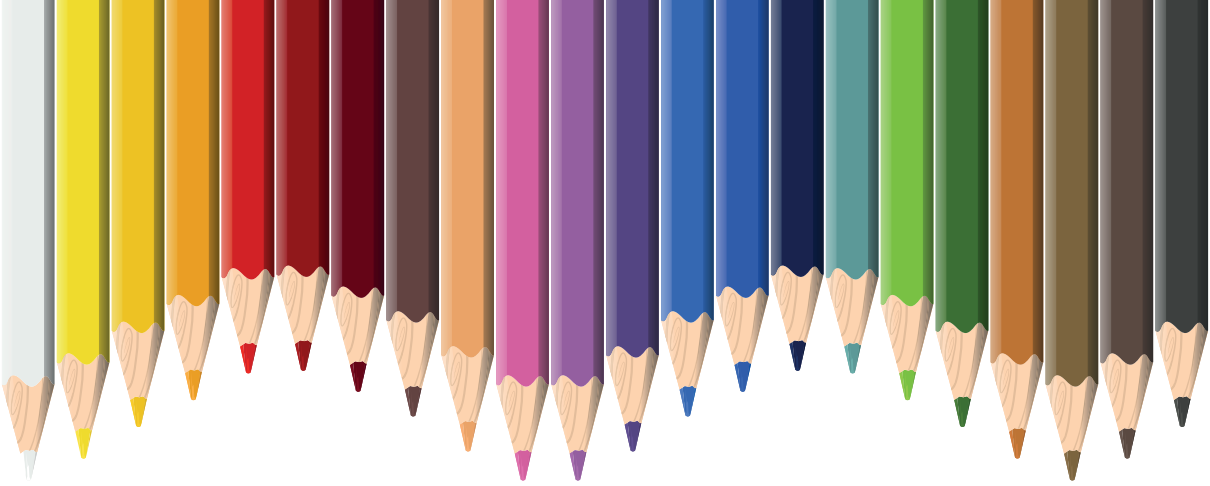


Chapter 10

EXPLORING TECHNOLOGY INTEGRATED PERSONALIZED LEARNING APPROACHES IN SCIENCE EDUCATION: AN EXAMINATION OF EMERGING TRENDS AND EFFICACIES

Özkan YILMAZ[1]

1 Doç. Dr., Erzincan Binali, Yıldırım Üniversitesi, ozkanyilmaz@erzincan.edu.tr,
ORCID ID: 0000-0001-8963-3354

Introduction: Science education and technology

The combination of science education and technology offers a powerful synergy, striving to offer students more efficient, engaging, and tailored learning experiences. The complex nature of scientific fields, combined with the swift progress of technology, highlights the growing importance of their convergence. This article examines the merging of science education and technology to investigate how this collaboration can improve students' comprehension and use of science.

The function of technology in science education largely centers on improving student-centered experiences and customizing the learning process. Virtual labs and simulations provide students with real-world experiences in a secure and controlled setting, assisting in understanding abstract concepts (Scherer & Wiberg, 2018). Additionally, the rise of individualized learning platforms permits tailoring content to match the particular needs and abilities of each student. Adaptive systems empower students to advance at their own speed, cultivating a more profound comprehension of concepts. Interactive educational tools have the potential to enhance science education and increase student engagement (Haidabrus, 2022; Saltan, Türkyılmaz, Karaçaltı, & Bilir, 2018).

Animation, augmented reality applications, and online interactive lessons motivate students to actively explore subjects, making the learning process more dynamic. Distance learning is instrumental in overcoming geographical obstacles and offering equitable educational access to students from various locations. Virtual classrooms enable students to engage with peers and educators, facilitating their integration into the scientific community (Potkonjak et al., 2016). Integrating technology into the assessment process is essential for more efficient evaluation of student performance and offering timely feedback to educators. Online tools for assessment are beneficial in gauging students' comprehension levels and enhancing the learning experience.

Understanding Personalized Learning

Personalized learning is an approach that tailors instruction to meet the unique needs, interests, and preferences of individual learners (Saltan et al., 2018). By leveraging technology, personalized learning can be implemented on a wider scale, providing adaptive and tailored instruction to students.

Personalized learning is an educational strategy that customizes the delivery of instruction, content, and speed of learning to accommodate each student's unique needs and preferences (Jemadi, 2021). This approach acknowledges the varying learning styles, strengths, and areas for growth

among students. At its essence, personalized learning moves away from the conventional uniform approach in favor of establishing a more student-centered and adaptable learning atmosphere.

In a personalized learning environment, students can advance through the curriculum at their individual pace. This flexibility allows them to explore challenging subjects more thoroughly while moving ahead quickly in familiar areas. Technology frequently plays a crucial role in personalized learning by offering adaptive software, online materials, and data analysis to monitor and assess each student's progress individually (Tang, Chen, Li, Liu, & Ying, 2019; Tetzlaff, Schmiedek, & Brod, 2021). These resources enable teachers to customize instruction using current information, addressing particular learning needs and providing specific assistance. Furthermore, personalized learning empowers students to take ownership of their learning journey (Tetzlaff et al., 2021)

Moreover, personalized learning highlights the importance of student choice and independence. It often involves granting students a level of control over their learning journeys, allowing them to choose projects or subjects that resonate with their individual interests. This method nurtures a feeling of ownership and drive as students recognize the significance of their studies in relation to their personal objectives and ambitions.

In personalized learning environments, collaboration is an essential component. Educators act as facilitators, assisting students in establishing objectives, tracking their advancement, and providing assistance when necessary (Dumont & Ready, 2023; Mirari, 2022). Encouraging peer-to-peer collaboration also allows students to learn from each other, exchange perspectives, and collaborate on joint assignments. As a result, personalized learning fosters not only academic growth but also critical thinking skills, problem-solving abilities, communication aptitude, and collaborative spirit.

The Role of Technology in Personalized Learning

Technology plays a crucial role in enabling personalized learning. The integration of technology is crucial in the execution and achievement of personalized learning, revolutionizing conventional educational frameworks into individualized and dynamic experiences for every student (Kaminskienė & Khetsuriani, 2019; Tang et al., 2019). An important aspect of technology's role is its capacity to offer customized learning platforms. These platforms utilize advanced algorithms and data analysis to evaluate each student's advancement, recognize their preferred learning methods, and tailor content accordingly. This customization guarantees that students access materials suited to their skill level, promoting an individualized and optimized learning experience. Additionally, personalized one-to-one learning has been found to

significantly benefit students compared to traditional educational methods (Latham & Carr, 2015; Zheng, Long, Zhong, & Gyasi, 2022).

In addition, technology enables the development of varied and interactive learning materials. Digital content, virtual simulations, and online resources provide students with a range of formats to interact with the curriculum (Schmid, Pauli, Stebler, Reusser, & Petko, 2022). This multimedia method not only caters to diverse learning styles but also enhances the dynamic nature of the learning process. By utilizing e-learning systems and personalized learning software tools, students can engage with interactive content that is tailored to their specific needs and preferences. This method ensures a more individualized approach to learning, accommodating different learning styles and rhythms while supporting the unique aspirations of each student.

The use of technology in personalized learning also promotes collaboration and communication. Online platforms allow students to work together on projects, exchange ideas, and participate in discussions outside the traditional classroom setting. This connection fosters a community atmosphere and broadens the learning environment beyond the school's physical boundaries.

Furthermore, technology is a valuable asset for monitoring and analyzing student progress. Insights obtained from data provide educators with instant feedback on the unique capabilities and areas for improvement of each student. Armed with this knowledge, teachers can tailor their instructional approaches, offer timely support, and provide targeted assistance to ensure the success of every student. Overall, technology integration in personalized learning offers the potential to revolutionize education by providing individualized learning experiences, supporting diverse learning styles, promoting collaboration and communication, and facilitating ongoing assessment and feedback (Pilley, 2016; Scherer & Wiberg, 2018).

New Approaches to Integrating Technology in Science Education

Recent progress in technology has created new opportunities to redefine the field of science education. Using technology in science education goes beyond just introducing digital tools; it includes transformative methods that utilize the potential of technology to improve the learning process. An important method is integrating virtual labs and simulations, creating digital settings where students can conduct experiments safely, providing a practical experience not always feasible in traditional labs (Hernández-de-Menéndez, Vallejo Guevara, & Morales-Menendez, 2019; Potkonjak et al., 2016). Furthermore, advanced technologies like augmented reality and virtual reality offer immersive experiences for students to explore intricate scientific concepts beyond conventional approaches (Papanastasiou, Drigas, Skianis, Lytras, & Papanastasiou, 2019) . These technologies can enhance students'

understanding of complex scientific phenomena by providing interactive and visually engaging experiences.

Adaptive learning systems offer a new and creative method. These platforms utilize artificial intelligence and data analysis to customize content and speed according to each student's requirements. By identifying and adjusting to the students' unique learning styles and development, adaptive learning technologies provide an individualized and adaptable learning experience (Shemshack & Spector, 2020; Shute & Towle, 2018) . This strategy guarantees that every student can grasp fundamental concepts before moving on to more complex subjects, catering to the varied needs of learners in one classroom.

Moreover, the incorporation of multimedia tools is changing the delivery of scientific content. Interactive simulations, animations, and online multimedia resources offer dynamic and captivating options compared to traditional textbooks. These materials address different learning preferences and foster a more profound comprehension of complex scientific concepts. The use of technology extends beyond students' experiences to also include professional development for educators. Teachers can utilize online platforms, webinars, and collaborative resources to improve their expertise and instructional methodologies while staying updated on the latest developments in science education and technology. Incorporating technology into science education opens up new opportunities for exploration and learning.

Case Studies: Successful Integration of Technology in Science Classrooms

The incorporation of technology into science classrooms is a developing area that has attracted considerable interest from educators and researchers. Encompassing diverse facets of this topic, the discussed studies investigate the implications, advantages, and obstacles associated with introducing technology-driven teaching tools—such as digital resources, computer simulations, and interactive whiteboards—into our educational settings. The study demonstrates how this integration can transform conventional teaching methods, encouraging student involvement, enhancing knowledge generation and evaluation processes, and fostering analytical thinking. It also underscores the important role of educators in skillfully coordinating these technologies and the necessity for ongoing professional training to ensure their effective utilization. However, despite the promising advantages, it is understood that the mere implementation of technology in classrooms does not ensure enhanced learning and highlights the need for systematic integration and careful planning. Implementing technology in classrooms hence remains a complex task that necessitates further research and innovation. Research on

the use of technology in education has been conducted as follows:

(1) "Effective Professional Development: Requirements for Technology Integration into Secondary Science Classrooms" by Maria Sophia Lobo emphasizes the importance of professional development in helping teachers integrate technology into their classrooms, specifically in secondary science education (Lobo, 2018). The paper highlights how technology enhances students' learning experiences, fostering problem-solving skills and critical thinking. The integration of technology into classrooms can be hindered by factors such as lack of professional development, teacher apprehensions, and time constraints. The paper emphasizes the importance of personalized, relevant, and collaborative professional development supported by school leadership. Furthermore, it suggests that professional development should not only concentrate on learning specific technologies but also encourage teachers to embrace new technologies independently. Successful technology integration requires teachers to adjust their teaching methods to create more student-centered environments. In science classrooms, technology integration is not just beneficial but essential due to the interconnectedness of science and technology. However, this necessitates substantial changes in pedagogical methods — a shift from traditional teacher-led instruction to a more student-centered, constructivist environment. In conclusion, successful technology integration in secondary science classrooms requires comprehensive professional development programs concentrating on technology, shifts in pedagogical approaches, collaboration, and sustained support from school leadership.

(2) The study examined 20 STEM curriculum units from a teacher professional development program, covering life science, earth science, and physical science (Guzey, Moore, & Harwell, 2016). These units involve real-world situations and require students to apply scientific and mathematical concepts, collaborate, and engage in design processes iteratively. The extent of integration in the curriculum units varies, as revealed through assessment with STEM-ICA. While this approach was effective, the study emphasized the necessity for more research into organizing curriculum and instruction to facilitate a smoother learning process across different STEM disciplines. Additionally, it underscored the significance of collaborative curriculum development, professional development programs, and improved design of STEM education material for teachers to enhance quality.

(3) The paper by Susanne Walan aims to understand "the practical implications and perceptions of science teachers who have transitioned their instruction to largely digital technology" (Walan, 2020). Two secondary school educators and their 7th-grade classes were observed and interviewed. The study found that teachers were confident in using digital technology and utilized predetermined digital study materials. They also noted increased

student motivation and improved assessment processes with the use of digital technology. Recent studies have shown that teachers need ongoing support and professional development to effectively integrate technology into their classrooms. Many institutions have implemented various programs, workshops, conferences, webinars, communities, and mentoring programs for this purpose. Moreover, the study reveals that the use of digital tools had reshaped their teaching, making it more varied and individualized. Due to the range of digital tools available, students could work at their own pace which was seen as an advantage.

(4) Based on the reviewed paper, computer simulations can be effective in science education across K-12 to college levels when used alongside traditional instructional approaches (Smetana & Bell, 2012). Implementing simulations can improve students' content knowledge, promote scientific process skills, and facilitate conceptual change. The efficacy of computer simulations depends on the quality of their design, embedded support systems, and the guidance provided by teachers. Simulations also prove beneficial when they challenge students' existing conceptions and promote cognitive dissonance, reinforcing the relevance of constructivist learning approaches. However, while effective in many cases, computer simulations should not replace other forms of instruction or hands-on learning experiences but supplement them. It is also suggested that simulations are most effective when they cater to individual learners' differences and pre-existing knowledge, allowing for an individualized learning experience. Complementary materials that support learning and allow students to become familiar with the technology are also essential for maximizing the benefits of using computer simulations. Finally, the order of using computer simulations, either before or after traditional instruction, could impact their effectiveness, but more research is needed to confirm the optimal sequencing.

(5) The paper focuses on pedagogical approaches for technology-integrated science teaching, especially through the use of simulations and interactive whiteboards (Hennessy et al., 2007). It suggests that these digital technologies can serve as effective tools for teaching science in ways that could foster student engagement, critical thinking, and conceptual understanding. Teachers need to ensure that students understand the limitations of virtual experiments. Therefore, teachers' role in orchestrating these technologies is crucial in enabling effective learning. The paper implies the potential of such tools in shaping innovative pedagogical strategies, yet it also highlights the complexities and potential challenges involved in effectively integrating these forms of technology into science classrooms.

(6) The paper examines how learning community frameworks can help preservice elementary teachers design digital technology-integrated science

experiments (Nipyrakis, Stavrou, & Avraamidou, 2023). The study found that participatory discussions and peer interactions were critical for the success of the learning community. Furthermore, understanding the interaction and collaboration among teachers during the design process can be essential for fostering effective learning environments. The paper emphasizes the importance of collaborative environments in designing technology-enhanced science teaching material and their potential to transform teacher preparation and enhance digitized education.

(7) The study "Examining technology integration in middle school STEAM units" examines the use of technology in STEAM education for middle school (Herro, Quigley, & Jacques, 2018). The authors found that technologies were frequently used for knowledge production, problem-solving, and collaboration to address real-world challenges, improving the overall learning experience. However, not all educators extensively utilized innovative technology. Technology was noted to contribute positively to STEAM education, requiring careful planning, practice, refinement, and support to fully encourage student-centered learning. The study acknowledges that while incorporating technology can drive educational progress in a STEAM curriculum, it does not guarantee an automatic shift from consuming to producing knowledge. This highlights the necessity for further research into the most effective methods of utilizing technology in STEAM education.

(8) This study focuses on the use of technology by Secondary Science Preservice Teachers during their methods courses and student teaching residency (Kilty & Burrows, 2021). Their utilization of technology varied based on personal experiences, teaching content areas, and available resources within their placements. However, this implementation did not always result in high scores on the Technology Use in Science Instruction instrument, indicating the use of technology did not consistently align with effective pedagogical strategies. These underlines possible gaps in the understanding among SSPSTs about how to meaningfully integrate technology into their teaching and suggests a need for further guidance and support in harnessing technology as a useful tool for scientific instruction. The study indicates the importance of further training and preparation for prospective teachers to effectively integrate technology into their teaching. This highlights the need for teacher educators to prioritize this area when preparing future teachers.

The studies reviewed demonstrate the transformative impact of digital technology in education across various disciplines, reshaping teaching methods and enhancing student learning experiences. The findings highlight that effective integration of technology in teaching, from STEM to science instruction, relies not only on adoption but also on a deep understanding of digital tools, extensive research, comprehensive training, meticulous

planning, and continuous support. Despite teachers' overall confidence in using digital technology, discrepancies exist in its application, emphasizing the need for more targeted professional development and guidelines. It is crucial to recognize that digital technology should complement traditional teaching methods rather than replace them. This emphasizes the requirement for a balanced and comprehensive approach to education. There is an urgent need for further exploration into the most successful approaches to implementing this shift towards digitization which necessitates educators continually adapting to technological advancements and emerging pedagogical strategies with thorough understanding.

In summary, the sources highlight the importance of integrating technology into education, particularly in STEAM classrooms and science instruction. The sources suggest that technology integration can positively impact student learning, but there is a need for effective professional development and support for teachers in order to meaningfully integrate technology into their teaching.

Challenges in Implementing Technology in Science Education

Implementing technology in science education can bring numerous benefits, but it also poses several challenges. Common challenges associated with integrating technology into science education include limitations on teacher knowledge and expertise related to curriculum design, the struggle of preservice teachers to use technology effectively due to lack of experience and resources, and resistance from some secondary science teachers who believe in teacher-led content delivery as the most efficient method for student learning. There is a need for effective professional development programs that address these barriers, build confidence among educators, encourage collaboration among peers, and promote student-centered inquiry-based lessons that successfully integrate technology. Implementing technology in science education requires overcoming challenges related to limitations in teacher knowledge and expertise, preservice teachers' lack of experience and resources, and resistance from some teachers who prefer traditional methods. Additionally, there are challenges related to the availability and adequacy of technology resources, time constraints for teachers to learn and implement new technologies, lack of support from school administration, and the need for ongoing professional development to stay abreast of new technologies and pedagogical strategies.

Implementing technology in science education can bring numerous benefits, but it also poses several challenges. Here are some common challenges associated with integrating technology into science education: "Inequality". The digital gap can lead to unequal educational opportunities as

not all students have the same access to technology, with some having limited or no access to essential devices and internet connectivity. This imbalance raises challenges for educators in delivering comprehensive teaching that effectively integrates technology into student-centered learning environments. Furthermore, it highlights the need for professional development aimed at addressing barriers and enabling equitable technology integration in education. "Teacher Training". Many educators face challenges in integrating technology into their teaching due to a lack of essential expertise and preparation. Ongoing professional development is crucial for ensuring that teachers not only have the necessary skills, but also feel confident in using educational technology effectively. "Inadequate Infrastructure". Some schools may face challenges with essential infrastructure, including bandwidth limitations and outdated hardware and software. These obstacles can hinder the seamless integration of technology in the classroom. "Financial Constraints". Acquiring and sustaining technological tools can be a costly endeavor for educational institutions, particularly those with limited funding. As a result, many schools may encounter difficulties in obtaining the latest educational technologies. "Integration with Curriculum". Ensuring that technology is aligned with the current curriculum and learning goals can present challenges, as teachers must have in-depth knowledge of the concepts and identify the unique affordances that technology provides for the subject matter. It is important to strike a balance between using technology for the sake of it and integrating it effectively into the educational process while also considering limitations "Resistance to Change". Teachers and school leaders might oppose the transition to a more technology-focused approach due to uncertainty, lack of self-assurance, or a preference for conventional teaching methods. This resistance can be attributed to their deep-seated beliefs about traditional modes of instruction and the challenges associated with integrating new educational technologies effectively. "Student Skills". While it is commonly stated that students are "digital natives," the reality is that they may not possess the necessary digital literacy skills required for academic and scientific purposes. Hence, educators need to ensure that these skills are taught alongside content knowledge. "Security Concerns". The incorporation of technology in education sparks worries regarding data security and student privacy. Educational institutions need to enforce strong measures to safeguard sensitive information, ensure adherence to privacy regulations, and address the ongoing concerns related to technology integration among teachers. "Rapid Changes". Educational technology is constantly evolving, presenting schools with the challenge of keeping up with the latest tools and trends. This can result in outdated technology and teaching methods in the classroom. To address these potential challenges and ensure successful technology integration, it is crucial for educational institutions to provide effective professional development for teachers. "Diversity and Inclusion".

Ensuring accessibility of technology for students with varying needs and learning styles is essential. It's crucial to take into account the requirements of students with disabilities and offer necessary accommodations, including assistive technologies and adaptable teaching methods. By doing so, educators can create an inclusive learning environment that promotes equal access to educational resources for all students.

Future of Science Education: The Potential of Personalized Learning

The potential of personalized learning in shaping the future of science education holds great promise. Tailoring educational experiences to individual students can revolutionize how science is taught and learned. Personalized learning allows for the creation of individualized learning paths based on students' interests, abilities, and learning styles (Grant & Basye, 2014). This means adapting content and activities to match each student's pace and preferences (Walkington & Bernacki, 2020).

The integration of adaptive technologies can provide real-time feedback and assessments, enabling educators to identify areas where students may need additional support. These technologies can adjust the difficulty of tasks to challenge students appropriately. Technology integration is essential to improve student learning and ready them for their future after formal education (West, 2012). The literature emphasizes the need for a fluency-friendly student-centered learning environment as ideal for technology integration(Chen & Tsai, 2021; Keengwe, Onchwari, & Onchwari, 2009).

Personalized learning can significantly boost student engagement by making science education more relevant and interesting, tailoring content to students' interests and incorporating real-world applications to enhance motivation and curiosity (Grant & Basye, 2014; Kallick & Zmuda, 2017). Personalized learning shifts the focus from a teacher-centered approach to a student-centered one, allowing students to become active participants in their learning journey and fostering a sense of ownership and autonomy. This has been argued as offering a more coherent and meaningful approach to teaching and learning science.

Educators can leverage data analytics to make informed decisions about teaching strategies, content delivery, and intervention plans. This data-driven approach helps optimize the learning experience for each student. Personalized learning, facilitated by technology, opens up opportunities for global collaboration (Beldarrain, 2006). Students can connect with peers worldwide, fostering a collaborative and culturally diverse approach to scientific inquiry. When communication technologies are integrated effectively in the learning process, they create engaging learning environments as learners progressively embrace technology for educational purposes (Groff, 2013).

Personalized learning is not bound by traditional classrooms. It allows for flexible environments, including online platforms, virtual labs, and interactive simulations, offering diverse and dynamic ways for students to explore scientific concepts.

Conclusion

In conclusion, the integration of technology in education, specifically personalized learning approaches, is crucial for enhancing student engagement and preparing them for the 21st century. By shifting to a student-centered learning environment, incorporating real-world applications, and leveraging technology tools, educators can create a more engaging and meaningful science education experience for students.

The integration of technology into science education supports the shift towards personalized learning, offering great potential to revolutionize teaching methods and enhance student learning outcomes. However, various challenges such as teacher training, inadequate infrastructure, resistance to change, and cybersecurity hinder seamless technology integration. Overcoming these barriers requires continuous professional development for teachers, financial resources, and a holistic understanding of the curriculum objectives. Also, a mindful approach in integrating technology effectively, rather than merely using it for the sake of it, is essential.

Personalized learning can tremendously increase student engagement by making science more relevant, adjusting content to students' interests, and incorporating real-world examples. Technology enables a shift from teacher-centered to student-centered learning, augmenting student autonomy and ownership over their learning journey. Integrated technology empowers educators with data analytics to make informed decisions about teaching strategies and intervention plans. The advent of digital learning platforms, virtual labs, and interactive simulations paves the way for students to explore scientific concepts more dynamically and engage in global collaboration.

In conclusion, while significant challenges remain, technology integration in science education, coupled with personalized learning, holds immense potential to redefine traditional teaching methodologies. By tailoring education to each learner and leveraging advanced technologies, we can enhance scientific literacy, foster a deeper understanding of concepts, and prepare students for an increasingly digital world. Overall, the integration of technology into science education has the potential to revolutionize teaching methods and enhance student engagement and learning outcomes.

References

Beldarrain, Y. (2006). Distance education trends: Integrating new technologies to foster student interaction and collaboration. *Distance education, 27*(2), 139-153.

Chen, C.-H., & Tsai, C.-C. (2021). In-service teachers' conceptions of mobile technology-integrated instruction: Tendency towards student-centered learning. *Computers & Education, 170*, 104224.

Dumont, H., & Ready, D. D. (2023). On the promise of personalized learning for educational equity. *npj Science of Learning, 8*(1), 26. doi:10.1038/s41539-023-00174-x

Grant, P., & Basye, D. (2014). *Personalized learning: A guide for engaging students with technology*: International Society for Technology in Education.

Groff, J. (2013). Technology-rich innovative learning environments. *OCED CERI Innovative Learning Environment project, 2013*, 1-30.

Guzey, S. S., Moore, T. J., & Harwell, M. (2016). Building up STEM: An analysis of teacher-developed engineering design-based STEM integration curricular materials. *Journal of Pre-College Engineering Education Research (J-PEER), 6*(1), 2.

Haidabrus, B. (2022). Information Technology and Management in Higher Education and Science. *Futurity Education, 2*(4), 29-41. doi:10.57125/FED.2022.25.12.03

Hennessy, S., Wishart, J., Whitelock, D., Deaney, R., Brawn, R., Velle, L. l., . . . Winterbottom, M. (2007). Pedagogical approaches for technology-integrated science teaching. *Computers & Education, 48*(1), 137-152. doi:https://doi.org/10.1016/j.compedu.2006.02.004

Hernández-de-Menéndez, M., Vallejo Guevara, A., & Morales-Menendez, R. (2019). Virtual reality laboratories: a review of experiences. *International Journal on Interactive Design and Manufacturing (IJIDeM), 13*, 947-966.

Herro, D., Quigley, C., & Jacques, L. A. (2018). Examining technology integration in middle school STEAM units. *Technology, Pedagogy and Education, 27*(4), 485-498.

Jemadi, F. (2021). *The Implementation of Moodle in Online Learning during Covid-19 Pandemic: EFL Undergraduate Students' Perception.* Paper presented at the First International Conference on Humanities, Education, Language and Culture, ICHELAC 2021, 30-31 August 2021, Flores, Indonesia.

Kallick, B., & Zmuda, A. (2017). *Students at the center: Personalized learning with habits of mind*: Ascd.

Kaminskienė, L., & Khetsuriani, N. (2019). Personalisation of learning through digital storytelling. *Management: journal of contemporary management issues, 24*(1), 153-166.

Keengwe, J., Onchwari, G., & Onchwari, J. (2009). Technology and student learning: Towards a learner-centered teaching model. *AACE Review (Formerly AACE Journal), 17*(1), 11-22.

Kilty, T. J., & Burrows, A. C. (2021). Secondary science preservice teachers: Technology integration in methods and residency. *Journal of Science Teacher Education, 32*(5), 578-600.

Latham, G., & Carr, N. (2015). Building on Authentic Learning for Pre-Service Teachers in a Technology-Rich Environment. *Journal of Learning Design, 8*(3), 65-77.

Lobo, M. S. (2018). Effective Professional Development: Requirements for Technology Integration into Secondary Science Classrooms.

Mirari, K. (2022). The Effectiveness of Adaptive Learning Systems in Personalized Education. *Journal of Education Review Provision, 2*(3), 70-76. doi:10.55885/jerp.v2i3.194

Nipyrakis, A., Stavrou, D., & Avraamidou, L. (2023). Designing technology-enhanced science experiments in elementary teacher preparation: the role of learning communities. *Research in Science & Technological Education*, 1-23.

Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2019). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. *Virtual Reality, 23*, 425-436.

Pilley, A. J. (2016). *The role of technology in personalized learning and the effect on student achievement.* Lindenwood University,

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. doi:https://doi.org/10.1016/j.compedu.2016.02.002

Saltan, F., Türkyılmaz, T., Karaçaltı, C., & Bilir, K. (2018). Use of Current Educational Technology in Science Education: A Scoping Review. [Güncel Eğitim Teknolojilerinin Fen Eğitiminde Kullanılması: Tarama Çalışması]. *Cukurova University Faculty of Education Journal, 47*(1), 308-336. doi:10.14812/cuefd.304015

Scherer, R., & Wiberg, M. (2018). Special feature: advanced technologies in educational assessment. *Behaviormetrika, 45*(2), 451-455. doi:10.1007/s41237-018-0071-y

Schmid, R., Pauli, C., Stebler, R., Reusser, K., & Petko, D. (2022). Implementation of technology-supported personalized learning—its impact on instructional quality. *The Journal of Educational Research, 115*(3), 187-198. doi:10.1080/00220671.2022.2089086

Shemshack, A., & Spector, J. M. (2020). A systematic literature review of personalized learning terms. *Smart Learning Environments, 7*(1), 1-20.

Shute, V., & Towle, B. (2018). Adaptive e-learning. In *Aptitude* (pp. 105-114): Routledge.

Smetana, L. K., & Bell, R. L. (2012). Computer simulations to support science instruction and learning: A critical review of the literature. *International Journal of Science Education, 34*(9), 1337-1370.

Tang, X., Chen, Y., Li, X., Liu, J., & Ying, Z. (2019). A reinforcement learning approach to personalized learning recommendation systems. *British Journal of Mathematical and Statistical Psychology, 72*(1), 108-135. doi:https://doi.org/10.1111/bmsp.12144

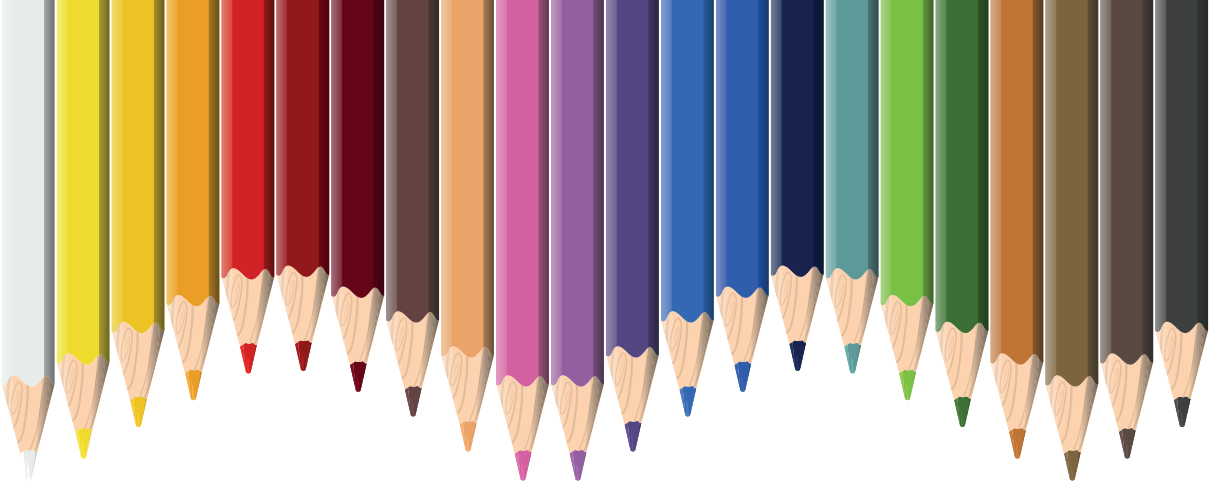
Tetzlaff, L., Schmiedek, F., & Brod, G. (2021). Developing Personalized Education: A Dynamic Framework. *Educational Psychology Review, 33*(3), 863-882. doi:10.1007/s10648-020-09570-w

Walan, S. (2020). Embracing digital technology in science classrooms—secondary school teachers' enacted teaching and reflections on practice. *Journal of Science Education and Technology, 29*(3), 431-441.

Walkington, C., & Bernacki, M. L. (2020). Appraising research on personalized learning: Definitions, theoretical alignment, advancements, and future directions. In (Vol. 52, pp. 235-252): Taylor & Francis.

West, D. M. (2012). *Digital schools: How technology can transform education*: Brookings Institution Press.

Zheng, L., Long, M., Zhong, L., & Gyasi, J. F. (2022). The effectiveness of technology-facilitated personalized learning on learning achievements and learning perceptions: a meta-analysis. *Education and Information Technologies, 27*(8), 11807-11830. doi:10.1007/s10639-022-11092-7



Chapter 11

THE IMPORTANCE OF OPEN SPACE DESIGNS IN RECREATION EDUCATION

Buket ÖZDEMİR IŞIK [1]
Sabiha KAYA[2]

1 (Assoc. Prof. Dr.) Trabzon University
E-mail:ozdemirbuket@trabzon.edu.tr
ORCID: 0000-0003-1617-8084
2 (Res. Assist)Trabzon University
E-mail:sabihakaya@trabzon.edu.tr
ORCID: 0000-0002-0883-4486

Introduction

In the modern world, individuals' lifestyles, technological advances and increased work pace have an increasingly complex impact on their lives. In this fast pace of life, it is of great importance for people to maintain and improve their physical, mental and emotional health. At this point, the concept of recreation refers to the whole of the activities that individuals carry out in order to effectively utilize their free time, rest, have fun and contribute to their personal development. Humans are not only individual but also social beings. After meeting their physiological and security needs, social needs emerge because individuals tend to satisfy their need for social connections such as being loved and being included in a group (Karaküçük, 2008). Leisure time refers to the period of time outside the working hours of the modern individual, outside of compulsory work duties such as weekends, annual leaves and retirement periods. The mental and physical fatigue, exhaustion and exhaustion that occur in individuals who are studying or working are explained as the recreation of the individual's energy through recreational activities. According to the general meaning of this recreation phenomenon; recreation is defined as activities that refresh, rest and voluntarily do after the compulsory work and activities of the person (Mirzeoğlu, 2003). Recreation can also be seen as a means for individuals to evaluate their free time and express themselves. Ven der Smissen (1990) defines recreation not as an activity, but as a result of the individual feeling better. Gray (1990) defines recreation as the creative use of free time. Fromm (1987) states that the aim of society is to ensure the full development of the individual's potential.

Today, developments in the understanding of leisure time are perceived as a process that should be evaluated in the most effective way in industrialized countries and partly in developing countries such as Turkey, by associating it with development and civilization. In this context, factors such as the reduction in daily and weekly working hours, the increase in vacation days and the evolution of social norms have increased the importance of leisure time in the social and social context more significantly and rapidly. Regaining the mental and physical fatigue and exhaustion that occur in individuals in the field of education or business life through recreational activities refers to the process of revitalizing the energy of the individual. This phenomenon of regaining energy is generally defined as recreational activities that the individual voluntarily performs after his/her compulsory work and activities (Mirzeoğlu, 2003). Researchers emphasize that participation in leisure activities is closely related to the level of social welfare and that leisure education can make significant contributions to individual and social development (Türkmen et al., 2013). Recreation is an important concept that enables individuals to engage in activities that they prefer to spend their free time in a pleasant way and that are suitable for their