The Role of Technology in Supporting Differentiated Learning for Students with Diverse Learning Needs: A Systematic Literature Review

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Abstract: Differentiated learning is a strategic approach to meet the diverse needs, interests, and learning abilities of students. However, its implementation still faces various challenges. This study regularly examines the use of technology in supporting differentiated learning and analyzes the barriers to its implementation. The method used is a Systematic Literature Review of 15 articles indexed by SINTA, Scopus, or Semantic Scholar in the last five years, through the stages of identification, selection, quality assessment, and descriptive-analytical data synthesis. The results of the study show that the integration of technology, such as digital media, LMS, WebQuest, animated videos, and DVGs, is effective in facilitating the diverse learning needs of students. Technology supports teachers in designing adaptive learning, increasing motivation and learning outcomes, and facilitating the assessment and feedback process. However, challenges in the form of limited infrastructure, digital literacy, and teacher readiness are still major obstacles. Therefore, continuous training and strengthening of supporting facilities are needed so that the implementation of technology-based differentiated learning can run optimally and effectively. The study recommends the development of a more adaptive technology integration model.

Keywords: Differentiated learning, learning technology, learning needs.

Introduction

Differentiated learning is currently one of the important approaches in the world of education to meet the diverse learning needs of students. Students in the classroom have different backgrounds, abilities, interests, and learning styles. This condition requires teachers to no longer use uniform learning methods (one size fits all), but to be able to design flexible learning so that each student can

achieve optimal competence (Sholeh & Rofiki, 2024). The success of differentiated instruction is reflected in students' sense of comfort, as the learning process is guided by diagnostic assessment, tailored to learning styles, problem- or project-based, and produces outcomes aligned with students' abilities and learning environments (Faigawati et al., 2023).

However, the implementation of differentiated learning in the field still faces challenges. Many teachers have difficulty implementing this strategy due to limitations in understanding the concept, long planning time, and limited media and learning resources (Simbolon & Bangun, 2024). In fact, several previous studies have shown that the application of technology in differentiated learning can be an effective solution. For example, research by Krishan and Al-rsa'i (2023) proved that technology integration can significantly increase student learning motivation in science subjects. Unfortunately, studies that specifically examine the model of technology application in supporting learning differentiation, especially at various levels and fields of science, are still limited and have not been widely developed. This is a gap that needs to be studied further.

The theory of learning differentiation emphasizes the adjustment of the process, content, and learning products according to the profile of the learner (Tomlinson, 2017). The application of technology such as animated video media, WebQuest, and online learning platforms has been proven to facilitate the differentiation process. Synekop (2020) in his research showed that the use of WebQuest in teaching English for Specific Purposes (ESP) is effective in increasing individual student engagement according to their needs. In addition, research by Smith et al. (2023) also emphasized that synchronous learning technology is effective in helping English Learners (ELs) who have different learning needs. The application of differentiated learning and the use of technology in learning is carried out as an effort to increase motivation and physics learning outcomes of students (Kurniawati, et al. 2023).

Based on the background and study, this study aims to examine the use of technology in supporting the implementation of differentiated learning at various levels of education and scientific fields, then find out the challenges faced in using technology for differentiated learning and see the effectiveness of technology in helping students with different learning needs. For this reason, the Systematic Literature Review (SLR) approach is used to be able to collect and analyze findings from various previous studies comprehensively. Through the results of this systematic study, it is hoped that it can be a reference for teachers, schools, and policy makers in designing learning strategies that are more adaptive, effective, and in accordance with the needs of students in the digital era.

Method

The research method used in writing this article is Systematic Literature Review (SLR). This approach is carried out by systematically reviewing various scientific sources, such as SINTA indexed journal articles, Scopus, books, and other relevant literature that discuss the role of technology in supporting differentiated learning. The SLR method has often been used by researchers (Latifah, 2024); (Kurnila et al., 2025); (Smale-Jacobse et al., 2019).

. Through this method, the author collects and analyzes information in depth to build a strong theoretical foundation and provide a comprehensive understanding of the issues being studied (Kitchenham, 2004; Snyder, 2019). The data collection process is carried out in a structured manner by considering several stages, namely determining research objectives, determining inclusion and exclusion criteria, data search strategies and study selection, data collection, assessment of study

quality, and synthesis of data results. The data obtained from various sources are then analyzed using a descriptive-analytical method, namely by editing, analyzing, and integrating various literature findings in order to formulate conclusions systematically and structured in narrative form (Suharsimi, 2010).

The journal search focused on publications published in the last five years and came from reputable academic databases, such as SINTA, Scopus, Garuda and Semantic Scholar. The keywords used in the data search include "technology in differentiated learning", "differentiated instruction technology", and "effective differentiated instruction technology". Based on the focus of the study, this study was designed to answer three research questions (Research Questions), namely: RQ1 regarding the use of technology in supporting the implementation of differentiated learning at various levels of education and scientific fields; RQ2 regarding the challenges faced in using technology for differentiated learning; and RQ3 regarding the effectiveness of technology in helping students with different learning needs. Through this systematic approach, it is hoped that the article will be able to present an accurate and comprehensive analysis of the topics discussed.

Results

Research related to the role of technology in supporting differentiated learning for students with diverse learning needs has been conducted by various previous researchers. In this study, several findings have been obtained from several research articles related to the role of technology in supporting differentiated learning for students with diverse learning needs.

The research article was obtained through a search, and based on the search results, 25 journals were found from various indexes, both from SINTA, SCOPUS, and Semantic Scholar. Which were then identified based on the criteria for limitations and exclusions. After being identified, 15 journals were selected that met the quality standards. Table 1 below is the result of the identification and meeting the quality standards.

Table 1. Identification Results

Researcher Name	Title	Source/Publication	Years	QA1	QA2	QA3	Hasil
Sholeh, M., & Rofiki, I.	Penerapan Pembelajaran Berdiferensiasi Berbantuan Media Teknologi pada Materi Teks Nonfiksi untuk Siswa Kelas VI Sekolah Dasar	Jurnal Ilmiah Pendidikan Dasar Islam	2024	✓	✓	✓	✓
Yahya, F., Suryani, E., Hermansyah, H., & Nurhairunnisah, N.	Pemanfaatan Teknologi dalam Pembelajaran Berdiferensiasi Beserta Kaitannya dengan Gaya Kognitif Siswa	Jurnal Pendidikan MIPA dan Teknologi	2024	✓	✓	✓	✓

Researcher Name	Title	Source/Publication	Years	QA1	QA2	QA3	Hasil
Kurniawati, M. P., Mustakim, A., & Hudha, M. N.	Peningkatan Motivasi dan Hasil Belajar Fisika Dengan Penggunaan Teknologi Dalam Pembelajaran dan Pendekatan Berdiferensiasi Pada Peserta Didik Kelas X – 1 SMA Negeri 6 Kediri Tahun Pelajaran 2022/2023	Jurnal Pembelajaran, Bimbingan, dan Pengelolaan Pendidikan	2023	✓	✓	✓	✓
Maruanaya, H. J., Camerling, B. C. F., Tanasale, I. O., Usmany, D. N., Aponno, V. I., & Josep, I.	Pemanfaatan Teknologi Digital untuk Pembelajaran Bahasa Inggris yang Berdiferensiasi	Jurnal Abdi Insani	2025	✓	✓	✓	✓
Ekaningtiass, P., Fitriani, H., Nurudin, M. N., & Akhodiyah, S.	Pengembangan Media Pembelajaran Berdiferensiasi Berbasis Teknologi pada Materi Teks Prosedur untuk Siswa Kelas VII SMP	Journal on Education	2023	✓	✓	✓	✓
Palieraki, S., & Koutrouba, K.	Differentiated instruction in information and communications technology teaching and effective learning in primary education	European Journal of Educational Research	2021	✓	✓	✓	✓
Santoso, P. H., Istiyono, E., & Haryanto.	Physics Teachers' Perceptions about Their Judgments within Differentiated Learning Environments: A Case for the Implementation of Technology	Education Sciences	2022	✓	✓	✓	✓
Synekop, O.	Webquest as technology of differentiated ESP instruction at university level	The Journal Of Teaching English For Specific And Academic Purposes	2020	✓	✓	✓	✓
Krishan, I. Q., & Al-rsa'i, M. S.	The effect of technology-oriented differentiated instruction on motivation to learn science	International Journal of Instruction	2023	✓	✓	✓	✓

Researcher Name	Title	Source/Publication	Years	QA1	QA2	QA3	Hasil
Smith, S., Carlo, M.S., García Plaza, E., Zayas Santiago, C. & Young, D.J.	Leveraging Technology to Increase Access to Differentiated Instruction: A Case Study of a Synchronous Remote Delivery Dual Language Intervention for English Learners	Journal of Interactive Learning Research	2023	✓	✓	✓	✓
Alshareef, K. K., Imbeau, M. B., & Albiladi, W. S.	Exploring the use of technology to differentiate instruction among teachers of gifted and talented students in Saudi Arabia.	Gifted and Talented International	2022	✓	✓	✓	✓
Estaiteyeh, M., & DeCoito, I.	Differentiated instruction in digital video games: STEM teacher candidates using technology to meet learners' needs	Interactive Learning Environments	2023	✓	✓	✓	✓
Kótay-Nagy, A.	Differentiated instruction in the EFL classroom: An interview study on Hungarian primary and secondary school EFL teachers' views and self-reported practices	Journal of Adult Learning, Knowledge and Innovation	2023	✓	✓	✓	✓
Uruskyi, A., & Havryshchak, H.	Differentiation of Tasks in The Process of Graphic Competence Formation of Higher School Students by Means of Computer-Oriented Technologies	Educological Discourse	2022	✓	✓	✓	✓
Mustofa, M.	Teachers' Perception on Integrating Technology In Differentiated Instruction and Collaborative Learning: A Case Study	Jurnal Simki Pedagogia	2024	✓	✓	✓	✓

✓: Literature included in the research.

X : Literature not included in the research.

Discussions

The integration of technology in education, especially in supporting the implementation of differentiated learning, has great potential in improving the quality of learning while preparing students to face challenges in the digital and technology-based era. However, challenges related to

teacher readiness, limited infrastructure, and digital literacy levels are still obstacles that must be overcome immediately to ensure the success of the implementation of this strategy. In this section, the results of the analysis of the literature review that has been conducted are presented. The discussion focuses on efforts to answer three research questions (Research Questions), namely RQ1, RQ2, and RQ3. The following is an explanation of the results of each of these research questions.

1. Utilization of Technology in Supporting the Implementation of Differentiated Learning (RQ1)

Technology plays an important role in supporting differentiated learning, especially in today's digital era. Technology allows teachers to adjust the teaching and learning process to the needs, interests, and characteristics of each student (Yahya et al., 2024; Sholeh & Rofiki, 2024). Through technology, teachers can more easily identify students' learning profiles and develop appropriate learning strategies, so that each student gets the opportunity to learn optimally. The use of technology in differentiated learning is a potential tool that allows teachers to adjust the learning process to students' cognitive styles so that teaching in schools can take place more optimally (Yahya et al., 2024). One of the uses of technology is by using learning media in delivering material through a projector by displaying work tutorials according to procedures, which have been tested valid by material experts, media experts, and practitioner experts (Ekaningtiass et al., 2023).

The use of learning applications such as Quizizz, interactive media, and Learning Management Systems (LMS) are concrete examples of how technology is used to accommodate differences in learning needs. This technology provides various material formats, ranging from text, video, to audio, which can be selected according to students' learning styles. Uruskyi & Havryshchak (2022), emphasized that the use of differentiated tasks based on graphic technology is effective in supporting the implementation of an individual approach in learning, while increasing competence. That way, students have the freedom to understand the material according to their abilities (Maruanaya et al., 2020). The application of digital media in differentiated learning has a positive impact on student motivation and learning outcomes. According to Kurniawati et al. (2023), the application of technology has a positive effect on student motivation. In addition, the application of asynchronous learning strategies can also be used by teachers in utilizing technology in the differentiated learning process (Palieraki, S., & Koutrouba, K., 2021)

Technology helps create a more engaging, interactive learning environment and encourages students to be more actively involved in the learning process (Maruanaya et al., 2020; Ekaningtyas et al., 2023; Mustofa, M., 2024). This is also in line with the opinion of Krishan & Al-rsa'i (2023), that based on the results of their research, the application of technology-oriented differentiated learning is more effective in increasing student motivation and activating student collaboration in groups. According to Synekop (2020), in his research he also explained that internet-based learning strategies or WebQuest as a technology that is adapted to student differentiation can also help improve learning and develop professional communication skills. In addition, recent studies have shown that the development of Digital Video Games (DVGs) by teachers is able to integrate the principles of differentiated learning effectively. DVGs allow for variations in learning speed, difficulty level, and content presentation in a multimodal format, so that they can accommodate the needs and learning styles of diverse students more flexibly and interactively (Estaiteyeh & DeCoito, 2023).

In addition, technology makes it easier for teachers to provide feedback quickly and accurately. This is in line with the suggestions of Santoso et al. (2022), regarding the need for support for the application of technology that helps the teacher assessment process. This allows teachers to continue

to monitor student progress individually and adjust learning methods if necessary. With this important role, technology is one of the key factors in the success of implementing differentiated learning in the classroom. According to Sholeh and Rofiki (2024), technology in differentiated learning, especially in non-fiction text materials, allows for more effective personalization. With the help of animated videos as teaching materials and products, students are actively involved in the learning process that is adjusted to the results of the diagnostic assessment, so that students' understanding of the material increases.

2. Challenges Faced in Using Technology for Differentiated Learning (RQ2)

Although technology provides many benefits in differentiated learning, its application in the field is not free from various challenges. Kótay-Nagy (2023), and Santoso et al. (2022), stated that the biggest challenge is the readiness of teachers to master technology and design learning that is truly in accordance with student characteristics. Many teachers still find it difficult to adjust their teaching methods to the demands of technology and the diverse needs of students. In Krishan & Al-rsa'i (2023), it is explained that teachers need to adapt to technology and utilize it in developing learning. In addition, limited facilities and infrastructure are also major obstacles. Not all schools have adequate access to technological devices and lack of training (Alshareef et al., 2022). This condition causes technology-based differentiated learning to not be applied evenly in all schools.

Santoso et al (2022), explained that there were limitations in teachers in developing differentiated learning strategies, namely the existence of fairness and accuracy of assessments and teacher workload. Therefore, the development of technology is recommended to overcome these obstacles. Then Palieraki, S., & Koutrouba, K. (2021), stated that one of the challenges in implementing technology in differentiated learning is when learning is carried out asynchronously and combined with tiered learning activities, which actually adds complexity and becomes an obstacle for teachers in managing the learning process effectively. From the student's perspective, differences in digital literacy levels are also a challenge in themselves. Not all students are able to utilize technology optimally in the learning process. Therefore, it is recommended that teachers need to provide assistance and guidance for students so that they can be serious and still be able to carry out their duties in their learning process (Sholeh & Rofik., 2024; Kurniawati et al., 2023). In addition, to make it easier for teachers to measure student learning outcomes fairly and evenly, teachers can use online evaluation application assessment strategies (Maruanaya et al., 2025). The strategy includes integrating technology into differentiated learning. Yahya et al. (2024), emphasized that technology in differentiated learning strengthens the implementation of strategies by providing various activities and materials according to students' cognitive styles. And according to Ekaningtiass et al. (2023), in implementing differentiated learning, learning media can be used that are designed according to students' learning styles.

With these challenges, teachers are required to be more creative in designing learning and providing extra assistance for students who are experiencing difficulties (Kótay-Nagy, 2023). The implication is that education must continue to improve by providing training and assistance to teachers in mastering educational technology. Maruanaya et al. (2025) also emphasized that ongoing training for teachers is very important so that the use of digital technology in differentiated learning is truly optimal and effective in the classroom. In addition, teachers also need to have self-awareness by showing a positive attitude by providing support for the application of technology. Because

implementing technology in the differentiated learning process can also help the teacher's assessment process of students.

3. Effectiveness of Technology in Helping Students with Different Learning Needs (RQ3)

In implementing differentiated learning, teachers need to choose the right strategies and models so that technology integration runs effectively. Based on existing studies, one of the most widely used strategies is the use of technology as an interactive media and assessment platform. Teachers can design learning activities that involve technology to facilitate differences in students' learning styles, interests, and ability levels. Several learning models such as flipped classroom, blended learning, and technology-based project-based learning (PjBL) are very effective in supporting differentiated instruction (Smith et al., 2023; Alshareef et al., 2022; Estaiteyeh & DeCoito., 2023). The use of various WebQuests (internet-based learning strategies) as technologies that are tailored to student differentiation can help improve learning to develop professional communication skills (Synekop, 2020). With this model, students are given flexible learning access through learning videos or online modules before face-to-face activities take place. While in class, teachers can focus more on activities that encourage exploration and problem solving according to the needs of each student. Maruanaya et al (2025), emphasized that the strategy of using technology in differentiated learning must consider the principles of interactivity and student involvement. The learning media chosen must be able to encourage active student participation, both individually and in groups. In addition, teachers must also ensure that the technology used is relevant to the learning objectives and characteristics of the students.

Palieraki et al (2021), explained that through the implementation of the evaluation of the effectiveness of differentiated learning, an increase in the quality of student assessment and active student participation was obtained. Grouping strategies, card techniques, and differentiated work routines have proven to be very effective. Then the use of online evaluation applications such as Kahoot! and Google Form, which allow teachers to provide questions with different levels of difficulty for each group of students (Maruanaya et al, 2025). With this strategy, teachers can more easily measure student learning outcomes fairly and evenly. This strategy shows that technology is not only a tool, but also the main media in supporting the implementation of differentiated instruction effectively in the classroom. Yahya et al (2024)., And Mustofa, M. (2024)., emphasized that technology in differentiated learning strengthens the implementation of strategies by providing various activities and materials according to students' cognitive styles. This encourages teachers to design more effective and interactive learning according to the characteristics of individual students.

Alshareef et al (2022), revealed that the use of technology in differentiated learning is an important approach in accommodating the needs and abilities of gifted and talented students so that their potential can develop optimally. The use of technology-based learning media in differentiated classes can increase motivation and learning outcomes that are adjusted to students' learning styles (Ekaningtiass et al., 2023; Yahya et al., 2024; Sholeh, M., & Rofiki, I. 2024; Kurniawati et al., 2023; Uruskyi & Havryshchak, 2022). The application of technology-based differentiated learning is significantly more effective in increasing students' science learning motivation compared to traditional learning (Krishan & Al-rsa'i, 2021). According to Smith et al. (2023), the application of distance synchronous academic learning through digital platforms has proven effective in providing differentiated learning for students, even with limited teachers and time at school (Simanjuntak et al., 2023).

Conclusion

This study concludes that the integration of technology in differentiated learning can significantly strengthen the effectiveness of the teaching and learning process in dealing with the diversity of student needs and characteristics. The use of various digital media, ranging from Learning Management Systems (LMS), animated videos, WebQuests, to digital video games (DVGs), has been proven to not only enrich students' learning experiences, but also make it easier for teachers to manage more personalized and adaptive learning. Technology allows teachers to develop learning strategies that are responsive to students' learning styles, interests, and levels of mastery of the material individually. Other positive impacts are increased student motivation and learning outcomes, as well as the creation of a more interactive and interesting learning environment. However, this study also highlights that the success of implementing technology in differentiated learning is highly dependent on teacher readiness, infrastructure availability, and the level of digital literacy from both teachers and students. Without adequate support, the great potential of technology can actually become a new challenge in the learning process. Therefore, strategic efforts are needed in the form of ongoing training for teachers and the provision of supporting facilities so that the integration of technology in differentiated learning can be implemented optimally at various levels of education.This study concludes that the integration of technology in differentiated learning can significantly strengthen the effectiveness of the teaching and learning process in dealing with the diversity of student needs and characteristics. The use of various digital media, ranging from Learning Management Systems (LMS), animated videos, WebQuests, to digital video games (DVGs), has been proven to not only enrich students' learning experiences, but also make it easier for teachers to manage more personalized and adaptive learning. Technology allows teachers to develop learning strategies that are responsive to students' learning styles, interests, and levels of mastery of the material individually. Other positive impacts are increased student motivation and learning outcomes, as well as the creation of a more interactive and interesting learning environment. However, this study also highlights that the success of implementing technology in differentiated learning is highly dependent on teacher readiness, infrastructure availability, and the level of digital literacy from both teachers and students. Without adequate support, the great potential of technology can actually become a new challenge in the learning process. Therefore, strategic efforts are needed in the form of ongoing training for teachers and the provision of supporting facilities so that the integration of technology in differentiated learning can be implemented optimally at various levels of education.

This study is recommended to develop a more specific and adaptive technology integration model according to the learning context in Indonesia. In addition, further research also needs to be directed at measuring the long-term impact of technology use on student learning outcomes in differentiated learning environments. This is important to ensure that the use of technology is truly able to bridge the learning gap and support the achievement of educational goals more evenly and inclusively in the digital era.

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