These difficulties were exacerbated by problems with teaching methods that negatively affected students' ability to focus. It is very important that faculty members stay up to date on modern teaching methods specifically

designed for online and distance education, as this directly affects students' learning attention (Tartari & Kashahu, 2021). While the flexibility of online education enhances students' access and participation in various activities, it also introduces certain challenges. Engaging in online learning outside the traditional school setting can hinder full participation in scheduled live sessions each week. Even when students allocate specific days and times for these live interactions, they may struggle to engage fully due to competing commitments and distractions (Gillett-Swan, 2017).

Challenges Related to the Content

When considering the issues arising from textbooks and teaching materials, it becomes evident that they often fail to provide effective learning opportunities for students. Teacher feedback indicates that these resources are criticized for lacking materials that facilitate effective English learning and insufficient communication activities necessary for acquiring proficiency in the target language (İyitoğlu & Alci, 2015). Furthermore, the inability of English teachers -who have taken courses on material use and adaptation during their university education- to effectively utilize the resources available to them complicates the language teaching process.

Moreover, limitations on acquiring supplementary resources within many official institutions, combined with a predominant focus on grammar-centred instruction, significantly hinder the effective teaching of the four essential language skills: reading, writing, speaking, and listening. These challenges are further intensified by overcrowded classrooms, which restrict the ability to incorporate a variety of materials and activities into the curriculum (Dursun et al., 2007). The lack of diverse instructional resources and methodologies not only stifles student engagement but also impedes the development of well-rounded language competencies, thereby affecting overall educational outcomes. Addressing these systemic issues is crucial for creating a more effective and comprehensive language learning environment.

Moreover, while there is a need for improved textbooks and teaching materials, an overreliance on pre-packaged resources can be problematic. Teachers must possess the skills to modify and adapt materials, which includes designing and integrating various audiovisual and authentic resources, as well as preparing handouts, activity sheets, and worksheets to complement textbook activities (Uztosun, 2017). Other issues related to the curriculum and materials encompass the scarcity of teaching materials and authentic resources, mechanical exercises, an excessive focus on vocabulary and grammar memorization, repetitive topics, and a reliance on direct translation in texts. Additionally, other pressing issues related to the curriculum and available materials include a scarcity of diverse teaching resources and authentic materials that reflect real-world language use. Mechanical exercises often dominate instructional time, resulting in a lack of engagement and practical application of language skills. Furthermore, there is frequently an excessive focus on memorization of vocabulary and grammar rules, which can inhibit critical thinking and meaningful communication. Repetitive topics may fail to capture students' interest, leading to disengagement. A reliance on direct translation in texts can undermine the development of students' proficiency in the target language, as it may discourage them from thinking in that language. Addressing these multifaceted issues is essential for fostering a more dynamic and effective language learning environment that meets the diverse needs of students.

Recent technological advancements empower educators to leverage a diverse array of media formats that can significantly enhance the teaching and learning experience. These technologies enable instructors to access electronic resources and digital textbooks, thereby promoting a deeper understanding of specific subjects among students (Noviani, 2021). However, challenges related to content and material design remain prevalent, particularly with regard to the integration of multimedia into the content development process. Effectively incorporating multimedia resources is often complex and requires careful consideration of pedagogical strategies, which may not seamlessly transfer from traditional face-to-face classrooms to online learning environments.

Instructors must adapt their teaching methodologies to ensure that multimedia elements are not only accessible but also pedagogically effective in engaging students and facilitating comprehension. Additionally, the potential for technical issues, varying levels of digital literacy among students, and the need for robust technological infrastructure can further complicate the successful implementation of multimedia in online education. Addressing these challenges is crucial for maximizing the benefits of technology in educational settings.

It has been noted that teachers primarily rely on textbooks when preparing online teaching materials. Aligning the online environment with English textbooks may yield more favourable outcomes. Consequently, it is posited that a more substantial impact on the development of online teaching resources could be achieved by integrating textbooks with contemporary technologies (Uluuysal & Kurt, 2022). Given that instructors frequently revisit the same concepts, it is essential to gain a deeper understanding of how students learn most effectively and which active learning exercises facilitate optimal retention and success. By identifying particularly impactful activities, educators can reintegrate these methods in subsequent semesters, thereby aiding students in constructing a robust knowledge framework (Cherney, 2011)

Challenges Related to Technology and Tools

The integration of technology into active learning strategies in English education presents a variety of challenges that educators must navigate. One significant issue is the presence of technical problems, such as unreliable internet connections and software glitches, which can disrupt the flow of lessons and hinder student engagement (Barbour & LaBonte, 2017). Furthermore, access to technology remains a critical barrier; not all students have equal access to devices or reliable internet, leading to disparities in participation and learning outcomes. As such, it is essential for institutions to address these infrastructural issues to create an equitable learning environment.

In addition to technical challenges, varying levels of digital literacy among students can complicate the effective use of technology in active learning. This lack of uniformity necessitates that educators incorporate digital literacy training into their curricula, ensuring that all students are equipped with the skills needed to succeed in a technology-enhanced learning environment. Moreover, the integration of various technological tools into lesson plans can be a daunting task for educators. Many teachers may struggle with effectively incorporating multimedia resources that foster collaboration and engagement (Hwang & Chang, 2011). This challenge underscores the importance of providing professional development opportunities that equip educators with the skills and confidence to utilize technology meaningfully. Additionally, an overreliance on technology can overshadow pedagogical objectives, diverting attention from meaningful learning experiences (Selwyn, 2014). To maximize the benefits of technology in active learning, educators must strike a balance between using digital tools and fostering genuine engagement with the material.

The effective design of digital content is also crucial for promoting student participation. Engaging digital resources can enhance the learning experience, particularly in flipped classroom models where students learn content before class (Moravec et al., 2010). However, creating such content requires significant effort and expertise, and educators may face difficulties in ensuring that materials are not only accessible but also pedagogically effective. Addressing these multifaceted technological challenges is essential for creating a supportive and effective active learning environment in English education. Technological challenges encompass errors, interruptions, and underutilization stemming from misconfigurations encountered during technology interactions. In the initial phases of classroom-based distance education, these challenges were prevalent, with unreliable technology leading to dropped connections and corrupted media, thus creating usability issues for both instructors and students. Although advancements have addressed many of these early concerns in distance education, new challenges have arisen as delivery methods such as the

'Web' have been adopted, pushing technology-delivered instruction beyond traditional classroom settings (Tai, 2007).

The effectiveness of online learning is significantly influenced by the foundational digital skills of both educators and students, yet this prerequisite is often unmet. Many teachers possess only basic technology skills, complicating their ability to deliver engaging and interactive online experiences. While students acknowledge the benefits of using technology for learning, challenges arise from software limitations. During assessments like online group presentations, the absence of face-to-face interaction and the inability to interpret nonverbal cues can impede effective communication. Nonetheless, the necessity of engaging audiences in non-visual formats, such as teleconferences, highlights the growing importance of clear, concise, and focused communication skills in contemporary educational narratives (Salmon, 2014). Utilizing appropriate online tools to deliver lesson plans via social networks can enhance communication with parents, ensuring they are informed about how to effectively supervise their child's learning during online lessons, particularly through mobile devices. However, many parents encounter challenges in providing support due to demanding work schedules that often extend throughout the day. They may struggle to allocate additional time outside their professional commitments to offer the necessary attention and support, which can detract from their ability to assist their children's learning through social media platforms (Olusola-Fadumiye et al., 2020).

Discussion

Active learning in English teaching has garnered considerable attention in educational literature for its efficacy in enhancing student engagement and language proficiency. According to Bonwell and Eison (1991), active learning strategies foster deeper understanding by involving students in their own learning process, as opposed to traditional lecture methods. Freeman et al. (2014) conducted a meta-analysis that revealed a significant improvement in student performance in STEM disciplines when active learning techniques were employed, which can be extrapolated to language learning contexts. Additionally, Prince (2004) emphasizes that collaborative learning—an integral component of active learning—promotes communication skills essential for language acquisition. Overall, integrating active learning into English instruction not only engages students but also cultivates critical thinking and practical application of language skills, as supported by various studies in the field.

Active learning has been significantly influenced by various historical approaches that emphasize student engagement and experiential learning. One foundational approach is constructivism, rooted in the theories of Piaget and Vygotsky, which posits that learners construct knowledge through interaction with their environment and social contexts. Recent studies have continued to highlight the relevance of constructivist principles in contemporary education. For example, a study by Hmelo-Silver (2013) underscores how constructivist practices enhance problem-solving skills and foster deeper understanding in learners. Similarly, Dewey's progressive education philosophy advocates for experiential learning, emphasizing that education should be relevant to students' lives and promote critical thinking (Do, 2022). Integrating progressive education principles within modern curricula helps cultivate an environment where students actively engage with the material. Moreover, cooperative learning and inquiry-based learning have emerged as key components of active learning strategies. Research by Johnson and Johnson (2014) demonstrates that cooperative learning not only improves academic achievement but also fosters social skills and teamwork among students. Inquiry-based learning, which encourages students to investigate questions and explore topics deeply, aligns with the active learning framework by promoting curiosity and critical analysis. A study by Furtak et al. (2016) illustrates that inquiry-based approaches can significantly enhance student engagement and understanding in science education, suggesting broader applicability across subjects, including language learning. These historical approaches have shaped active learning into a dynamic pedagogical framework

that emphasizes collaboration, critical thinking, and real-world application, reflecting ongoing innovations in teaching and learning.

Active learning can be effectively employed in English teaching through various strategies that engage students in meaningful ways. For instance, collaborative activities such as peer review and group discussions can enhance language skills and promote critical thinking. According to Batmaz (2023), integrating peer feedback not only improves writing proficiency but also fosters a sense of community among learners. Role-playing exercises allow students to practice conversational skills in authentic contexts, thereby increasing their confidence and fluency (Anderson, 2015). Additionally, project-based learning enables students to explore topics of interest while developing their language skills through research and presentation. A study by Becker and Park (2011) highlights that project-based learning can lead to significant improvements in students' language abilities and motivation.

Teachers can effectively cope with the challenges of implementing active learning in English classrooms through several strategies. First, they can establish clear expectations and guidelines for participation, ensuring that all students understand the objectives and the roles they play in collaborative activities. This clarity can help alleviate anxiety and foster a more inclusive environment. Additionally, professional development and peer collaboration can provide teachers with innovative ideas and support. Engaging in workshops or sharing experiences with colleagues can enhance their repertoire of active learning techniques. Incorporating technology can also facilitate active learning by providing diverse resources and tools that cater to different learning styles, such as interactive platforms and multimedia content. Moreover, teachers should remain flexible and responsive to student needs, adjusting their approaches based on feedback and observing how students engage with the material. This adaptability can create a more dynamic and responsive learning environment that maximizes the benefits of active learning.

Students can be actively engaged in the learning process in an English classroom through various interactive strategies that promote participation and collaboration. One effective method is group discussions, where students share their perspectives on a text or topic, encouraging critical thinking and deeper comprehension. Peer teaching can also be valuable; when students explain concepts to each other, they reinforce their understanding and develop communication skills (Demirci and Akcaalan, 2020). Additionally, incorporating project-based learning allows students to explore real-world issues while utilizing their language skills, fostering both engagement and practical application. Role-playing and simulations can immerse students in authentic scenarios, enhancing their conversational abilities and confidence in using English. Utilizing technology -such as interactive online platforms or multimedia presentations- can cater to diverse learning styles and make lessons more dynamic (Boud & Falchikov, 2006). Implementing reflective practices, like journals or group reflections, encourages students to think critically about their learning experiences and articulate their thoughts. By combining these strategies, teachers can create an engaging and participatory environment that motivates students to take ownership of their learning

Institutions can play a pivotal role in encouraging the active learning process in English classrooms through several strategic initiatives. First, they can provide professional development opportunities for teachers, equipping them with the knowledge and skills needed to implement active learning strategies effectively. Workshops, seminars, and peer collaboration can help educators share best practices and innovative approaches, as highlighted by Darling-Hammond, Hyler, and Gardner (2017), who emphasize the importance of ongoing professional development in enhancing teaching practices. Second, institutions can foster a supportive learning environment by creating flexible classroom spaces that facilitate collaboration and interaction. This might include rearranging furniture for group work or providing technology-enhanced tools that promote engagement, such as interactive whiteboards and online collaboration platforms. Such

environments encourage students to participate actively in their learning experiences. Moreover, integrating active learning into the curriculum can ensure that all courses incorporate these strategies. Institutions can encourage interdisciplinary projects that connect language learning with other subjects, making the process more relevant and engaging for students. Becker and Park (2011) found that such integrative approaches significantly enhance student learning outcomes across disciplines. Additionally, providing access to diverse resources, such as literature, multimedia materials, and online tools, can further enrich the active learning experience.

References

Adler, M. J. (1982). The Paideia proposal: An education manifesto. NY: Macmillan.

Akbari, Z. (2015) 'Current challenges in teaching/learning English for EFL learners: The case of junior high school and high school', *Procedia - Social and Behavioral Sciences*, 199, p. 396. https://doi.org/10.1016/j.sbspro.2015.07.524.

Altin, M. and Saracaloğlu, A.S. (2018) 'İngilizce öğretimindeki ihtiyacimiz nedir? Bir olgu bilim çalişmasi', *Dil Eğitimi ve Araştırmaları Dergisi*. httos://doi.org/10.31464/jlere.379358.

Anderson, L. (2015). A Scholar's guide to getting published in English: Critical choices and Practical Strategies. *ELT Journal*, *69*(3), 339–342. https://doi.org/10.1093/elt/ccv022

Azevedo, R., Greene, J. A., Moos, D. C., Winters, F. I., & Godbole-Chaudhuri, P. (2006). Is externally regulated learning by a human tutor effective in facilitating learning with hypermedia? In S. A. Barab, K. E. Hay & D. T. Hickey (Eds.), *The 7th international conference of the learning sciences* (pp. 16–22). Mahwah, NJ: Erbiyum.

Barbour, M. K., & LaBonte, R. (2017). The impact of technology on student engagement and achievement. *Journal of Educational Technology Systems*, 45(3), 364-384. https://doi.org/10.1177/0047239517694573

Batmaz, Ö. (2023). The Effect of Student-Centered Teaching Practices on the Development of Speaking Skills: A Meta-Analysis Study. *Dil Eğitimi ve Araştırmaları Dergisi*, *9*(1), 59–105. https://doi.org/10.31464/jlere.1212545

Becker, K., & Park, K. (2011). "Effects of Integrative Approaches among STEM Subjects on Students' Learning: A Preliminary Meta-Analysis." *Journal of STEM Education Research*, 2(1), 23-37.

Bell, D. & Kahrhoff, J. (2006). Active learning handbook. Louis, Missouri: Copyright Webster University.

Biswas, G., Leelawong, K., Schwartz, D., Vye, N., & Teachable Agents Group at Vanderbilt (2005). Learning by teaching: A new agent paradigm for educational software. *Applied Artificial Intelligence,* 19, 363–392.

Bodemer, D., Ploetzner, R., Feuerlein, I., & Spada, H. (2004). The active integration of information during dynamic and interactive visualizations. *Learning and Instruction, 14*, 325–341.

Bonwell, C. C., & Eison, J. A. (1991). *Active Learning: Creating Excitement in the Classroom*. ASHE-ERIC Higher Education Report No. 1. Washington, DC: George Washington University, School of Education and Human Development.

Boud, D., & Falchikov, N. (2006). Aligning assessment with long-term learning. *Assessment & Evaluation in Higher Education*, *31*(4), 399–413. https://doi.

org/10.1080/02602930600679050

Bransford, J. (2000). *How people learn: Brain, mind, experience, and school*. Washington, D.C: National Academy Press, 195

Brown, H. D. (2000). Principles of language learning and teaching (4th ed.). New York, NY: Pearson Longman.

Charalambos, Vrasidas. (2000). Constructivism versus objectivism: *Implications for Educational Telecommunications.* 6.

Cherney, I.D. (2011). Active learning. In R. L. Miller, E. Amsel, B. M. Kowalewski, B. C. Beins, K. D. Keith, & B. F. Peden (Eds*.), Promoting student engagement, (1*), p. 154

Chi, M.T. (2009) 'Active-constructive-Interactive: A conceptual framework for differentiating learning activities', *Topics in Cognitive Science*, 1(1), p. 77. https://doi:10.1111/j.1756-8765.2008.01005.x.

Chickering, A.W. and Gamson, Z.F. (1991) 'Appendix A: Seven principles for good practice in Undergraduate Education', *New Directions for Teaching and Learning*, 1991(47), p. 43. doi:10.1002/tl.37219914708.

Chinn, C. A., & Malhotra, B. A. (2002). Epistemologically authentic inquiry in schools: A theoretical framework for evaluating inquiry tasks. *Science Education*, 86, 175–218.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective Teacher Professional Development.* Palo Alto, CA: Learning Policy Institute

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. Plenum Press. http://dx.doi.org/10.1007/978-1-4899-2271-7

Demirci,C. & Akcaalan, M. (2020). Active learning: English language teaching via write share learn strategy. *International Journal of Educational Research Review*, 5(3), 214-220.

Dirsa, A., Bp, S. A., Diananseri, C., & Setiawan, I. (2022). Teacher role as professional educator in school environment. *International Journal of Science Education and Cultural Studies*, *1*(1), 32–41. https://doi.org/10.58291/ijsecs.v1i1.25

Do, Trang. (2022). Progressive Education: Views from John Dewey's Education Philosophy. WISDOM. 4. https://doi.org/10.24234/wisdom.v4i3.907.

Doğan, C. (2016). Self-efficacy and anxiety within an EFL context. Journal of Language and Linguistic Studies, 12(2), p. 63.

Dursun, F., Bektaş Bedir, S., & Önkuzu Gülcü, E. (2017). Lise İngilizce Dersi Öğretmenlerinin Öğretim Programına İlişkin Görüşlerinin İncelenmesi. *Milli Eğitim Dergisi,* 46(216), 135-163.

Erarslan, A., & Arslan, A. (2020). Online Learning Experiences of University Students and the Effects of Online Learning on their Learning Practices. *Language and Technology,* 2(1), 44-58.

Ermawati, E., Nurchalis, N. F., & Sardi, A. (2021). Online EFL teaching and learning: different skills, different challenges. *DOAJ (DOAJ: Directory of Open Access Journals)*. https://

doi.org/10.24256/ideas.v9i1.1912

Felder, R. M., & Brent, R. (2009). Active learning: An introduction. *ASQ higher education brief*, 2 (4), 1-5.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education,* 78(7), 674-681.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist,* 34(10), 906-911. https://doi.org/10.1037/0003-066X.34.10.906

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Wenderoth, M. P., & Crowe, A. J. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences,* 111(23), 8410-8415. https://doi.org/10.1073/pnas.1319030111

Furtak, Erin & Seidel, Tina & Iversen, H. & Briggs, Derek. (2012). Experimental and Quasi-Experimental Studies of Inquiry-Based Science Teaching: A Meta-Analysis. *Review of Educational Research.* 82. 300-329. 10.3102/0034654312457206.

Gillett-Swan, J. (2017) 'The challenges of online learning: Supporting and engaging the isolated learner', *Journal of Learning Design*, 10(1), p. 27. doi:10.5204/jld.v9i3.293.

Graesser, A. C., Person, N. K., & Magliano, J. P. (1995). Collaborative dialogue patterns in naturalistic one-on-one tutoring. *Applied Cognitive Psychology,* 9, 495–522.

Granmo, M. and Bengtsson, F. (2015) 'Teaching anatomy in the multimedia world—using digital tools for progressive learning over time', *Creative Education*, 06(11), p. 1194. doi:10.4236/ce.2015.611117.

Hamad, W. (2022) 'Understanding the foremost challenges in the transition to online teaching and learning during COVID-19 pandemic: A systematic literature review', *Journal of Educational Technology and Online Learning*, 5(2), p. 400. doi:10.31681/jetol.1055695.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research,* 77(1), 81-112. https://doi.org/10.3102/003465430298487

https://doi.org/10.1177/1469787407074008.

Hmelo-Silver, C. E. (2004). Problem-Based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235–266. https://doi.org/10.1023/b:edpr.0000034022.16470.f3

Hwang, G. J., & Chang, T. S. (2011). Seamless flipped learning: A mobile technology enhanced learning environment for encouraging student engagement and collaboration. *Educational Technology & Society*, 14(3), 131-143.

İyitoğlu, O. and Alci, B. (2015) 'A qualitative research on 2nd grade teachers' opinions about 2nd grade English language teaching curriculum', *İlköğretim Online*, 14(2), p. 692. doi:10.17051/io.2015.73998.

Johnson, D. W., & Johnson, R. T. (1994). Cooperative learning: JSAS Catalog of Selected Documents in Psychology, 24(8), 8.

Johnson, D. W., & Johnson, R. T. (2014). "Cooperative learning in 21st century." *Anales de Psicología*, 30(3), 841-851.

Kastens, K. A., & Liben, L. S. (2007). Eliciting self-explanations improves children's performance on a field-based map skills task. *Cognition and Instruction*, 25, 45–74.

Keyser, M.W. (2000) 'Active learning and cooperative learning: Understanding the difference and using both styles effectively', *Research Strategies*, 17(1), pp. 35–44. doi:10.1016/s0734-3310(00)00022-7.

Khamwan, T. (2007). The Effects of interactional strategy training on teacher-student interaction in an EFL classroom. Suranaree University of Technology, Nakhon Ratchasima, Thailand.

Klahr, D., & Nigam, M. (2004). The equivalence of learning paths in early science instruction. *Psychological Science,* 15, 661–667.

Krishnan, S., & Nalim, R. (2009). Project - Based learning in introductory thermodynamics. Paper AC 2009-1911, Session: Outstanding Contributions to Mechanical Engineering Education. Presented at the 116th ASEE Annual Conference.

Larsen-Freeman, D., & Anderson, M. (2011). Techniques and principles in language teaching (3rd ed.). London, UK: Oxford University Press.

Machemer, P. L., & Crawford, P. (2007). Student perceptions of active learning in a large cross-disciplinary classroom. *Active Learning in Higher Education*, *8*(1), 9–30.

Makovec, D. (2018) 'The teacher's role and Professional Development', *International Journal of Cognitive Research in Science Engineering and Education*, 6(2), p. 43. doi:10.5937/ijcrsee1802033m.

Mazlan, A. F., Mohamad, M., Reesha, A., Kassim, R., Othman, Z., & Kummin, S. (2021). Challenges and Strategies to Enhance Online Remote Teaching and Learning by Tertiary Institution Educators: A Literature Review. *Creative Education,* 12, 718-726. https://doi.org/10.4236/ce.2021.124050

Mestre, J. P. (2001). Implications of research on learning for the education of prospective science and physics teachers. *Physics Education,* 36, 44–51.

Michael, J. (2006). Where's the evidence that active learning works? *Advances in Physiology Education,* 30(4), 159-167. https://doi.org/10.1152/advan.00053.2006

Moravec, M. P., Williams, A., Aguilar-Roca, N., & Carle, A. (2010). Learn before lecture: A strategy for increasing student engagement in a flipped classroom. *Journal of College Science Teaching*, 40(5), 24-29.

Mukminin, A., Muazza, Hustarna, & Sâri, S. R. (2015). Stories from the frontlines: Iniservice teachers' demotivating factors and policy recommendations. *International Journal of Academic Research in Education,* 1(2), 40-52. DOI: 10.17985/ijare.56085

Nartiningrum, Novrika & Nugroho, Arif. (2021). English Teachers' Perspectives on Challenges, Suggestions, and Materials of Online Teaching amidst the Global Pandemic. *IJEE (Indonesian Journal of English Education).* 1. 101-119. 10.15408/ijee.v1i1.17886.

Nguyen, K. A., Borrego, M., Finelli, C. J., DeMonbrun, M., Crockett, C., Tharayil, S., Shekhar, P., Waters, C., & Rosenberg, R. (2021). Instructor strategies to aid implementation of active

learning: a systematic literature review. *International Journal of STEM Education*, *8*(1). https://doi.org/10.1186/s40594-021-00270-7

Niktinat, S. (2021) 'Active learning in online classes', *Proceedings of the 3rd International Conference on Modern Research in Education, Teaching and Learning*, p. 8. doi:10.33422/3rd.icmetl/.2021.08.97.

Nishanthi, R. (2018) 'The importance of learning English in today world', *International Journal of Trend in Scientific Research and Development,* Volume-3(Issue-1), pp. 871–874. https://doi.org/10.31142/ijtsrd19061.

Noviani, S. (2021). Instructional Strategies Toward Real-Time Online Teaching at an Informal English Institution: An Explanatory Study on Instructional Strategies. *Journal of English teaching,* 7(3), 273-285. DOI: https://doi.org/ 10.33541/jet.v7i3.2921

Nurbavliyev, O., Kaymak, S. y Sydykov, B. (2022). The effect of active learning method on students' academic success, motivation and attitude towards mathematics. *Journal of Language and Linguistic Studies,* 18(2), p. 710.

Nycz, M. and Cohen, E.B. (2007) 'Basics for Understanding E-Learning', in *Principles of Effective Online Teaching*. Santa Rosa, CA: Informing Science Press, pp. 5–6.

O'loughlin, M. (1992) 'Rethinking science education: Beyond Piagetian constructivism toward a sociocultural model of teaching and learning', *Journal of Research in Science Teaching*, 29(8), pp. 792–793. doi:10.1002/tea.3660290805.

Olusola-Fadumiye, T.O., Harun, J.B. and Oke, J.O. (2020) 'Challenges of learning-based technology in the COVID-19 ERA through the use of social media implementation in the Educational System', *Proceedings of the 2nd Early Childhood and Primary Childhood Education (ECPE 2020)*, p. 288. doi:10.2991/assehr.k.201112.051.

Özmat, D. and Senemoğlu, N. (2020) 'Yabancı Dil öğrenmeyi Zorlaştıran Faktörler üzerine Nitel Bir çalışma', *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, 21(3), p. 1239. doi:10.17679/inuefd.734985.

Park, C. (2003) 'Engaging students in The learning process: The learning journal', *Journal of Geography in Higher Education*, 27(2), pp. 183–184. doi:10.1080/03098260305675.

Patrick, L. E., Howell, L. A., & Wischusen, W. (2016). Perceptions of active learning between faculty and undergraduates: Differing views among departments. *Journal of STEM Education: Innovations and Research*, *17*(3), 55

Piaget, J. (1973). To understand is to invent: The future of education. Grossman Publishers.

Prabhu, N. S. (1990). There is no best method—why? TESOL Quarterly, 24(2), 161-176.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education,* 93(3), 223-231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Prince, M.J., & Felder, R.M. (2007). The Many Faces of Inductive Teaching and Learning. *The journal of college science teaching,* 36(5), p. 16.

Ragan, L.C. (2023) *10 Principles of Effective Online Teaching: Best Practices in Distance Education*, *Faculty Focus | Higher Ed Teaching & Learning*. Available at: https://www.facultyfocus.com/ (Accessed: 11 May 2024).

Richardson, V. (2003) 'Constructivist pedagogy', *Teachers College Record: The Voice of Scholarship in Education*, 105(9), pp. 1623–1624. doi:10.1046/j.1467-9620.2003.00303.x.

Salmon, G. (2014) 'Learning innovation: A framework for transformation', *European Journal of Open, Distance and E-Learning*, 17(2), p. 225. doi:10.2478/eurodl-2014-0031.

Schwartz, D. L., & Bransford, J. D. (1998). A time for telling. *Cognition and Instruction*, 16, 475–522.

Selwyn, N. (2014). Digital technology and the contemporary university: The digital university. *International Journal of Digital University*, 1(1), 5-20. https://doi.org/10.4324/9781315768656

Siemens, G. (2005). Connectivism: A learning theory for the digital age. International Journal of Instructional Technology and Distance Learning, 2(1), 3-10

Stump, G. S., Husman, J., & Corby, M. (2014). Engineering students' intelligence beliefs and learning. *Journal of Engineering Education*, *103*(3), 369 387. https://doi.org/10.1002/jee.20051.

Suleiman, A.A. (2022) 'Active learning strategies administration in English language e-learning environments in Saudi universities', *EPRA International Journal of Multidisciplinary Research (IJMR)*, 8(12), p. 219. https://doi.org/10.36713/epra2013.

Suthers, D. D., & Hundhausen, C. D. (2003). An empirical study of the effects of representational guidance on collaborative learning. *Journal of the Learning Sciences,* 12, 183–219.

Tai, L. (2007) Corporate e-learning. doi:10.1093/acprof:oso/9780195311310.001.0001.

Tartari, E. and Kashahu, L. (2021) 'Challenges of students in online learning', *Kultura i Edukacja*, 134(4), p. 238. doi:10.15804/kie.2021.04.13.

Taşçı, S. (2023). A comprehensive study on the problems of English language teaching in Turkey: Reflections from pre-service ELT teachers. *Trakya Journal of Education*, 13(3), p. 1668.

Tedesco-Schneck, M. (2013). Active learning as a path to critical thinking: Are competencies a roadblock? *Nurse Education in Practice, 13*(1), 58-60.

Todd, R.W. (2020) 'Teachers' perceptions of the shift from the classroom to online teaching', *International Journal of TESOL Studies*, p. 14. doi:10.46451/ijts.2020.09.02.

Tong, F. H., Marlin, S. G., & Frost, B. J. (1995). Cognitive map formation in a 3D visual virtual world. Poster presented at the IRIS/PRECARN workshop, Vancouver, BC.

Uluuysal, B. and Kurt, A.A. (2022) 'Analysis of a teacher's online teaching material planning and Development Processes: English lesson example', *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, (62), p. 254. doi:10.21764/maeuefd.972999.

Uztosun, M.S. (2017) 'Hizmetiçi öğretmenlerin Türkiye'de İngilizce öğretim Kalitesi Hakkında görüşleri', *Erzincan Üniversitesi Eğitim Fakültesi Dergisi*, p. 150. doi:10.17556/erziefd.334460.

Vygotsky, L.S. (1930) 'Social Interaction and the Transformation of Practical Activity', in *Mind and Society*. Massachusetts, Cambridge: Harvard University Press, p. 12.

Wahyudin, A.Y. and Rido, A. (2020) 'Perceptuals learning styles preferences of international master's students in Malaysia', *BAHTERA : Jurnal Pendidikan Bahasa dan Sastra*, 19(1), p. 102. doi:10.21009/bahtera.191.10.

Walker, Stacy. (2003). Active Learning Strategies to Promote Critical Thinking. *Journal of athletic training.* 38. p. 265.

Zeidan, A. (2023) *Languages by total number of Speakers*, *Encyclopædia Britannica*. Available at: https://www.britannica.com/topic/languages-by-total-number-of-speakers-2228881. (Accessed: 02 October 2024).

About the Authors

Prof. Dr. Cavide Demirci is a faculty member at Eskisehir Osmangazi University, where she is situated within the Faculty of Education. Demirci completed her undergraduate, postgraduate, and doctoral studies at Hacettepe University and currently holds the position of head of the Educational Sciences Department. Her research and teaching interests are primarily centered on active learning methodologies, teacher training, and the learning-teaching process.

E-Mail: demircicav@gmail.com, cdemirci@ogu.edu.tr, **ORCHID:** 0000-0003-4789-4286

Kamil Yar is a postgraduate student at Eskişehir Osmangazi University in the Faculty of Education. He is presently engaged as an English language teacher, with a primary focus on linguistics and second language acquisition. His research involves comparative analyses of language pedagogy and instructor competence.

E-Mail: kamil.yar@icloud.com, **ORCHID:** 0009-0000-0669-5008

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 4%.

To Cite This Chapter:

Demirci, C. & Yar. K. (2024). Active Learning in english language teaching: Bridging theory and practice. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024.* (pp. 167-196) ISRES Publishing

Juniper (Ar'ar) Tree in Classical Turkish Literature

Fatıma AYDIN

Osmaniye Korkut Ata University

Introduction

Trees play a major role in the daily life and beliefs of human beings. Humans have used trees to survive, to keep warm, to attack or to produce. Since the Chipped Stone Age, people have continuously benefited from the tree species around them. Prioritizing trees with more vital value at first, human beings have also attributed a spiritual value to trees over time. Thus, trees and their fruits, which were initially used as a source of food and for the treatment of diseases, have gained a different identity. Over time, trees have become symbols with different meanings. Some trees were considered sacred in mythologies and religions and were seen as a gift from the gods (Gezgin, 2021, pp. 11-12).

In many cultures, trees have been seen as symbols of life, vitality and growth and development (Yıldırım, 2006, p. 245). The tree, which has a place as important as air, water and soil in the beginning and continuation of humanity, has influenced many cultures throughout the ages. In many cultures, the tree was considered sacred and turned into a cult. Cult means respect and worship towards beings known as supreme and sacred (Kayabaşı & Cini, 2024, p. 640). The basis of the acceptance of plants as cults is the concept of cosmic tree. In world cultures, there are three cosmic levels: underground, earth and sky. The communication between these three cosmic levels is sometimes a mountain, sometimes a universal pillar, and sometimes the tree of life, which is the source of human life (Ergun, 2017, p. 26). The tree of life rises from the center of the earth and connects all cosmic regions (Isık, 2004,p. 92). This tree, which is at the center of everything, is thought to be higher than all the trees of the earth and to be the representative of God on earth.

The tree is also given great importance in Turkish culture. In Turkish thought, the tree has assumed many roles such as derivation, nutrition, contact with God, reaching heaven, healing, wishes, and managing natural events (Ergun, 2017, p. 25). From ancient times to the present day, it has been believed among Turkish communities that planting trees around temples and near graves is a sacred duty. However, it is reported that the tree was considered sacred not as a result of its material existence, but as a result of some of its properties and the power it represents (Işık, 2004, p. 90). In ancient Turkic culture, it is believed that rocks, trees, bushes, mountains, floods, grasses, flowers, and especially objects made by human hands carry within them a very special essence, a being, a spirit (Roux, 2000, p. 32). We see the sacred tree form in many Turkish epics. According to the Altais, there was water before the creation of the earth. God, called Kuday or Ulgen, commanded the "person" who befriended him to bring up soil from the bottom of the sea. The first humans grew like fruit on a tree branch (Inan, 1986: 14). In the Er- Sogotoh saga of the Yakut Turks, Er- Sogotoh, the first human being, was brought down to the earth with a sacred tree (Ogel, 2010, p. 97). A similar motif is also seen in the Uighurs' Derivation myths. The princes, who are considered to be the ancestors of the Uighurs, were born from the beech tree between two rivers (Ogel, 2010, p. 141). Again in Dede Korkut, it is seen that Basat derives from a great tree (Işık, 2004, p. 92). In the Oghuz Kagan epic, Oghuz Kagan is found in the middle of a river.

The place of the tree is also important in Abrahamic religions. In the Torah, the holy book of Judaism, the tree of life and the tree of knowledge of good and evil are mentioned in the creation of the world. Another tree considered sacred in Judaism is the gopher tree. God told Noah to build his ark from the gofer tree. Other trees that are considered sacred are the oak, acacia tree, sunnuk

tree, erz tree and date palm. It is reported that the Erz tree is the tree of Allah, that it was planted by Him and that birds build nests on it (Ergun, 2017:, p.138-140). In Christianity, the cross made from the wood of the tree of good and evil has replaced the cosmic tree. The cross is seen as a tree rising from the ground to the heavens. The most important symbol of the tree is that it is accepted as the tree where Jesus was crucified. Another important tree in Christianity is the pine tree. Pine is the symbol of Christmas, the religious holiday of Christianity (Ergun, 2017, p. 130). In Islam, the protection of plants, which are very necessary for the health and nutrition of people and other living creatures and for providing various means of livelihood, and the issue of not cutting them unnecessarily has also been given importance. Plants are given a wide coverage in the Holy Quran and hadiths. In Mecca, the plucking of plants was forbidden from the time of Prophet Abraham. Prophet Muhammad also attached great importance to the planting, cultivation and protection of trees and planted trees himself. He also had many miracles related to trees (Topaloğlu, 1988, p.458; And, 2007, p. 141). In the Islamic world, the pomegranate, fig and olive trees mentioned in the Qur'an were considered sacred and valued. The olive tree was also referred to as the tree of blessings. Another tree mentioned in the Qur'an is the oleander tree, which grows in hell and is said to be the food of the people who will go there. It is referred to as the Shajar-i mel'ûna, the cursed tree. It is also called Shajar al-ahdar, the green tree, and it is stated that Allah created fire from it and put it at the service of people. As for the tree of eternity, it is mentioned in the Qur'an as the tree that Adam and Eve were forbidden to eat from. It was under the shade of the tree of contentment, or shajarat al-ridwān, that Muslims pledged allegiance to Prophet Muhammad. The tree of Tûbâ is promised in the Qur'ân al-kerîm to those who do good deeds. It is believed that the roots of the Sidret al-muntehâ are located in Paradise. The Yaktîn tree is a tree said to have been created for Prophet Yunus in the Qur'an (Ergun, 2017, pp.107-108; Tanyu, 1988, pp. 458-459). Among plants, trees are perhaps the most important. In many communities, trees are considered sacred and valued. In the Qur'an, the holy book of Islam, the word shajar or shajarah occurs in twenty-six places, both in the sense of tree and plant in general. The Qur'an states that the tree was created as a work of divine grace and power and draws attention to the fact that many living things cannot live without trees (Topaloglu, 1988, p. 457). The Qur'an mentions the names of some trees such as dates, pomegranates, grapes, bananas, figs and olives. Apart from these, trees such as zakkûm, tûbâ, sidretü-l- müntehâ, yaktîn, şecer-i memnu, şecer-i ahdar, şeceretü'l- huld are also mentioned (Topaloğlu, 1988, p. 457; Ergun, 2017, pp. 107-108). In Surah Tîn, fig and olive trees are sworn by (Tîn 95/1). In Surah Hajj, it is said that everything in the heavens and the earth, the sun, moon, stars, mountains, trees, animals and many people prostrate to Allah (Hajj 22/18). This is one of the indicators of the importance given to the tree.

The tree motif occupies a large place in classical Turkish poetry. The tree is seen as a symbol of life, vitality, growth and development. In Classical Turkish Literature, trees are also discussed outside of garden depictions. According to the poets, trees are Allah's gift to His servants. Allah has hidden many wisdoms in mountains, stones and of course trees:

"Bu tag u taş u toprakda agaçlarda vü yaprakda

Ne hikmetler nihân eyler te'âla'llah zihî sâni' " Hakîkî (Esir, 2017, K. 266/9)

(In this mountain, stone, soil, trees and leaves, Allah hides wisdom, and He is the best of builders.)

Studying the colors of the leaves of trees reminds the servants of Allah's art:

"Ne san'at itdi agaçlara Kudretün kalemi

Ki reng reng görinür nite ki bûkalemûn" Ahmedî (Akdogan, 1979, K. 65/2)

(How Allah's pen made art on the trees so that they appear colorful like chameleons).

Each leaf of the trees turns into a mouth and tells about Allah:

"Bahâr eyyâmı remz-i vahdeti berg-i çemen söyler

Şecerde her varak esrâr-ı Hakkı bî-dehen söyler" Mehmed Sıdkî (Eren, 2017, G. 55/1)

(In the days of spring, the leaves of the garden speak the sign of unity. Every leaf on the tree speaks the secret of Allah without a mouth).

The movement of the trees in the wind reminds poets of someone praying. Şeyh Gâlib refers to the prostration of trees in his masnavi Hüsn ü Aşk:

"Hep secdeye vardı berg ü eşcâr

Hayretle eridi akdı enhâr" Şeyh Gâlip (Dogan, 2017, Hüsn ü Aşk, Mes./ 293)

(All leaves and trees prostrated themselves. All rivers melted and flowed in amazement.)

Mehmed Sıdkî, on the other hand, stated in the following couplet that the trees prostrate themselves. He also said that at the time of dawn, birds and savages express the oneness of Allah with love:

"Sâcid olmuş cümle esmâr râki'olmuş hep şecer

Mürg ü vahşî 'aşk ile tevhîd okur vakt-i seher" Mehmed Sıdkî (Eren, 2017, G. 70/2)

(All the trees have bowed down, all the fruits have prostrated. At the time of dawn, birds and wild animals recite Tawheed with love).

Trees have also been the subject of prophetic miracles. In the following couplet, Vahyî alludes to the Prophet Muhammad's revival of a dead tree. The poet says, "*You are that prophet of miracles who, with the effect of your gaze, made the dead tree fruitful in one breath*.":

"Sen ol Peygam-ber-i iccâz-perversin ki bir demde

Dıraht-ı mürdeyi feyz-i nigâhun mîvedâr eyler" Vahyî (Tas, 2017, K. 6/26)

The revival of the dead tree is also among the miracles of Jesus Christ. In the following couplet, Naylī says, "*Just as Jesus' breath revived the dead tree, the morning wind made the cypress of the rose garden walk."*:

"Nesîm-i subh reftâre getürdi serv-i gülzârı

Dem-i 'Îsî gibi ihyâ idüp emvât-ı eşcârı" Neylî (Erdem, 2005, Byt. 83)

Süleyman Çelebi, on the other hand, in the following couplet, refers both to the tree's bearing witness to the prophethood of the Prophet Muhammad and its prostration to the Prophet Muhammad:

"Hem ağaçlar kıldılar ana sücûd

Oldılar haklığına cümle şühûd" Süleyman Çelebi (Pekolcay, 2007, Vesiletü'n- Necat, 330)

There is also a miracle of the Prophet Muhammad walking a tree (Yucel, 2020 316). Hamdî of Lârendeli alludes to this event in the following couplet:

"Bir barmagunla iki bölünür felekde ay

Köklü ağaçları yürüdürsin bilâ-kadem" Lârendeli Hamdî (Kutuk, 2002, Leylâ u Mecnûn, Mes. / 273)

Since trees are seen as living beings in some cultures, they feel the treatment they receive. For this reason, bad words and behaviors in the presence of trees are frowned upon. In the couplet below, Âşık Çelebi states that the tree should not be stoned and that it will not bear fruit when stoned:

"Urdukça seng 'Âşıka eyler du'â senâ

Taşlanmaz ol dıraht ki ol virmeye semer" Âşık Çelebi (Kılıc, 2017, G. 84/5)

In Classical Turkish Poetry, some trees are especially included in garden metaphors. This study examines how the Juniper tree, which has an important place in Turkish culture, is handled in Classical Turkish Poetry. While selecting examples from the hundreds of couplets analyzed, only one of the couplets with the same meaning or repeating the same metaphor was selected in order to avoid repetition.

Juniper Tree in Classical Turkish Poetry

Juniper is defined as "a tree of the cypress family, fragrant, evergreen in winter, whose round black nuts are used as medicine" (Parlatır, 1998, pp. 83-128). It is also known as mountain cypress and ar'ar. The juniper tree has pointed and long leaves and shiny black, cone-shaped fruits. It has a very effective odor that strikes people. It is known that its smell is more pronounced especially in rainy weather. This tree can grow up to 8-9 meters in average. Since the juniper tree is resistant to difficult climatic conditions, it can live for hundreds of years. Juniper is even known as the last tree to leave the forest. It is thought that the word juniper, which means remaining and not disappearing, was given as a name to this tree for this reason (Alçay, Akgül et al. 2018: 45; Torlak, 2009). Juniper is a tree that does not shed its leaves in winter.

Juniper is a well-known and respected tree in the Turkic world. The juniper tree is seen in ancient Uyghur inscriptions. In ancient Turkic beliefs, juniper represents strength and resilience. The sanctity of this tree, which is the subject of Kashgarli Mahmut's work, came from Asia to Anatolia through Turkmens. According to Kashgarli, the word juniper is the name of two places in Kashgar. In another narration, the ay agili (moon house) is mentioned as the most beautiful thing among the Turks. Kashgarli Mahmut: Whoever said (shameful), the ear has heard that the moon house is a juniper branch (Ogel, 1995, pp. 472-473). Juniper graves have a very important place in Central Asia and Anatolia. Juniper has been one of the symbolic trees of Turkish culture. It is used as "arça" in Turkestan and "arçın" further north. The ancestors of the Yakuts believed that juniper had a divine, magical power, and they fumigated many places with juniper incense (Ergun, 2017, p. 281). The Turks living in Altai used the word "arçın" for juniper. Juniper is the most important symbol of cleanliness and holiness. Juniper is used against the devil and all kinds of evil spirits (Ergun, 2017, p. 283). Juniper is one of God's blessed trees. With its tall stature, it rises up to the sky and scatters the light of God. At the same time, the moon receives its light from the juniper and therefore from God. Because juniper is described as the home of the moon. In other words, the moonlight received its beauty from the juniper tree that carries God's blessing (Ergun, 2017, p. 282). Incense was burned from juniper tree to purify from evil.

Since the juniper tree is very valuable and has many benefits, it is forbidden to be cut in some regions and certain rules are imposed when its branches are plucked. The person who takes the juniper branch must be clean, and none of his/her close relatives must have died within a year. Before taking the branch of the tree, an anchor should be tied and a prayer to God should be

made. Then, after telling the reason for taking the branch and asking permission from the tree, the branch should be taken in a hurry by sprinkling milk around. However, two branches should not be taken at once and the branch should be broken by leaning towards the north. It is believed that bad words and behaviors should not be made in places where juniper trees grow. It is believed that those who act badly will be punished with illness or death (Ergun, 2017,p. 284). In Fethiye and Seydikemer Yoruks, old juniper trees are considered great because they are likened to human beings. Therefore, juniper trees are never cut down as long as they do not dry up. Even damaging the leaves is considered a sin (Eroglu, 2015: 99).

In classical Turkish poetry, juniper is often used with the name "ar'ar". This beautiful tree is an indispensable element of garden descriptions. In his song heralding the arrival of spring, Gâlib depicts green cypresses, nesrin, ar'ar and jasmines watching the way to spring:

"Muntazır teşrîfine saf saf durur serv-i çemen

Vaktidir ey nev bahâr-ı işve bu gülzâra gel

Yolların bekler gül-i nesrîn ü ar'ar yâsemen

Vaktidir ey nev-bahâr-ı işve bu gülzâra gel" Şeyh Gâlib (Okcu, 2017, Şarkı-4/1)

When the rose garden is likened to a battlefield, the juniper becomes the banner:

"Leşker-i sultān-ı gül baŝdı çemen iḳlìmini

Dikdi ŝahn-ı gülşene 'ar'ar livā nev-rūzda" Feridûn (Simşek, 2002, G. 14/10)

In winter depictions, the juniper covered with snow is likened to a wandering person wearing a white turban:

"Başında kar saçağı sarık arkada sâde

Nice gezer bu soğuklarda bilmezem ar'ar" Nedim (Macit, 1997, K. 13/2)

Juniper trees are used in city descriptions:

"Hevâsı mu'tedildür suyı kevser

Dırahtı nâr-venle serv ü 'ar'ar

Otı reyhân u sünbül hâki 'anber

Ne hoş yaylak imiş bu şehr-i Lâdik" Mihrî Hatun (Arslan, 2007, Kt. 4)

Juniper is likened to many elements in Classical Turkish poetry. It is likened to a pen with its smooth length:

"Yazdıgun her nâme ki bir gülşen-i inşâ olur

Hat şükûfe nokta jâle satr cû 'ar'ar kalem" Âşık Çelebi (Kılıc, 2017, K. 7/20)

(Every letter I write becomes a prose rose garden. Every flower bud and dewdrop is a dot, a line is a stream and a juniper is a pen.)

The straight stature of this tree reminded the poet of the righteous chaste person:

"Serv ü 'ar'ar pāk-dāmen iki doġrı Ĥūbdur

Bāġ içinde el uzatmasın çenār anlara hā" Seyrî (Gokkaya, 2017, K. 5/10)

(The cypress and the juniper are two chaste, righteous beauties. Let not the sycamore lay a hand on them in the vineyard).

Juniper is also called mountain cypress tree. In this respect, poets have described it as a peasant:

"Nigāruŋ ŝūreti āyìnesi ŝōfî Ĥudāyìdür

Ŝafā-yı ĥāšır ile baķmayan aŋa mürāyìdür

Kemāl-i i'tidāl-i ķaddi yoķdur serv ü 'ar'arda

Biri ġāyetde şehrìdür birisi rūstāyìdür" İshak Çelebi (Keklik, 2014, M. 86/1)

(O ascetic! The beauty of the beloved is from Allah; he who does not look at her sincerely is a hypocrite. The superior beauty of her measured height is not found in the cypress and juniper; one is very urban and the other is a peasant.)

The juniper tree is described as a person who opens his hands and prays:

"Bâg-ı 'âlemde müdâm açup elün çün 'ar'ar

'İzzet ü devletine eyle du'â her meh ü sâl" Âşık Çelebi (Kılıc, 2017, K. 6/30)

(Every year and month, the Juniper constantly opens its hand in the garden of the universe to pray for the glory and state).

The juniper tree is remembered in Classical Turkish poetry for its tall stature. In the following couplet, Nev'i-zâde Atâyî refers to the height of the juniper tree while praising the morning wind. The morning wind is so strong that it bends the head of the juniper tree, whose head is high:

"Sabâ gibi kanı 'âlemde rind-i şâhid-bâz

Baş egdürür niçe 'ar'ar gibi serefrâze" Nev'i-zâde Atâyî (Karakose, 2017, G. 95/2)

The center of the world of Classical Turkish Poetry is love. For this reason, all beauty reminds the beloved. The juniper tree that beautifies the garden reminds the poet of the beloved in many ways. The height of the juniper tree reminds the lover of the beloved's height. The poet compares the beloved to a cypress and a juniper tree and expresses that he/she does not know whether it is a cypress tree that adorns the heart or a tall juniper tree swaying in the garden of his heart:

"Bâg-ı dilde salınan serv-i dilârâ mı gelür

Bilemem yohsa ki bir 'ar'ar-ı bâlâ mı gelür" Enderunlu Hasan Yâver (Ustuner, 2010, G. 68/1)

When the beloved sways with her tall stature, some liken her to a hind and call her the one who draws the heart:

"Kaçan ol serv ü sehî-kaddi hirâmanda gôrüp

Kimiler 'ar'ara nisbet ile dil-cû dediler" Ali Handi (Senyurt, 2004, G. 49/3)

The juniper tree is famous for its tall stature. However, the poet finds the juniper tree short compared to the lover's height:

"Bâgbân her ne kadar göge çıkarsa ögerek

Kadüne nisbet ile `ar'ara kûtâh derin" Şeyhülislam Yahyâ (Kavruk, 2001, G. 275/2)

(No matter how much the gardener praises and ascends to the sky, I call the juniper tree short compared to (the lover's) height.)

Bâkī also compares the height of the beloved and the juniper tree. The poet acknowledges that the juniper tree is tall, but states that it does not have the beauty of the beloved's height:

"Egerçi 'ar'ar-ı bâgun bülend kâmeti var

Nihâl-i kaddüñe nisbet letâfeti yokdur" Bâkî (Kucuk, 1994, G. 169/2)

Juniper is an evergreen tree that adorns gardens. But the most important element that adorns the world of the lover poet is his beloved. For this reason, instead of the cypress or juniper tree in the garden of the universe, the poet wants his beloved who is as tall as them:

"Ne serv ister ne 'ar'ar ister anca bāğ-ı ālemde

Hemān bir serv-kadd-i dildār-ile geşt ü güzār ister" Nazir İbrahim (Sengun, 2006, G 246/4)

Poets make comparisons between the height of the juniper tree and the height of the beloved. The winner in these comparisons is always the beloved. İshak Çelebi says that the lover is taller than the juniper:

"Ķāmet-i bālāŋ ile işin bitürdüŋ 'ar'aruŋ

Dōstum ġāyet ser-āmedsin bulınmaz hem-serüŋ" İshak Çelebi (Cavusoglu&Tanyeri, 1989, M. 4/1)

(You defeated the juniper with your long neck. My friend, you are very tall, there is no one of the same height as you).

No cypress and juniper grow in any garden like your beloved's height:

"Serv ü 'ar'ar bitmedi ḳaddüñ gibi bustānda

Olmadı ṭāvūs zülfüñ bigi Hindistānda" Sevdayî (Yasar, 2008, G. 50/1)

(A cypress and juniper like [your] height did not grow in the orchard. There was not a peacock like your hair in India.)

With its long and straight shape, the juniper tree is likened to the letter Elif, the first letter of the Arabic alphabet. The expression "Elif çekmek" is used in the sense of making a linear wound with a flat object, writing the letter elif. The poet interprets these wounds on his chest as the letter Elif being written by his beloved who is tall like a juniper tree:

"Gül-şen-i bâġ-ı mahabbetde diker tâze nihâl

Her elif kim sineme ol kâmeti 'ar'ar çeker" Baki (Kucuk, 1994, G183/3)

(Every elif that that Juniper tree tall one pulls on my chest plants fresh saplings in the rose garden of the vineyard of love).

Sometimes it is the lover himself who inflicts these wounds that remind us of the beloved's height:

"Çekdüm elif bu sîneye 'ar'ar kadüñ añup

Bâg-ı cihânda tâ ki kala bir budagımuz" Emrî (Sarac, 2002, G.205/2)

(In order that we might have a branch in the garden of the world, I made elif-shaped scratches on my chest because of your height, which resembles a juniper tree).

In Pertev's ghazal, the beloved accepts the juniper tree analogy made about his height:

"Dâmen-i mîvesine dest-i emel nâ-reste

Kâmeti 'ar'ar u şimşâd ki dirler o bizüz" Muvakkitzâde Pertev (Bektas, 2017: 250/4)

(The fruit of the juniper does not reach the skirt of the tree, and we are the one they call juniper and shimshad).

Juniper is one of the trees that grow in wetlands. For this reason, the poet wants to embrace his beloved, whom he depicts as a juniper, and rub his face on her feet like water:

"Belki ol 'ar'arı âgûş iderem ey Âsaf

Gideyim yüz süreyim makdemine âb gibi" Asaf (Kaya, 2009, G. 1064/5)

If the beloved walks on the lawn with his tall stature, the juniper admires him/her:

"Çemende servi seyr itse hırâmân

Sanavber deng ü 'ar'ar kala hayrân" Şeyhi (San, 2017, Hüsrev ü Şirin, 5296)

(Juniper and pine admire the lover's coy walk on the lawn like a cypress).

God's blessed trees are also extraordinary with their swaying (Ergun, 2017: 281). In a Uyghur poem, it is expressed that the juniper and willow tree's branches sway in a hundred different ways. Yâver refers to the swaying of the juniper tree in the following couplet. The poet says, "The meaning of the beloved is accent, beauty and manners. What is meant by the tall juniper tree is always coy swaying.":

"Şîve vü hüsn ü edâdur kadd-i dilberden garaz

Hep hırâm-ı nâzdur bâlâ-yı 'ar'ardan garaz" Enderunlu Hasan Yâver (Üstüner, 2010, G. 91/1)

Azmizâde Hâletî also mentions the beauty of the juniper tree swaying in the wind in the following couplet:

"Tîz-kâm idi çün nesîm-i seher

Hoş-hırâm idi nitekim 'ar'ar" Azmizâde Hâletî (Kaya, 2017, K. 4/24)

The juniper tree swaying freely in the wind is interpreted as arrogance:

"Görmedi şíve-i reftāruŋı beŋzer ki senüŋ

Böyle ser-keşlik ėder bāġda 'ar'ar güstāĥ" Hayretî (Musluoglu, 2021, G. 101/5)

(The insolent juniper has not seen the dignity of your gait, so it is being obstinate in the vineyard.)

If the juniper walks with his tall stature, swaying with grace and dignity, the cypress on the lawn is subject to his sublimity:

"Reftâre gelse kâmet-i ʿarʿar-hırâm ile

Bâlâ-yı yâre serv-i çemen zîr-dest olur" Baki (Kucuk, 1994, G97/3)

No matter how beautiful the juniper swings, the beloved surpasses this tree in swinging:

"Hakkâ budur salınmada ol serv-i hoş-hırâm

Dikdi tepesi üstine tûbâ vü 'ar'arı" Hecrî (Zulfe, 2010, G. 140/3)

(This is the truth, the beloved, like that pleasant swaying cypress, planted the Tuba and juniper trees on her hill in her swaying)

Those who see the swaying of the beloved as she walks remember the juniper:

"Seni bâġ içre ṣalındıḳca görenler dirler

Bu ẖırâm u bu reviş var mı 'aceb 'ar'arda" Bolulu Hanif (Baser, 2018, G. 97/4)

(Those who see you swaying in the vineyard wonder if juniper has this gait)

The idea of the lover's height falling into the lover's heart is similar to the reflection of the juniper tree's height in the water:

"Her ḳaçan kim gönlüme fikr-i ḳad-i dil-ber düşer

Ŝanasın āb içre 'aks-i ḳāmet-i 'ar'ar düşer" Çorlulu Zarifi (Taskın, 2019, G. 60/1)

This tree even trembles with jealousy and shame when it sees the beloved:

"Gülşende görüp kadd ü ruhuň reşk u hayādan

Güller kızarup lerze ten-i 'ar'ara düşdi" Adnî (Kufacı, 2005, G. 90/6)

(Seeing your height and cheek in the rose garden, the roses blushed and trembling from jealousy and envy fell on the skin of the juniper.

In the following couplet, Mostar Ziya expresses that while he was watching the gardens of the angelic world, he saw the juniper tree in the garden of the first and most sublime world, which is unique to Allah. With this couplet, the poet expresses that the juniper tree is a very valuable and sublime tree and that it is in Allah's garden:

"Kıldı çün seyr-i riyâz-ı melekût

Gördi kim 'ar'ar-ı bâg-ı lâhût" Mostarlı Hasan Ziyâ'î (Gurgendereli, 2007, Şeyh

Sanan, Mes. 1334)

Juniper is mentioned together with different tree species in Classical Turkish Poetry. One of these is the poplar tree. To have the winds of poplar blowing over one's head means to be far from a sense of responsibility and to pursue pleasure and enjoyment. Poets use the words poplar and juniper in accordance with these meanings:

"Esmesün hîç kavak yili başunda 'ar'ar

Göklere degse başun irmez ayagına elün" Âşık Çelebi (Kılıc, 2017, G. 19/3)

(May the poplar wind never blow on the juniper's head, even if your head reaches the heavens, your feet will never reach your hand.)

Another tree associated with the juniper is the willow:

"Sefîd câmede yârı görüp didüm bu bahâr

Şükûfe ile bezenmiş nihâl-i ‹ar'ar u bîd" Helakî (Cavusoglu, 1982, G. 23/2)

(I saw the beloved dressed in white and said that this spring the willow and juniper trees were adorned with flowers.)

The wounds in the lover's bosom resemble the juniper, the cypress and the weeping willow:

"Ḳāmeti yādına çekdüm sīnem üzre şerḥalar

Kimi serv oldı kimi 'ar'ar kimisi bān sürḫ" Hasreti (Donuk, 2018, G.1/11)

(I opened wounds on my chest in remembrance of your height. Some became cypresses, some junipers, some red wisteria willows).

Among the trees, the cypress is the one he is most often mentioned with:

"Bulundı ḳaydı teşrîfāt-ı gülde serv-i āzādıñ

Anıñ çün ṭutdılar 'ar'arla anı şimdi hem-pāya" Karabacakzade (Hakverdioglu, 2012, 191/ 7).

(Since the list of those who welcomed the rose included the cypress, they now equated it with the juniper tree.)

The juniper tree is a tree associated with birds. Ravzî mentions this relationship between the juniper and birds in the following couplet:

"Ravzî o servkâmete dil murgın uçurur

Kuşlar mı kondurur 'acebâ ar'ar üstine" Ravzî (Aydemir, 2007, G. 478/5)

(Ravzi makes the bird of her heart fly to that cypress, does she make birds land on the juniper tree?)

Azmizâde Hâletî interprets the birds living in this tree as follows:

"Cihânda kalmadı bir murg-ı destâmûz kim şimdi

Kaçup bâga çenâr u ‘ar‘ar üzre tutmaya me’vâ” Azmizâde Hâletî (Kaya, 2017, K. 8/15)

(They fled to the garden to take up residence on sycamore and juniper trees, so that a bird that we used to handle as a fledgling is now gone).

Among birds, the thrush is especially associated with the dove:

“Murg-ı dili Emrînüñ ol kadd-i bülendüñde

Bir kumrı-ı nâlândur san ‘ar‘aruñ üstinde” Emrî (Sarac, 2002, G. 495/5)

(The bird of Emrî’s heart is as if a dove moaning on a juniper tree in that tall stature).

The juniper tree is a fruitless tree and is therefore often mentioned with the word âzâd. The poets have treated the fact that the juniper tree is flowerless and fruitless not as a deficiency but as freedom:

“Gelmiş çemende ‘ar’ara âzâd kâgezi

Ol serv-i bâg-ı sâyefikenden midür ‘aceb” Muvakkitzâde Muhammed Pertev (Bektas, 2017, G. 25/2)

(The juniper tree in the garden received a freedom paper. I wonder if it is from the cypress tree that casts shade in the garden).

Some poets interpreted the fruitlessness and flowerlessness of this beautiful tree as useless:

“Ne mîvesiyle temettu’ ne sâyesinde huzûr

Ne fâyide tutalum kadd-i yâr ola ‘ar’ar” Âşık Çelebi (Kılıc, 2017, K. 14/207)

(Neither benefit with its fruit, nor peace in its shade! Let us suppose that the juniper has become the height of the beloved, what is the use!)

Juniper trees have been planted on graves since ancient times because of their evergreen characteristic. Biological properties also lie behind the planting of juniper trees on graves. Juniper trees can stand for more than 300 years without collapsing and can stand for more than 100 years without decomposing after falling. In this respect, the juniper tree planted at the graves symbolizes that the deceased are not destroyed but are still standing (Torlak, 2009, p. 97). Juniper, which symbolizes not being forgotten by remaining green throughout the year, is planted in cemeteries. The relationship between juniper trees and cemeteries is mentioned in poems:

“Ger ölürsem hasret-i kaddiyle ol servün beni

Bir yire defn eylenüz kim sâye-i ‘ar‘ar düşer” Baki (Kucuk, 1994, G.119/2)

(If I die longing for the height of that cypress, bury me in a place where the shadow of juniper falls).

Conclusion

As in many cultures, trees have mythical and religious values in Turkish culture. Trees are frequently featured in classical Turkish poetry. In classical Turkish poetry, trees are more than an aesthetic element in environmental depictions. They are a part of Allah’s art. For this reason, each tree leaf describes the art of Allah. Poets have likened the shapes and movements of trees to

a Muslim praying. Trees are included in many prophet miracles. The poets of classical Turkish literature believe that trees are alive and therefore they should be treated well. Among the trees mentioned, the juniper tree stands out. The juniper tree, which was considered sacred according to the ancient Turks, maintained its importance after the acceptance of Islam. It was believed that incense made with juniper tree would purify from evil. These evergreen trees were planted in cemeteries.

In classical Turkish poetry, this tree is mostly called ar'ar, which is its Arabic equivalent. Juniper is also known as mountain cypress. In classical Turkish poetry, juniper frequently appears in garden descriptions. When the battlefield is depicted as a garden, the juniper becomes the banner of the army. This tree, which remains green in winter, is likened to a man wearing a white turban when covered with snow. With its smooth shape, it reminds poets of a pen. The poets, who thought that the tree's character was proper when its shape was proper, introduced it as a chaste person. With its smooth shape, it is likened to the letter Elif, the first letter of the Arabic alphabet. In the depictions, they are mentioned with other trees such as cypress, poplar, willow and bunch willow.

Classical Turkish literature is centered on the beloved. Every beauty reminds of the beloved. The tall height of the juniper tree reminds of the lover's height. The beloved is as tall as or even taller than the juniper tree. The swaying of the juniper tree in the wind is beautiful. But the sway of the beloved as she walks is more beautiful.

The juniper tree is mentioned together with birds. In classical Turkish poetry, especially doves and juniper trees are considered as nesting birds. Classical Turkish literature poets do not consider the fact that this tree is fruitless and flowerless as a flaw. According to poets, this situation provided freedom for the juniper tree. In classical Turkish poetry, this tree is one of the sacred trees declared by God. Juniper trees are planted in cemeteries. It symbolizes not being forgotten by being always green. Poets wished their graves to be under the shade of this tree. When we look at the place of the juniper tree in classical Turkish poetry, we see that this tree, which was considered sacred in Turkish society before Islam, maintained its importance after Islam.

Recommendations

Cultural studies are generally carried out on folklore. Works on Classical Turkish poetry are very important for Turkish culture in the Ottoman period. Cultural studies in Classical Turkish literature will open important doors to readers about past cultures and the continuity of culture.

References

Akdogan, Y. (1979). *Ahmedî divânı I-II: tenkitli metin ve dil hususiyetleri.* (Doctoral dissertation). İstanbul University, Istanbul

Alcay, A. U., Akgul, C., Badayman, M., & Dincel, E. (2018). Ardıc meyve ve yagının kullanım alanları. *Aydın Gastronomy*, *2*(2), 45-60.

And, M. (2007). *Minyaturlerle Osmanlı-Islam mitologyası.* Istanbul: Yapı Kredi Publishing.

Arslan, M. (2007). *Mihrî Hâtun dîvânı*. Amasya Valiligi Publishing.

Aydemir, Y. (2007). *Ravzî divanı,* Ankara: Birlesik Publishing.

Baser, R. (2018). *Bolulu Hanif divanı.* (Doctoral dissertation). Gazi University, Ankara.

Bektas, E. (2017). *Muvakkit-zâde Muhammed Pertev dîvânı*. Ankara.

Cavusoglu, M. (1982), *Helâkî: Divan, tenkidli basım.* Istanbul: Istanbul Universitesi Edebiyat Fakultesi Yayınları.

Cavusoglu, M., &Tanyeri, M. A. (1989). *Uskublu Ishâk Celebî divan tenkidli basım*. Istanbul: Mimar Sinan Universitesi Yayınları.

Dogan, M. N. (2017). *Hüsn ü ask.* Ankara.

Donuk, S. (2018). Antepli hasretî ve siirleri. *Gaziantep University Journal of Social Sciences*, *17*(4), 1270-1297.

Erdem, S. (2005). *Neylî ve dîvânı.* Ankara: Ataturk Kultur Merkezi Baskanlıgı Yayınları.

Eren, A. (2017). *Mehmed Sıdkî dîvânı.* Ankara: Altıpost.

Ergun, P. (2004). *Türk kültüründe agac kultu* (Vol. 305). Ankara: Ataturk Kultur Merkezi Baskanlıgı Yayınları.

Eroglu, E. F. (2015). *Türkistan'dan uzak diyara beskaza Fethiye ve Seydikemer yörükleri.* Ankara.

Esir, H. A. (2017). *Hakîkî dîvânı*. Ankara.

Gezgin, D. (2021). *Bitki mitosları*. Istanbul: Pinhan.

Gokkaya, R. (2017). *16. asır sairlerinden seyrî ve dîvân'ı [inceleme- metin- dizin]*. Suleyman Demirel University, Isparta.

Gurgendereli, M. (2007). *Mostarlı Ziyâ'î Seyh-i San'ân mesnevisi*. Ankara: *Kultur ve Turizm Bakanlığı Yayınları (e-kitap).*

Hakverdioglu, M. (2012). *Nevsehirli Damat Ibrahim Pasa icin yazılan Lâle Devri kasideler.* Ankara.

Isık, R. (2004). Turklerde agacla ilgili inanıslar ve bunlara baglı kultler. *Fırat Universitesi İlahiyat Fakultesi Dergisi*, 9/2, 89-106.

Karakose, S. (2017). *Nev'î-zâde Atâyî dîvânı.* Retrieved from http://ekitap.kulturturizm.gov.tr/belge/1-90181/nevizade-atayi-divani.html

Kaya, B. A. (2017). *Azmizâde Hâletî dîvânı.* Ankara.

Kavruk, H. (2001). *Seyhulislâm Yahyâ divânı: Tenkitli metin.* Ankara.

Kaya, H. (2009). *18. yy. sairi Asaf ve divanı (inceleme-tenkitli metin-dizin)*. (Doctoral dissertation). Marmara University, Istanbul.

Kayabası, R. G., & Cini, O. (2024). Hayvan kultu baglamında Turk mitolojisinde kurbaga. *Motif Akademi Halkbilimi*, 17(46), 635-654.

Keklik, M. (2014). *Uskuplu Ishak Celebi divanı.* (Doctoral dissertation). Kırgızistan-Turkiye Manas University., Biskek.

Kılıc, F. (2017). *Âşık Çelebi divanı.* Ankara.

Kufacı, O. (2005). *Adnî dîvânı.* Ankara.

Kucuk, S. (1994). *Baki divani.* Ankara.

Kutuk, R. (2002). *Lârendeli Hamdî'nin Leylâ ile Mecnûn Mesnevîsi (inceleme/metin ve diğer Leylâ ile Mecnûn Mesnevîleriyle mukayesesi)*. (Doctoral dissertation). Atatürk University, Erzurum.

Macit, M. (1997). *Nedîm divânı.* Ankara.

Musluoglu, F. (2021). *Hayretî divanı.* (Doctoral dissertation). Marmara University, İstanbul.

Okcu, N. (2017). *Seyh Gâlîb divanı*. Ankara: Kultur ve Turizim Bakanlıgı.

Ogel, B. (1995). *Turk mitolojisi (kaynakları ve acıklamaları ile destanlar). II. Cilt.* Ankara.

Ogel, B. (2010). *Türk mitolojisi* (1st ed.). Ankara.

Ogel, B. (2010). *Turk mitolojisi* (2nd ed.). Ankara.

Parlatır, I. (1998). *Turkce sozluk.* Ankara.

Pekolcay, N. (2007). *Mevlid (Vesîletü'n-Necât) Suleyman Celebi.* Ankara.

Sarac, M. A. Y. (2002). *Emrî divanı.* Ankara.

San, F. (2017). *Şeyhî'nin Husrev u Sîrîn'i (inceleme-metin-ceviri-dizin/sozluk)*. (Doctoral dissertation). Yıldız Teknik University, Istanbul.

Sengun, N. (2006). *Nazîr İbrahim ve dîvânı (metin-muhtevâ-tahlîl)*. (Doctoral dissertation). Dokuz Eylül University, Izmir.

Senyurt, A. (2004). *Ali Handî ve dîvânı*. (Doctoral dissertation). Marmara University, Istanbul

Simsek, K. (2002). *Feridun divanı.* (Master's thesis). Kutahya, Dumlupınar University.

Tanyu, H. (1988). *Agac, Islam ansiklopedisi (*1st ed*.,* pp.458-459). Istanbul.

Tas, H. (2017). *Vahyî dîvân*. Ankara.

Taskın, G. (2009). *Corlulu Zarifî dîvanı: Inceleme-edisyon kritikli metin*. (Doctoral dissertation). Marmara University, Istanbul.

Topaloglu, B. (1988). *Agac. Turkiye Diyanet Vakfı İslam ansiklopedisi* (1st ed., pp. 457-459).

Torlak, H. (2009). Anadolu ve Türk kültüründe ardıc agacı. *Yolculuk, 63*, 94-97.

Ustunerr, K. (Ed.). (2010). *Enderunlu Hasan Yaver: Divan: inceleme, metin, ceviri, dizin*. Ankara: Birlesik.

Yasar, Z. (2008). *Sevdâyî Dîvânı'nın ceviri yazı metni, ve günümüz Türkçesiyle nesre aktarımı*. (Master dissertation). Selcuk University, Konya.

Yıldırım, N. (2006). *Fars mitoloji sozlugu.* Istanbul: Kabalcı Publishing.

Yucel, D. (2020). Dîvân siirinde agac: Inanc ve kultur. *Kesit Akademi*, *6*(24), 304-323.

Zulfe, O. (2010). *Hecrî divanı*. Retrieved from https://ekitap.ktb.gov.tr/Eklenti/10618,hecripdf.Pdf

About the Authors

Dr. Fatıma AYDIN is studying Turkish Language Department, Osmaniye Korkut Ata Üniversity. Osmaniye/Turkiye

E-mail: *faydin@osmaniye.edu.tr,* **ORCID:** 0000-0002-6245-4492

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 22 %.

To cite this article:

Aydın, F. (2024). Juniper (Ar'ar) tree in classical Turkish literature. In S.A. Kiray & O. Cardak (Eds.), *Current Studies in Social Sciences 2024,* (pp .197-211) ISRES Publishing

Current Studies in Social Sciences 2024 is published annually from the selected papers invited by the editors.

This edition includes 6 sections and 14 papers from the field of *Current Studies in Social Sciences 2024*

Current Studies in Social Sciences 2024 is published by ISRES Publishing.

ISRES Publishing