

Systematic Literature Review (SLR): Curriculum 4.0: Integrating Technology in Learning to Improve Students' Competence

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Abstract

Curriculum 4.0 is a response to technological advancements in the era of the Industrial Revolution 4.0, aiming to integrate technology into education to enhance student competencies. This integration involves the use of artificial intelligence, the Internet of Things, big data, and blockchain, which are expected to make education more effective, efficient, and relevant. This study uses the Systematic Literature Review (SLR) method to evaluate effective strategies for integrating technology in education. The results show that technology can support the development of 21st-century skills such as critical thinking, creativity, collaboration, and communication. However, the implementation of Curriculum 4.0 faces challenges such as the digital divide and teacher readiness. Training and professional development for teachers, as well as support from the government, industry, and community, are needed to overcome these challenges. With the right strategies, Curriculum 4.0 has the potential to improve the quality of education and prepare students to face future challenges.

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1. INTRODUCTION

a. Background

Rapid technological developments in the Industrial Revolution 4.0 era have brought significant changes in various aspects of life, including education. Curriculum 4.0 is a response to the challenges and opportunities presented by digital technology and the internet, which aims to integrate technology into the learning process in order to increase student competence. With the adoption of technologies such as artificial intelligence (AI), Internet of Things (IoT), big data, and blockchain, education can become more effective, efficient, and relevant to the needs of the times.

Integrating technology in learning is not just adding technological devices to the classroom, but more than that, namely redesigning the learning process so that technology becomes an integral part of teaching and learning strategies. This includes the use of online learning platforms, AI-based learning applications, virtual simulations, and various other digital tools that can enhance the student learning experience. According to Davidson and Goldberg (2009), digital technology has the potential to change the way we teach and learn by offering opportunities for more personalized, interactive, and globally connected learning.

In the context of Curriculum 4.0, expected student competencies are not only limited to academic knowledge, but also include 21st century skills such as critical thinking, creativity, collaboration and communication. Technology can help develop these skills in a variety of ways, such as project-based learning, online collaboration, and the use of social media as a communication and collaboration tool. For example, learning platforms such as Google Classroom, Edmodo, and Moodle allow teachers and students to interact and collaborate in dynamic and flexible digital learning environments.

In addition, technology also enables the collection and analysis of student learning data in real-time, which can be used to provide faster and more precise feedback. With

this data, teachers can adjust teaching strategies according to individual student needs and development, so that learning becomes more effective and in line with each student's potential. According to research conducted by Johnson et al. (2016), the use of analytical data in education can improve student learning outcomes by providing deeper insight into their learning process.

However, the implementation of Curriculum 4.0 also faces various challenges. One of them is the digital divide, where not all students have the same access to technology and the internet. This can cause disparities in the quality of education that students receive. Therefore, governments and educational institutions need to work together to provide adequate technological infrastructure and ensure that all students have equal access to technology. According to Warschauer and Matuchniak (2010), the digital divide can be overcome with policies that support the provision of equitable access to technology and training programs for teachers and students to maximize the use of technology in learning.

Another challenge is the readiness of teachers to integrate technology into learning. Many teachers are still unfamiliar with new technology and find it difficult to use it in their teaching. Therefore, training and professional development for teachers is essential to ensure they have the skills and knowledge necessary to teach in the digital era. As stated by Lawless and Pellegrino (2007), effective teacher training must include not only technical knowledge, but also digital pedagogy that enables them to design and implement innovative and effective learning strategies.

In addition, it is important to create a learning environment that supports the use of technology. This includes adequate technological infrastructure, supportive policies, and a school culture that encourages innovation and experimentation. Research by Fullan (2013) shows that successful educational change requires support from all parties, including teachers, students, parents and other stakeholders. A supportive learning environment will provide students with the opportunity to develop technical and non-technical skills that are essential for future success.

In order to implement Curriculum 4.0, collaboration between government, educational institutions, industry and communities is very important. The government must establish policies that support the integration of technology in education, while educational institutions must be ready to implement these policies in an effective manner. Industry can play a role in providing the necessary resources and technology, as well as providing training and support for teachers and students. The community can also contribute by creating a supportive environment and providing constructive feedback.

Curriculum 4.0 offers great opportunities to improve the quality of education by integrating technology into learning. With the right strategies, existing challenges can be overcome, and technology can be used to provide better and more relevant learning experiences for students. Thus, Curriculum 4.0 will not only improve students' academic competence, but also prepare them to face challenges and opportunities in the future. The aim of writing this article is to identify effective strategies for integrating technology in learning in the Curriculum 4.0 era, explain the 21st century skills that students need to develop through implementing Curriculum 4.0, analyze the impact of the use of technology on student learning outcomes, identify challenges in implementing Curriculum 4.0 in schools, providing solutions to overcome challenges in implementing Curriculum 4.0.

2. RESEARCH METHOD

This research uses the Systematic Literature Review (SLR) method, a type of literature analysis that attempts to collect all empirical evidence that meets predetermined requirements, with the aim of answering specific research questions (Higgins et al., 2019). The goal of the SLR is to provide a thorough summary of all available primary research in response to a specific research question. Systematic reviews use all existing research and are sometimes referred to as 'secondary research' (research about research)(Clarke, 2011);(Pollock & Berge, 2018)

Reports on search results and study selection stages must follow the guidelines set out in "Preferred Reporting Items for Systematic Reviews and Meta-Analysis" (PRISMA). (Moher et al., 2009) . Until the whole action becomes orderly and easy to understand (Moher et al., 2009); (Page et al., 2021). There are 5 stages used to conduct a literature review: (1). define eligibility criteria (2). define information sources (3). literature selection (4). data collection (5). selection of data items

Stage 1: Define Eligibility Criteria. The inclusion criteria in the Systematic Literature Review (SLR) methodology are determined in order to be able to select articles to be used. This is important, in order to ensure that you focus on relevant and high-quality literature.

Stage 2: Define Information Sources. This stage involves searching for appropriate research based on the use of a particular query. The search statement used is. The keyword queries or expressions used in this research are “Project-based Module Development” OR “Digital Technology” OR “Mathematical problem-solving skills”, to find relevant research(Calderón & Ruiz, 2015),

Stage 3: Literature Selection: 1). Keyword determination: The initial stage involves identifying and determining relevant keywords. 2). Article selection: After searching, the next step is to explore the title, abstract, and keywords in the articles according to previously established eligibility criteria. 3). Article selection: Articles that successfully passed the initial selection stage were then read in full or in part to determine whether they met the eligibility criteria for inclusion in the next study. 4). Reference review: The reference lists of selected articles were also reviewed to find other related studies. Articles related to this research will go through a re-selection stage by carrying out stages 3 and 4.

Stage 4: Data Collection. Data collection was carried out manually by creating a data extraction form which includes various information such as type of article, journal name, year of publication, topic, title, keywords, country of origin, research methodology, and other relevant elements. Stage 5: Data Item Selection. From the selected articles, three data elements were successfully obtained. 1). Article demographics: studies related to the development of textbooks and teaching materials, countries conducting related research, development research methods, year of research publication, and type of literature used. 2). Textbooks and teaching materials based on learning theory.

3. RESULTS AND DISCUSSION

This research aims to understand how the implementation of Curriculum 4.0, with a focus on the integration of technology in learning, can improve student competence. Based on the problem formulation that has been identified, several main findings from the analyzed literature show that the use of technology in learning requires careful strategic planning. Technology must be integrated as an integral part of teaching and learning strategies, not just as an addition. This can be achieved through the use of online learning platforms, artificial intelligence-based learning applications, virtual simulations, and other digital tools. Teachers need to use appropriate digital methods and tools, such as Google Classroom, Edmodo, and Moodle, which enable interaction and collaboration in a dynamic and flexible digital learning environment (Davidson and Goldberg, 2009).

Curriculum 4.0 focuses not only on academic knowledge but also on developing 21st century skills such as critical thinking, creativity, collaboration and communication. Technology can help develop these skills through project-based learning, online collaboration, and the use of social media as a communication and collaboration tool. Online learning platforms and AI-based applications play an important role in supporting the development of these skills (Johnson et al., 2016). The use of real-time analysis of student learning data can provide fast and precise feedback, allowing teachers to adjust teaching strategies according to individual student needs. This can improve student learning outcomes by providing deeper insight into their learning process. Personalized learning through technology has a positive effect on students' academic development (Warschauer and Matuchniak, 2010).

However, the implementation of Curriculum 4.0 also faces various challenges. The digital divide is a major challenge, where not all students have equal access to technology and the internet, which can lead to disparities in the quality of education students receive. Teacher readiness and competence in integrating technology is also a challenge, because many teachers are not familiar with new technology and find it difficult to use it in their teaching (Lawless and Pellegrino, 2007). To overcome these challenges, training and professional development for teachers is essential to ensure they have the skills and knowledge necessary to teach in the digital era. Effective training must include technical knowledge and digital pedagogy. Apart from that, collaboration between government, educational institutions, industry and communities is very important to support the implementation of Curriculum 4.0. The government must establish policies that support technology integration, while educational institutions must be ready to implement these policies in an effective way (Fullan, 2013).

Implementation of Curriculum 4.0 requires comprehensive integration of technology in the learning process to increase student competence. This is in line with the concept of Technological Content Pedagogical Knowledge (TPACK), which emphasizes the importance of combining technological, pedagogical and content knowledge. To achieve effective technology integration, key components such as confidence, competence, and accessibility as well as effective ICT resources, good professional development, sufficient time, and technical support for teachers are necessary (Koehler et al., 2013; Bingimlas, 2009).

The Merdeka Curriculum in Indonesia emphasizes the importance of cultural integration in science learning as a response to educational challenges in the era of revolution 4.0. This policy aims to train students to think critically, have high curiosity, and encourage creativity to maximize student potential (Hasibuan, 2023; Iksan, 2024; Fatonah, 2023). In facing an ever-developing educational environment, teacher digital competence is very important to support the learning process. Teachers need to be well prepared to integrate technology in the curriculum as a whole, so that they can adapt to an increasingly technological educational environment (Kiryakova, 2024; García-Delgado et al., 2023; Tondeur et al., 2016). In addition, the balance between student privacy and the integration of technology in higher education must also be considered. The use of technology in education must pay attention to aspects of student privacy to create a safe and comfortable learning environment (Blackmon, 2023; Paris et al., 2021).

Technology integration in Curriculum 4.0 has great potential to increase student competence. However, the success of this implementation is very dependent on teacher readiness and competence, support from all related parties, and the provision of adequate technological infrastructure. With the right strategies and good collaboration, existing challenges can be overcome, and technology can be used to provide better and more

relevant learning experiences for students, preparing them to face the challenges and opportunities of the future.

4. CONCLUSIONS AND SUGGESTIONS

1. Conclusion

Implementation of Curriculum 4.0 which integrates technology in learning has great potential to increase student competence in various aspects, including 21st century skills such as critical thinking, creativity, collaboration and communication. Technology enables more personalized, interactive and globally connected learning. The use of online learning platforms, artificial intelligence-based applications, and other digital tools can enhance students' learning experiences. However, this implementation requires careful strategic planning, teacher readiness, and adequate technological infrastructure support.

2. Suggestion

There is a need for comprehensive training and professional development for teachers to increase their competence in using technology in learning. This training should include technical knowledge and digital pedagogy.

The government and educational institutions must work together to provide adequate technological infrastructure. This includes equitable internet access and the provision of necessary technological devices for students and teachers.

Collaboration between government, educational institutions, industry and communities is very important to support the implementation of Curriculum 4.0. Industry can play a role in providing the necessary resources and technology, as well as providing training and support.

Efforts must be made to address the digital divide, ensuring all students have equal access to technology and the internet. Training programs for students and teachers also need to be improved to maximize the use of technology in learning.

The use of analytical data in education can improve student learning outcomes by providing fast and precise feedback. Teachers must be trained to use this data to adapt teaching strategies to individual student needs.

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