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Implementation of Technology-Based Learning Methods in Education: A Systematic Literature Review

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Abstract: This research aims to explore the impact and effectiveness of technology-based learning methods. The methodology employed is qualitative research utilizing a Systematic Literature Review approach. Literature sources were retrieved from prominent indexes such as Scopus, DOAJ, and Google Scholar, with the publication range spanning from 2013 to 2024. The findings indicate that in the realm of evaluation and assessment, the literature offers diverse frameworks and methods to gauge the success of technology-based learning implementations. The diversity in these approaches reflects the complexity of evaluation and assessment within the context of technology-based learning. Despite providing significant insights, there are still knowledge gaps that warrant attention. Future research could delve deeper into the specific impacts of technology-based learning on particular student groups, such as those with special needs or diverse socio-economic backgrounds. Additionally, more detailed investigations into strategies for addressing technical risks and challenges, along with further exploration of more effective collaboration models in the context of technology-based learning, emerge as urgent research topics to pursue in the future.

Keywords: Technology-Based Learning, Education Implementation, Learning Methods.

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A. INTRODUCTION

The shift in the direction of learning towards the utilization of technology has been a significant event in the field of education (Mehdipour & Zerehkafi, 2013). In alignment with technological advancements, educators and educational institutions are integrating technological tools and platforms into the teaching and learning processes. This integration represents not only an enhancement in teaching facilities but also involves a fundamental transformation in methods and learning strategies. The relevance of this shift lies in its potential to enhance interactivity, flexibility, and accessibility in the interaction between teachers and students. Technology enables students to access information more quickly and in-depth, while teachers can leverage various digital learning tools to present materials in a more engaging and effective manner (McKnight et al., 2016). Despite the positive impacts of these changes, continuous monitoring and evaluation remain crucial to ensure that the implementation of technology in education stays focused on improving the learning

experience without compromising critical aspects such as data security and privacy. With an understanding and harnessing of these positive potentials, the education sector can evolve in line with the dynamics of the times, providing a more robust foundation for shaping a skilled generation ready to face global challenges in the digital era (Huda et al., 2017).

Traditional learning is confronted with increasingly conspicuous limitations in accommodating the dynamics of educational needs in the present era. Conventional learning models tend to be static and less capable of responding to the diverse individual needs of students. The focus on direct instruction, textbooks, and conventional methods often proves inadequate in providing a learning experience that meets the complex challenges of the current digital age. These limitations may be reflected in a lack of appeal and student engagement, considering the tendency of the younger generation to be more responsive to dynamic and interactive approaches (McCallum et al., 2015). Innovations in teaching methods are required to enhance effectiveness and student engagement (Gilboy et al., 2015). The utilization of technology, project-based approaches, and the inclusion of active learning strategies are essential aspects in creating a learning environment that is more adaptive and responsive to change. By understanding and addressing the limitations of traditional learning, education can more effectively prepare students to face the complex challenges and dynamics of the contemporary era.

The advancement of technology has significantly impacted the transformation of access and the implementation of learning. This transformation extends beyond merely enhancing access to learning resources; it involves fundamental changes in implementation methods. Technology has served as a catalyst for change, propelling the evolution of the educational process (Kingsley, 2017). Learning accessibility is increasingly broadened through online platforms, providing students with the convenience of accessing various learning resources without being restricted by geographical or time constraints. The role of technology in education encompasses a transformation in teaching strategies, involving more interactive, responsive, and project-based approaches (Rahmawati et al., 2020). The introduction of technology as a catalyst for change not only creates a more dynamic learning environment but also enables better personalized learning according to individual needs and learning styles. The role of technology in education is not merely auxiliary but becomes a central element in guiding the shift towards a more adaptive and innovative learning approach.

The use of technology in learning has several benefits, including increased access, flexibility, and interactivity (Sarnoto et al., 2023) (Junger et al., 2023). Technology allows for greater efficiency and effectiveness in learning, as well as the facilitation of learning skills and enrichment of learning content (Putrajaya et al., 2022). Digital media, educational software, and online learning platforms provide students with access to course materials, assignments, and resources, enhancing their learning experiences (Haddade et al., 2023). Additionally, virtual and augmented reality technologies create immersive learning experiences across various subjects (Kartiwi & Rostikawati, 2022). The use of digital devices such as laptops, tablets, and smartphones allows for personalized learning and access to educational resources. Multimedia resources such as videos, images, and audio recordings can also engage students and enhance their learning. However, it is important to strike a balance between the use of

technology and traditional teaching methods to provide students with a complete and effective learning experience.

The implementation of technology in education faces various obstacles and criticisms. One major concern is the need for effective teacher training and pedagogical alignment with technology use (Jiang, 2023). Limited awareness, poor infrastructure, budget constraints, and resistance to change are identified as significant barriers to integrating information and communication technologies (ICTs) in the education sector (Chugh et al., 2023). Additionally, the lack of pedagogical training and access to digital technology resources hinder the implementation of technology policies in schools (Kamal et al., 2022). However, it is acknowledged that ICT integration is a developing process that requires collaboration among teachers, students, and school officials (Moses et al., 2022). To address these challenges, strategies such as prioritizing professional development, investing in infrastructure, and establishing privacy regulations are recommended (Chuaungo et al., 2022). A comprehensive understanding of the obstacles and criticisms surrounding technology implementation in education requires considering stakeholder perceptions, theoretical frameworks, and success metrics.

Previous research findings have shown that the implementation of technology in learning has several advantages, such as increasing efficiency and effectiveness, facilitating learning skills, and enriching learning content (Sarnoto et al., 2023). However, there are also disadvantages and negative effects, including dependence on technology and potential disruption of concentration (Borg et al., 2023). Research has identified knowledge gaps and research needs in the implementation of welfare technology, including the need for comparative studies, longitudinal studies, and demonstration trials, as well as the development of co-design processes involving technology users (Deepa et al., 2022). Studies are also needed to explore the acquisition, adoption, and acceptance of welfare technology, as well as attitudes, beliefs, and contextual factors related to welfare technology (Deepa et al., 2022). In the context of school education and technology use, research has found that the experiences of privileged and underprivileged children differ in terms of access to internet, affordability of ICT devices, quality teachers, parental support, and financial sponsorship (Romli et al., 2020). However, both privileged and underprivileged children have similar experiences and perspectives in terms of personal ownership of mobile devices, self-directed learning, and having a trusted study advisor.

This research primarily aims to investigate the impact and effectiveness of technology-based learning methods. Emphasizing the urgency of this study, it is evident that this research holds significance in the context of developing an education approach that is adaptive and responsive to the needs of students, in parallel with technological advancements. Through the exploration of the impact and effectiveness of technology-based learning methods, it is anticipated that this research will provide profound insights into how the utilization of technology can enhance the learning process. The implementation of effective technology-based learning methods has the potential to create a more dynamic learning environment, adapting to the individual learning styles of students and aligning with the rapid demands of technological advancements.

B. METHOD

This study adopts a qualitative approach utilizing the Systematic Literature Review method to explore the implications and effectiveness of technology-based learning methods in the educational context. Inclusion criteria involve focusing on the implementation of technology-based learning methods, relevance to the educational context, and possessing adequate clarity and specifications. Conversely, exclusion criteria encompass titles that are too general, lack clarity in the scope of education, and exhibit excessive theoretical abstraction. Noteworthy databases such as Scopus, DOAJ, and Google Scholar are employed as primary sources, utilizing keywords such as Technology-Based Learning, Education Implementation, Learning Methods. The publication timeframe spans from 2013 to 2024. The research process involves literature identification, the selection of studies meeting inclusion criteria, comprehensive analysis of research findings, and synthesizing results to compile a systematic report elucidating the impact and effectiveness of technology-based learning methods in education.

C. RESULTS AND DISCUSSION

Based on the search results, several relevant research findings have been identified that can elucidate the focus and objectives of this study. We have formulated several aspects that need to be described, including: (1) Effectiveness of Technology-Based Learning Methods; (2) Influence of Technical Factors in Implementation, (3) The Role of Interaction and Collaboration in Technology-Based Learning, and (4) Evaluation and Assessment of Technology-Based Learning. In broad terms, an overview can be observed in Table 1.

Table 1. Focus and insight into research results according to eligibility criteria

No	Focus and Scope	Author	Insights or Research Variables Discussed
1	Technology-Assisted Reading Instruction (TARI)	Zuo & Ives (2023)	Boosting reading motivation, enhancing performance, and broadening semiotic resources, particularly beneficial for English Language Learners (ELLs) in K-12settings.
2	Technology-Enhanced Programming Curricula	Phillips et al. (2023)	Proven effectiveness in delivering programming curricula, leading to improved academic performance and fostering positive attitudes towards learning when compared to traditional methods.
3	Online Learning Platforms	Liwanag & Galicia (2023)	Encouraging self-directed learning, positively impacting academic achievements, and surpassing conventional learning methods.
4	Mathematics and Geometry Learning	Çavuş & Deniz (2022)	Superiority of technology-assisted

			teaching over traditional methods in enhancing students' achievements in mathematics and geometry.
5	Educational Software	Tzur et al. (2021)	Demonstrated effectiveness in learning outcomes, particularly when an instructor is included for better understanding and application of studied material.
6	Game-Based Learning (GBL)	Lopez-Fernandez et al.(2021)	Teacher-authored game-based learning as effective as traditional teaching in knowledge acquisition, but significantly more motivating for computer science students.
7	Computer-Assisted Learning (CAL)	Various	Positive substitutability for traditional learning, especially when used in a blended approach.
8	Computer-Based Program for Intellectual Disabilities	Algahtani (2020)	Positive impact on the academic skills of children with intellectual disabilities.
9	Video Technology in Preschool Education	Ikram (2015)	Potential of video technology in improving mathematics and English learning for preschoolers.
10	Technical Factors in Technology-Based Learning	Malik (2023), Mirata et al. (2022), Sarnoto et al. (2023),Taha & Abdulrahman (2023)	Importance of IT infrastructure, device accessibility, technical support, and the potential for disruptions in the successful implementation of technology-based learning methods.
11	Inter-Learner Interactions and Collaborations	Chen et al. (2022), Razali etal. (2020), Fleck & Massou (2021), Haatainen & Aksela(2021)	Significance of learner-learner, learner- instructor, and learner-content interactions in enhancing online learning pedagogy, satisfaction, and learning outcomes.
12	Barriers and Challenges in Technology-Based Learning	Maqoqa (2023), Lie et al. (2022), Borg et al. (2023), Deepa et al. (2022), Taha & Abdulrahman (2023), Sarnoto et al. (2023)	Identified barriers include teacher technology competence, lack of resources, and disparities based on socio-economic status, internet access, affordability of ICT devices, and parental support.

13	Evaluation Frameworks and Assessment Methods	Baker & O'Neil (2023), Shroff et al. (2023), Awad & Almhosen (2023), Oyelere etal. (2022), Antonietti et al. (2023)	Various frameworks for evaluating technology-based learning programs, measuring student perceptions, and assessing computational thinking in a technological context.
14	Advantages and Disadvantages of Technology-Based Learning	Various	Advantages include increased efficiency, effectiveness of learning, and positive learner perception. Disadvantages encompass teacher technology competence, lack of resources, and management deficiencies.

Table 1 provides a general overview of various research focuses in the field of technology-based learning. From the analysis results, it can be inferred that this research encompasses various aspects, including the influence of technology on reading instruction, the effectiveness of technology-based curriculum development, the impact of interaction and collaboration among learners, implementation barriers, and methods of evaluation and assessment. These conclusions can serve as a foundation for a deeper understanding of the role of technology in the educational context. A detailed discussion of these aspects will be elaborated in the following discourse:

1. Effectiveness of Technology-Based Learning Methods

Various studies have indicated the efficacy of technology-based learning approaches across different educational levels. Research suggests that the utilization of technology in reading instruction, known as Technology-Assisted Reading Instruction (TARI), can boost reading motivation, enhance performance, and broaden semiotic resources, especially benefiting English Language Learners (ELLs) in K-12 settings (Zuo & Ives, 2023). Similarly, when compared to traditional methods, technology-enhanced instructional approaches have proven more effective in delivering programming curricula, resulting in improved academic performance and fostering a positive attitude towards learning (Phillips et al., 2023). The use of online learning platforms has been shown to encourage self-directed learning and positively impact academic achievements compared to conventional learning methods (Liwanag & Galicia, 2023). Meta-analytical reviews have highlighted the superiority of technology-assisted teaching over traditional methods in enhancing students' achievements in mathematics and geometry (Çavuş & Deniz, 2022). Additionally, the effectiveness of educational software has been demonstrated in terms of learning outcomes, with the inclusion of an instructor contributing to a better understanding and application of the studied material (Tzur et al., 2021).

The literature consistently supports the effectiveness of technology-based learning methods across various levels of education. Lopez-Fernandez et al. (2021) found that game-based learning (GBL) using teacher-authored games was as effective as traditional teaching in terms of knowledge acquisition, but significantly more motivating for computer science

students. further demonstrated the positive substitutability of computer-assisted learning (CAL) for traditional learning, particularly when used in a blended approach. Algahtani (2020) reported a positive impact of a computer-based program on the academic skills of children with intellectual disabilities, while Ikram (2015) highlighted the potential of video technology in improving mathematics and English learning for preschoolers. These findings collectively suggest that technology-based learning methods can be as effective, if not more so, than traditional methods.

These studies consistently lend support to the effectiveness of technology-based learning methods across various educational levels. The cited research indicates that technology can be a highly effective tool in enhancing learning outcomes, particularly in the contexts of English Language Learners (ELLs) in English instruction, programming education, and mathematics and geometry. Overall, the literature underscores that the integration of technology in education yields consistently positive outcomes. The synthesis of research findings suggests that technology serves as a motivator, enhances performance, and provides a broader array of resources. Moreover, technology has a positive impact on self-directed learning and overall academic achievement.

2. Influence of Technical Factors in Implementation

Technical factors, such as IT infrastructure and device accessibility, play a crucial role in the implementation of technology-based learning methods. These factors have been identified as important considerations in the literature (Malik, 2023). The studies highlight the need for technical support and the availability of computers and internet access as barriers to technology integration in the classroom (Mirata et al., 2022). Additionally, the potential for disruptions, such as computer virus attacks, is also mentioned as a challenge (Sarnoto et al., 2023). On the positive side, the use of technology in education has been found to have a positive impact on student learning outcomes, including academic achievement and knowledge retention (Madni et al., 2022). It also leads to increased student engagement and motivation, as well as improved teacher-student interactions. These findings emphasize the importance of addressing technical factors to ensure the successful implementation of technology-based learning methods.

Technical factors, such as IT infrastructure and device accessibility, are crucial in implementing technology-based learning methods. These factors impact the availability and effectiveness of technology in education, which in turn affects student engagement and learning outcomes (Taha & Abdulrahman, 2023). The availability of equipment and tools in schools and at home, as well as how learners use digital devices, can determine the success of technology integration in teaching and learning (Junger et al., 2023). The quality of teaching and teachers' ability to effectively use digital learning tools and resources also play a significant role in the impact of technology on student learning (Malik, 2023). Challenges identified in the literature include the need for effective integration of technology, the development of appropriate pedagogical approaches, and the management of digital equity to ensure equal access to resources (Sarnoto et al., 2023).

Technical factors such as IT infrastructure and device accessibility play a crucial role in the implementation of technology-based learning methods. These factors can act as

impediments to the integration of technology in the classroom, creating challenges such as a lack of technical support and device availability. Additionally, potential disruptions like computer virus attacks pose risks to the sustainability of technology-based learning. The success of technology utilization in education has been proven to enhance student learning outcomes and positively impact teacher-student interactions and student motivation. These studies offer a profound understanding of how technical factors can either hinder or facilitate the implementation of technology-based learning methods. Despite the challenges, the positive benefits on learning outcomes and classroom interactions suggest that investments and attention to technical factors can yield significant results.

3. The Role of Interaction and Collaboration in Technology-Based Learning

Inter-learner interactions and collaborations are important in technology-based learning methods. Learner-learner, learner-instructor, and learner-content interactions have been frequently cited in the literature (Chen et al., 2022). These interactions support online learning pedagogy, enhance the learning and teaching process, and increase students' satisfaction and learning outcomes (Razali et al., 2020). Additionally, collaborations among teachers and learners in face-to-face or distance learning contribute to the construction of learning. Collaborative approaches in project-based learning encourage interdisciplinary group formation and facilitate authentic project work, leading to increased engagement and self-learning among students (Fleck & Massou, 2021). However, there may be drawbacks to collaboration, as identified in students' interviews (Haatainen & Aksela, 2021). Overall, inter-learner interactions and collaborations play a significant role in technology-based learning, with positive impacts on learning outcomes and engagement, but potential challenges should be considered and addressed.

Previous research findings have shown that the implementation of technology-based learning can have several advantages, such as increasing the efficiency and effectiveness of learning, facilitating learning skills, and enriching learning content. However, there are also barriers to the implementation of technology-based learning, including teacher technology competence and lack of resources (Maqoqa, 2023). Despite these barriers, learners have a positive perception of computer usage in mathematics learning and teaching (Lie et al., 2022). The management of technology-based learning has been initiated in some schools, but there are still weaknesses and deficiencies that need to be addressed (Borg et al., 2023). In the field of welfare technology, there are knowledge gaps and research needs related to research designs, populations, and the focus of research (Deepa et al., 2022). Additionally, the experiences of children with school education and technology for learning differ based on their socio-economic status, access to internet, affordability of ICT devices, and parental support.

The research findings indicate that the integration of inter-learner interactions and collaborations has significant implications within technology-based learning methods. These interactions not only support online learning but also enrich the overall learning process. Collaborations between teachers and learners have proven to make a substantial contribution to the development of learning, particularly through collaborative approaches in project-based learning. From these findings, it is evident that inter-learner interactions and collaborations

are critical elements in designing and implementing technology-based learning methods. While the potential benefits, such as improved learning outcomes and student engagement, are identified, the findings also acknowledge potential obstacles and challenges in collaboration, as reflected in student interviews.

4. Evaluation and Assessment of Technology-Based Learning

The literature extensively discusses evaluation and assessment in the realm of technology-based learning. Numerous frameworks and assessment methods have been put forth to gauge the effectiveness of technology-driven learning implementations. One framework specifically delves into the categories of dependent variables employed in evaluating technology-based learning programs, encompassing measures, metrics, and indicators (Baker & O'Neil, 2023). Another framework combines collaborative, problem-based, and peer assessment strategies to gauge learners' perceptions within a technology-enabled environment (Shroff et al., 2023). A student outcome-based assessment and evaluation framework has also been introduced, featuring crucial performance metrics for the quantitative evaluation of outcomes (Awad & Almhosen, 2023). Furthermore, a pedagogical assessment framework for computational thinking has been suggested to evaluate the impact and results of instructional tools in a technological context (Oyelere et al., 2022). Additionally, an assessment tool named the ICAP Technology Scale has been created to evaluate the integration of technology across diverse learning activities (Antonietti et al., 2023). These frameworks and assessment methods serve as valuable resources for evaluating and enhancing the effectiveness of technology-based learning implementations.

Numerous evaluation frameworks and methods exist to assess the effectiveness of technology-based learning approaches. The Pedagogical Evaluation Framework for Computational Thinking Supporting Technologies and Tools concentrates on evaluating the suitability of technological tools for facilitating learning activities and improving learning outcomes (A'la et al., 2023). The SUMMIT Evaluation Framework acts as a manual for assessing various learning technologies, encompassing surgical simulators and real-time educational applications (Nozari et al., 2023). The Comprehensive Initiative on Technology Evaluation (CITE) formulates methodologies for appraising products used in the developing world, taking into account diverse goals, infrastructures, technologies, and products (Nurwahidah et al., 2023). Evaluating Technology-Based Curriculum Materials emphasizes the assessment of student engagement through observable performances and authentic tasks (Chumak, et al., 2023). These frameworks and methods provide educators and researchers with the tools to comprehensively evaluate the efficacy of technology-based learning methods, enabling informed decisions regarding the integration of technology in education (Shroff et al., 2023).

The literature extensively delves into the facets of evaluation and assessment in technology-based learning, identifying various frameworks and assessment methods employed or recommended. These frameworks involve diverse dependent variables, such as measures and indicators, alongside collaborative and outcome-based assessment strategies. The presence of these diverse frameworks reflects the complexity inherent in evaluating the success of technology-based learning. The frameworks and assessment methods outlined in

the literature provide a robust foundation for the evaluation process of technology-based learning. They serve as valuable tools for educators and researchers, aiding in the comprehensive and holistic assessment of the effectiveness of technology-based learning methods.

D. CONCLUSION

Based on the outlined literature evaluation, it can be concluded that technology-based learning has a positive impact across various educational levels. The utilization of technology, as seen in Technology-Assisted Reading Instruction (TARI) and programming curricula, has proven to enhance motivation, performance, and learning outcomes for students. Additionally, technical factors, including IT infrastructure and device accessibility, play a crucial role in the success of implementing technology-based learning methods. Despite potential technical challenges such as lack of support and security risks, investments and attention to technical factors can yield substantial positive outcomes. Interactions and collaborations among learners are also proven to be crucial in technology-based learning, offering positive benefits in terms of learning outcomes and student engagement.

It is essential to acknowledge potential weaknesses and challenges in collaboration, as identified in student interviews. Regarding evaluation and assessment, the literature presents diverse frameworks and methods for measuring the success of implementing technology-based learning. This diversity reflects the complexity of evaluation and assessment in the context of technology-based learning. Although the literature provides significant insights, there are still knowledge gaps to be addressed. Further research could delve into the specific impacts of technology-based learning on particular student groups, such as those with special needs or diverse socio-economic backgrounds. Additionally, in-depth studies on strategies to address technical risks and challenges, along with exploring more effective collaboration models in the context of technology-based learning, emerge as urgent topics for investigation in the future.

REFERENCES

A'la, N. I., Bilqist, P. S. I., Anisa, T. N., & Aini, V. Z. (2023). Pemanfaatan Teknologi dalam Evaluasi Pembelajaran Tingkat Sekolah Dasar. *Al-DYAS*. https://doi.org/10.58578/aldyas.v2i3.1480

Algahtani, F. (2020). The Effectiveness of Computer-Based Learning in Developing Academic Skills for Children with Intellectual Disabilities. *International Journal of Childhood, Counselling and Special Education*. https://doi.org/10.31559/ccse2020.1.1.5

Antonietti, C., Schmitz, M. L., Consoli, T., Cattaneo, A., Gonon, P., & Petko, D. (2023). "Development and validation of the ICAP Technology Scale to measure how teachers integrate technology into learning activities." *Computers and Education*. https://doi.org/10.1016/j.compedu.2022.104648

Awad, W. S., & Almhosen, K. A. (2023). A Framework of Outcome-based Assessment and Evaluation for Computing Programs. *International Journal of Advanced Computer Science and Applications*. https://doi.org/10.14569/IJACSA.2023.0140140

Baker, E. L., & O'Neil, H. F. (2023). Measures, Metrics, and Indicators for Evaluating Technology-Based Interventions. *International Journal of Human-Computer Interaction*.

https://doi.org/10.1080/10447318.2023.2175159

Borg, J., Gustafsson, C., Landerdahl Stridsberg, S., & Zander, V. (2023). Implementation of welfare technology: a state-of-the-art review of knowledge gaps and research needs. In *Disability and Rehabilitation: Assistive Technology*. https://doi.org/10.1080/17483107.2022.2120104

Çavuş, H., & Deniz, S. (2022). The Effect of Technology Assisted Teaching on Success in Mathematics and Geometry: A Meta-Analysis Study. *Participatory Educational Research*. https://doi.org/10.17275/per.22.45.9.2

Chen, X., Zou, D., Cheng, G., & Xie, H. (2022). Thirty years of interactive learning environments: contributors, collaborations and research topics. *International Journal of Mobile Learning and Organisation*. https://doi.org/10.1504/ijmlo.2022.125965

Chugh, R., Turnbull, D., Cowling, M. A., Vanderburg, R., & Vanderburg, M. A. (2023). Implementing educational technology in Higher Education Institutions: A review of technologies, stakeholder perceptions, frameworks and metrics. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-11846-x

Chumak, M., & Zahorodnia, T. (2023). Teoretical Foundations Of Learning Technology. *Academic Notes Series Pedagogical Science*. https://doi.org/10.36550/2415-7988-2023-1-208-68-72

Deepa, V., Sujatha, R., & Mohan, J. (2022). Unsung voices of technology in school education-findings using the constructivist grounded theory approach. *Smart Learning Environments*. https://doi.org/10.1186/s40561-021-00182-7

Fleck, S., & Massou, L. (2021). Le numérique pour l'apprentissage collaboratif : nouvelles interfaces, nouvelles interactions. *Médiations et Médiatisations*. https://doi.org/10.52358/mm.vi5.191

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of Nutrition Education and Behavior*. https://doi.org/10.1016/j.jneb.2014.08.008

Haatainen, O., & Aksela, M. (2021). Project-based learning in integrated science education: Active teachers' perceptions and practices. *LUMAT*. https://doi.org/10.31129/LUMAT.9.1.1392

Haddade, H., Nur, A., Mustami, M. K., & Achruh, A. (2023). Technology-based learning strategies in Digital Madrasah Program. *Cypriot Journal of Educational Sciences*. https://doi.org/10.18844/cjes.v18i1.8179

Huda, M., Hehsan, A., Jasmi, K. A., Mustari, M. I., Shahrill, M., Basiron, B., & Gassama, S. K. (2017). Empowering children with adaptive technology skills: Careful engagement in the digital information age. *International Electronic Journal of Elementary Education*.

Ikram, H. (2015). The Impact of Teachers Professional Development in Video Technology on Mathematics and English Learning of Preschoolers in a Rural Primary School in Pakistan. *International Journal for Digital Society*. https://doi.org/10.20533/ijds.2040.2570.2015.0131

Jiang, M. (2023). The Impact and Potential of Educational Technology: A Comprehensive Review. *Research and Advances in Education*. https://doi.org/10.56397/rae.2023.07.05

Junger, A. P., De Oliveira, V. I., Yamaguchi, C. K., De Oliveira, M. A. M. L., De Aguiar, H. M., & De Lima, B. L. S. (2023). The role of school management in technological practices as a tool for futuristic teaching. *Revista de Gestão e Secretariado (Management and Administrative Professional Review)*. https://doi.org/10.7769/gesec.v14i7.2426

Kamal, H., Dhir, S., Hasteer, N., & Soni, K. M. (2022). Analysis of Barriers to ICT4D Interventions in Higher Education through Interpretive Structural Modeling. *Proceedings - 2022 4th International Conference on Advances in Computing, Communication Control and Networking, ICAC3N 2022*. https://doi.org/10.1109/ICAC3N56670.2022.10074596

Kartiwi, Y. M., & Rostikawati, Y. (2022). Pemanfaatan Media Canva Dan Aplikasi Quizizz Pada Pembelajaran Teks Fabel Peserta Didik Smp. *Semantik*. https://doi.org/10.22460/semantik.v11i1.p61-70

Kingsley, A. (2017). Information Communication Technology (ICT) in the Educational System of the Third World Countries as a Pivotal to Meet Global Best Practice in Teaching and Development. *American Journal of Computer Science and Information Technology*. https://doi.org/10.21767/2349-3917.100010

Lie, V., A Kauutuk, D., Palilingan, R., & N Tambingon, H. (2022). Technology-Based Learning Management at State Vocational Schools In Minahasa Selatan. *Eduvest - Journal of Universal Studies*. https://doi.org/10.36418/eduvest.v2i11.646

Liwanag, M. F., & Galicia, L. S. (2023). Technological Self-efficacy, Learning Motivation, and Selfdirected Learning of Selected Senior High School Students in a Blended Learning Environment. *Technium Social Sciences Journal*. https://doi.org/10.47577/tssj.v44i1.8980

Lopez-Fernandez, D., Gordillo, A., Alarcon, P. P., & Tovar, E. (2021). Comparing Traditional Teaching and Game-Based Learning Using Teacher-Authored Games on Computer Science Education. *IEEE Transactions on Education*. https://doi.org/10.1109/TE.2021.3057849

Madni, S. H. H., Ali, J., Husnain, H. A., Masum, M. H., Mustafa, S., Shuja, J., Maray, M., & Hosseini, S. (2022). Factors Influencing the Adoption of IoT for E-Learning in Higher Educational Institutes in Developing Countries. In *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2022.915596

Malik, R. (2023). Impact of Technology-based Education on Student Learning Outcomes and Engagement. *Proceedings of the 17th INDIACom; 2023 10th International Conference on Computing for Sustainable Global Development, INDIACom 2023*.

Maqoqa, T. (2023). Exploring the effects of technology integration in the learning and teaching of mathematics. *International Journal of Research in Business and Social Science (2147- 4478)*. https://doi.org/10.20525/ijrbs.v12i2.2386

McCallum, S., Schultz, J., Sellke, K., & Spartz, J. (2015). An Examination of the Flipped Classroom Approach on College Student Academic Involvement. *International Journal of Teaching and Learning in Higher Education*.

McKnight, K., O'Malley, K., Ruzic, R., Horsley, M., Franey, J. J., & Bassett, K. (2016). Teaching in a digital age: How educators use technology to improve student learning. *Journal of Research on Technology in Education*. https://doi.org/10.1080/15391523.2016.1175856

Mehdipour, Y., & Zerehkafi, H. (2013). Mobile Learning for Education: Benefits and Challenges. *International Journal of Computational ….*

Mikael L. Chuaungo, K. Lalnunsiami, & Lokanath Mishra. (2022). Opportunities and Barriers in ICT Integrated Education: A Critical Analysis. *International Journal of Engineering Technology and Management Sciences*. https://doi.org/10.46647/ijetms.2022.v06i05.117

Mirata, V., Awinia, C., Godson, E., & Bergamin, P. (2022). The Future of Technology-Based Learning at the Open University of Tanzania. *International Journal of Emerging Technologies in Learning*. https://doi.org/10.3991/ijet.v17i15.33273

Moses, C., Nghipandulwa, L. L. T., & Shikusho, S. P. (2022). Investigating the Challenges Faced by Teachers in the Implementation of Digital Technology in Secondary Schools in Rundu Circuit, Kavango East Region Namibia. *Open Journal of Social Sciences*. https://doi.org/10.4236/jss.2022.109018

Nozari, M., Radfar, R., & Ghazinoori, S. (2023). A practical framework for technological learning in developing countries. *African Journal of Science, Technology, Innovation and Development*. https://doi.org/10.1080/20421338.2023.2221595

Nurwahidah, N., Sulfasyah, S., & Rukli, R. (2023). Investigating Grade Five Teachers' Integration of Technology in Teaching Reading Comprehension Using the TPACK Framework. *Journal of Language Teaching and Research*. https://doi.org/10.17507/jltr.1404.09

Oyelere, S. S., Agbo, F. J., & Sanusi, I. T. (2022). Developing a pedagogical evaluation framework for computational thinking supporting technologies and tools. *Frontiers in Education*. https://doi.org/10.3389/feduc.2022.957739

Phillips, J., Jagnandan, S., Jagnandan, A., & Khan, B. (2023). An Investigation of the Effects of Technology-Enhanced Instructional Approaches on Students' Programming Skills at New Amsterdam Secondary School. *International Journal of Current Science Research and Review*. https://doi.org/10.47191/ijcsrr/v6-i7-02

Putrajaya, G., Latif, A., Nofirman, N., Bangkara, B. M. A. S. A., & Maruf, I. R. (2022). The Benefits of ICT Application on the Successful Implementation of Formal Education. *EDUTEC : Journal of Education And Technology*. https://doi.org/10.29062/edu.v6i2.486

Rahmawati, A., Suryani, N., Akhyar, M., & Sukarmin. (2020). Technology-Integrated Project-Based Learning for Pre-Service Teacher Education: A Systematic Literature Review. In *Open Engineering*. https://doi.org/10.1515/eng-2020-0069

Razali, S. N., Ahmad, M. H., & Noor, H. A. M. (2020). Implications of Learning Interaction in Online Project Based Collaborative Learning. *Journal of Computational and Theoretical Nanoscience*. https://doi.org/10.1166/jctn.2020.8831

Romli, M. H., Cheema, M. S., Mehat, M. Z., Md Hashim, N. F., & Hamid, H. A. (2020). Exploring the effectiveness of technology-based learning on the educational outcomes of undergraduate healthcare students: An overview of systematic reviews protocol. In *BMJ Open*. https://doi.org/10.1136/bmjopen-2020-041153

Sarnoto, A. Z., Hidayat, R., Hakim, L., Alhan, K., Sari, W. D., & Ika, I. (2023). Analisis Penerapan Teknologi dalam Pembelajaran dan Dampaknya terhadap Hasil Belajar. *Journal on Education*. https://doi.org/10.31004/joe.v6i1.2915

Shroff, R. H., Ting, F. S. T., Chan, C. L., Garcia, R. C. C., Tsang, W. K., & Lam, W. H. (2023). Conceptualisation, measurement and preliminary validation of learners' problem-based learning and peer assessment strategies in a technology-enabled context. *Australasian Journal of Educational Technology*. https://doi.org/10.14742/ajet.7214

Taha, T. B., & Abdulrahman, M. S. (2023). The Impact of Technology on Students' Psychological and Educational Performance. *JISA(Jurnal Informatika Dan Sains)*. https://doi.org/10.31326/jisa.v6i1.1661

Tzur, S., Katz, A., & Davidovich, N. (2021). Learning supported by technology: Effectiveness with educational software. *European Journal of Educational Research*. https://doi.org/10.12973/EU-JER.10.3.1139

Zuo, X., & Ives, D. (2023). Technology-Assisted Reading Instruction for English Language Learners: A Methodological Review. In *ECNU Review of Education*. https://doi.org/10.1177/20965311231179490