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Implementation of Technology-Based Learning Innovation: Analysis of Opportunities and Challenges Perspective

Efendi[1], Nasrul[2], Zainal Asril[3], Afifah Febriani[4], Gifa Oktavia[4]
[1]STKIP Pesisir Selatan, Indonesia
[2]STIT Al-Yaqin Muaro Sijunjung, Indonesia
[3]Universitas Islam Negeri Imam Bonjol Padang, Indonesia
[4]International Islamic Studies Development and Research Center, Indonesia
efendi@gmail.com *

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Abstract

Learning in the digital age has undergone significant transformation thanks to rapid technological developments. Innovations in education are now increasingly widespread, changing the way teachers teach and students learn. This study aims to analyze how learning innovations in the digital age work. This study uses qualitative research using literature studies. The main focus of the literature review is to identify previous research findings, relevant theories, and conclusions drawn by previous researchers. To make it more interesting, all themes from this research will be discussed in conjunction with the findings of previous researchers. Overall, learning innovations in the digital age have brought about very positive transformations in the world of education, creating a more inclusive, engaging, and technology-aligned learning experience. The research findings indicate that various technology-based learning innovations, ranging from interactive materials, project-based learning, problem-based learning, to educational games, have proven to enhance student learning outcomes and make the learning process more enjoyable, thereby motivating students to actively participate. The implications of digital learning innovations hold great promise for improving educational quality but also demand readiness in infrastructure.

INTRODUCTION

All aspects of life have been affected by advances in technology and information, including education (Atika & Nilwan, 2022; Engkizar, Kaputra, et al., 2022; Fauzi et al., 2022; Muaddyl Akhyar et al., 2023; Muh David Balya Al, 2023). This development aims to bridge the present and the future by implementing changes that lead to improved educational quality. The relentless march of time drives innovation.

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. The primary factors driving educational reform are students' need for specialized services and various improvements in learning opportunities. Education is a complex and interdependent system; changes in the field of education can encompass many aspects. Innovations or changes are necessary to improve quality (Nana & Surahman, 2019; Saiful Rizal, 2023; Shefira et al., 2024). Education in the digital age differs significantly from education in previous eras (Zohriah et al., 2023). This is due to the increasingly dominant role of technology in daily life, including in the learning process. Learning in the digital age can be conducted online or offline and utilizes various technologies, such as smartphones, tablets, laptops, or computers. However, learning in the digital age also presents various challenges (Abdul Ghofur & Restu Budiansyah Riski, 2024; Fitri Barokah et al., 2024; Sagala et al., 2024; Sari et al., 2024). such as unequal internet access, unequal technological capabilities among students, and a lack of understanding of how to effectively utilize technology in the learning process.

Therefore, learning innovation is crucial to address these challenges and improve the quality of learning and student outcomes in the digital age. Education in Indonesia encompasses aspects of technological development used in the educational process, the educational system implemented, and innovations directly related to the learning process, such as innovations in curriculum, learning strategies, teaching methods, or models applied in the teaching and learning process.

In today's highly advanced era, innovation has become a necessity. All parties, whether government agencies, companies, educational institutions, community organizations, or even individuals, must innovate. Failing to innovate means falling behind, losing out, going bankrupt, or even ceasing to exist. A country that does not innovate will fall behind, while a company that does not innovate will lose out, go bankrupt, and eventually cease to exist. Individuals who do not innovate will lose out in the competition for decent jobs and may even become unemployed, ultimately relying on charity to survive.

METHODS

This study uses a qualitative descriptive method in the form of a literature review, which aims to describe the findings of several journal articles (Akmal et al., 2024; Engkizar et al., 2023; Guspita, 2025; Ikhlas et al., 2025; Khairunisa et al., 2025; Faddhia et al., 2025; Wulandari et al., 2024). Sugiyono explains that qualitative research methods with a descriptive analysis design are carried out intensively, conducting a reflective analysis of various documents found, and producing a detailed research report. This literature review is conducted with the awareness that knowledge continues to evolve alongside changes and advancements in society. The purpose of the literature review is for the researcher's own research project. In this case, conducting a literature review is to enrich the researcher's understanding of the research topic being studied, assist the researcher in formulating the research problem, and help the researcher in determining the appropriate theories, methods, and research findings to be used in the ongoing research (Engkizar et al., 2024, Engkizar, et al., 2025; Istiqamah et al., 2024; Mahira et al., 2024; Mustafa et al., 2025; Wati et al., 2025).

RESULT AND DISCUSSION

The author will explain all the findings of this research in narrative form, stating that learning innovation in the digital age refers to the application of information and communication technology in the educational process to improve the effectiveness, efficiency, and quality of learning. This concept encompasses various approaches and methods that leverage technology to create more interactive, flexible, and personalized learning experiences. Educational innovation in the digital age offers significant opportunities to improve the quality of education through the

use of technology. However, its implementation requires attention to existing challenges to ensure that its benefits can be fully realized by all parties (Burhanuddin et al., 2023; Engkizar et al., 2018; Fiqhiyah et al., 2025; Khusna et al., 2025).

To make it more engaging, the author attempts to elaborate starting from the terminology aspect, followed by expert opinions and related theories. The author also discusses the results of this study with the findings of current education researchers addressing similar issues and contexts (Engkizar, Sarianti, et al., 2022; Hasanah, 2021; Muthatahirin et al., 2025).

Learning Innovation in the Digital Age

Every second that passes accompanies Indonesia's struggle to make changes that cannot be separated from the collaboration between the younger and older generations. The older generation has a wealth of experience, while the younger generation has a wealth of ideas about the future. The digital age presents both opportunities and challenges when one is unprepared for change. Changes in lifestyle and cultural norms have shifted many functions of print media to digital media. Every evolving change gives rise to new discoveries that can bring convenience but also create new problems. Therefore, behind the conveniences we enjoy today, new challenges will emerge, requiring innovative solutions and fresh perspectives. The challenge we face is the importance of developing learning strategies for the digital age.

Without innovation in learning, students are more likely to engage in activities that are more appealing than studying, such as playing games or browsing social media. This issue must be addressed promptly to ensure that classroom learning remains engaging for students. Teachers can bridge the gap between their use of technology and that of their students by innovating in learning. Learning innovation is a solution that needs to be designed and implemented by educators to maximize the use of both online and offline media.

Learning innovations can improve the quality, effectiveness, and efficiency of learning, as well as adapt to the development of science and technology in the 4.0 era (Aminullah & Ali, 2020; Engkizar et al., 2025; Widiyono & Millati, 2021). The innovations made by teachers not only include adjustments to lesson plans but also all elements that support the learning process. Educational innovation must facilitate children's development by making learning a fun activity for them. Educational innovation must continue during the pandemic to ensure that changes in the learning system do not negatively impact children's development. Updates or changes in the system, activities, and methods of learning must be made to improve the learning process and adapt it to children's needs.

The presence of these digital devices can be a blessing or a curse depending on how teachers manage them. If managed properly, these digital devices can be very sophisticated tools in the learning process. However, if not used properly, the presence of these digital devices can be a disaster for education. Ingriansari, in his research, said that deviant behavior can occur in students due to negative effects that can directly influence them. Some of these negative effects include viewing negative content, imitating negative behavior such as hairstyles and clothing, lack of concentration while studying, and rude behavior such as using harsh words.

This means that innovation in learning does not always have a positive impact on students. Not all learning innovations are suitable for the current context. However, based on the author's findings from various scientific literature, there are learning innovations that can be applied in schools to improve student learning outcomes in the digital age. Some of these educational innovations include, first, the use of technology in education. Technology can be used to facilitate the learning process, such as using computers, the internet, or mobile devices to access information and learn online. Additionally, technology can be used to create more

engaging and interactive educational materials. Research conducted by Devie Anggraeny states that technology-based learning implemented by teachers significantly aids the learning process in education, particularly for elementary school students who are still in the early stages of development. Therefore, teachers should utilize technology as a learning medium to engage students' interest in participating in learning activities. Furthermore, it is crucial for teachers to understand current technological advancements to avoid being left behind by the times.

This is also in line with research conducted by Eusi Mukaromah. In her research, she stated that most students prefer learning that utilizes Information and Communication Technology, such as using LCD projectors to present material and utilizing the internet to complete assignments, because it is considered more modern, interesting, and not boring. Based on the observations, enthusiastic learners exhibit several characteristics, including actively participating in lessons, being willing to answer questions, frequently asking about things they do not understand, being diligent so they can complete assignments on time, and enjoying seeking out and solving problems independently.

Instead, it aims to strengthen the spirit of unity and integrity within the framework of a moderate religion, mutual love and affection within the framework of the Unitary State of the Republic of Indonesia. This is what needs to be instilled in students in order to create a future generation that truly upholds the unity and integrity of the Indonesian state. In addition to explaining this point, the speaker explained the points contained in P5-PPRA as follows

The results of the study show that technology-based and digital media learning innovations can improve student learning outcomes. This is due to the variety of learning resources, better interaction between students and teachers, and increased motivation to learn. Second, the development of interesting and interactive learning materials. Although educators are expected to be creative in developing diverse, innovative, contextual, and student-centered teaching materials, in reality, the materials used are still conventional. This is because educators tend to purchase and use teaching materials without attempting to plan, prepare, and create them themselves. As a result, there is a risk that the teaching materials used cannot be utilized to their full potential. Therefore, in the learning process, teaching materials that are practical and can support students' skills are needed.

Interactive learning materials are a combination of several types of learning media such as audio, video, text, and graphics that are interactive in nature to control behavior or commands in a presentation. These alternative teaching materials can be used as learning support to improve understanding of the material being studied. Conventional or printed teaching materials have weaknesses because they are easily lost or damaged, and there is a lack of variety in learning materials because teachers have not fully utilized current advances in information technology.

Learning in schools is still carried out conventionally without the use of adequate supporting media, which can cause boredom in learning. Ultimately, this has an impact on the low learning outcomes of students, which are often below the minimum passing criteria. This can be seen from the learning outcomes obtained, where around 70% of students have not reached the passing standard.

The influence of learning materials is so significant that teachers need to vary their teaching materials in order to make students more interested. Developing interesting and interactive learning materials can increase students' interest in learning and make the learning process more enjoyable. Therefore, teachers must be able to use a variety of learning materials to help students succeed in their studies.

Third, developing effective learning methods. Using a variety of teaching methods is very important in the learning process. Some effective learning method variations include:

This activity was carried out successfully, thanks to the well-planned organization. There were various committees involved in the In-House Training, and each committee functioned effectively. An evaluation was conducted at the end of the In-House Training.

Cooperative learning

Cooperative learning is a learning model that involves dividing students into small teams of four to six members with different academic abilities, genders, races, or ethnicities (heterogeneous). In the cooperative learning assessment system, assessment is carried out on the group as a whole. If the group achieves the specified performance, the group will receive a reward. This makes each group member positively dependent on one another, thereby encouraging individual responsibility towards the group and interpersonal skills among each group member.

Individuals in the group help one another, with the same motivation for the group's success. In this system, each individual has the same opportunity to contribute to the success of the group. Thus, cooperative learning can run effectively because each individual who is learning has a responsibility to understand the material being studied. In addition, students do not get bored because they are directly and actively involved in the learning process. This is supported by testing cooperative learning techniques based on the Think Pair Share method.

This study shows a significant increase in student learning outcomes using the Think Pair Share method compared to conventional methods. Similarly, research conducted by Fajuri when applying Cooperative Learning with the Jigsaw type shows that the Jigsaw type of Cooperative Learning has been proven to be effective in increasing student activity and learning outcomes. This is evident from the achievement of success indicators and the improvement in student learning outcomes after implementing this approach. These facts further confirm that cooperative learning can be an innovation in education because it can improve student learning outcomes compared to using conventional teaching methods.

Project-based learning

Project-based learning emphasizes the importance of students' ability to explore their knowledge through experience and their desire to find solutions to the problems they face. This is in line with John Dewey's concept of "learning by doing," which states that learning only has meaning if it is accompanied by actions that are in line with the objectives to be achieved. PBL gives students the freedom to choose learning methods that suit their preferences and participate in collaborative learning. This approach encourages students to contribute creative ideas in creating projects based on the knowledge they have (Emira Hayatina Ramadhan & Hindun Hindun, 2023; Engkizar, Muslim, et al., 2025; Jalil & Shobrun, 2023).

A study conducted by Colley states that the implementation of PBP can improve students' ability to solve problems collaboratively and develop their skills in utilizing knowledge in decision-making. That is why project-based learning can be one of the innovations in learning because it can help students understand the material better and apply their knowledge in the projects they work on. This method also helps students to work together and collaborate with their classmates. In addition, this method can help students develop social and problem-solving skills. This learning method can also motivate students to learn and improve their learning outcomes.

Problem-based learning

The Problem-Based Learning model is a learning method that emphasizes solving problems that occur in everyday life. In this model, students experience firsthand and are involved in overcoming problems that are relevant to their daily lives. The knowledge acquired by students does not only depend on teaching from teachers, but also through the process of exploration and active problem solving by

students. The problems used in PBL are real and open-ended, serving as a context for students to develop problem-solving skills, creative thinking, and the construction of new knowledge. By applying the PBL method, students become more open to the problems that occur in the real world. What is learned in school becomes more relevant for application in daily life.

Not only that, PBL can also significantly improve student learning outcomes. This was demonstrated by Tamariska Febri Kristiana, who applied it in science learning in elementary school. In her research, she concluded that the use of the Problem Based Learning model was very effective in improving the science learning outcomes of elementary school students. The average pretest score before using this model was 56.4264, while the average posttest score after using this model increased significantly to 86.2729. This significant change proves that the use of the Problem-Based Learning model can help students improve their science learning outcomes in elementary school.

Problem-based learning focuses on solving real-world problems and helps students apply their knowledge in relevant situations. This method helps students to think critically and solve problems well. Moreover, in this digital era, any information is very easily accessible to every student. The PBL method can be a very good alternative in learning so that students can achieve maximum results in learning in the digital era.

Game-based learning

Game-based learning is a type of game specifically designed for educational purposes as a learning tool, which is considered more interesting than conventional teaching methods. These games have been proven effective in improving student achievement and strengthening the educational process. Game-based learning makes learning more fun and interactive for students. Games can teach material indirectly and help students understand the material better (Engkizar et al., 2021; Sindi et al., 2023).

This is supported by research conducted by Komang Redy Winatha. The results of the study show that the application of the game-based learning model has a significant impact on student learning motivation and achievement compared to the direct learning model. Game-based learning can significantly improve student learning motivation and academic achievement. This means that game-based learning is an educational innovation that can enhance student learning outcomes in the digital age. In addition to improving learning outcomes, GBL can also significantly enhance student learning motivation.

Factors Affecting the Success of Learning Innovation in the Digital Age

Implementing innovation in learning to improve student learning outcomes in the digital age certainly has many factors that can influence it. Not everything can run smoothly and seamlessly. There are inhibiting factors, as well as supporting factors. The details are as follows:

Barriers

Teachers who struggle to adapt to technology

This is commonly observed among teachers born between 1960 and 1964, often referred to as the baby boomer generation. Although not all are the same, this generation is generally less adaptable to digital-based learning. Wida Kurniasih states that despite the advancement of technology, aging baby boomers often face difficulties in adjusting to technological developments. Therefore, they need to learn how to use technology. It takes time for this generation to adapt. This is certainly a hindering factor in learning innovation in the digital age.

Limited availability of technology and the internet

Whether we admit it or not, educational facilities in Indonesia are unevenly

distributed. This is especially true for private schools that are not funded by the state. These limitations can certainly be a significant obstacle to innovation in learning. How can we innovate in technology when the technology is not available? How can we learn through the internet if internet access is not affordable? In 2019, around 94 million adults in Indonesia could not access the internet using mobile devices, and even fewer could access cable internet networks.

Most of those without internet access are in rural areas on the islands of Sumatra, Java, and Bali, which are the three most densely populated islands in Indonesia. In addition, 60 to 70 percent of Indonesians in the eastern part of the country do not have adequate internet access due to varying service quality. This will certainly be a serious obstacle to the development of learning innovation in the digital age.

Weak literacy culture

Indonesia is one of the countries with the lowest literacy rates in the world. According to the results of the PISA survey released by the Organization for Economic Cooperation and Development in 2019, Indonesia ranked 62nd out of 70 countries measured, making it one of the 10 countries with low literacy rates. This shows how low the literacy culture of Indonesians is. This weak literacy can trigger many complex issues in the world of education. Such as laziness in reading, being easily provoked by hoaxes, jumping to conclusions before conducting in-depth analysis, and so on.

This weak literacy culture has a domino effect that can hinder the maximum implementation of innovations in learning. Imagine if there is a policy from the government or school that cannot be properly understood by teachers and students. This will lead to many misunderstandings and weak implementation in the field.

Feeling complacent

Feeling complacent about what has been done will be a hindrance to innovation in learning in the digital age. Teachers who are quick to feel satisfied with their knowledge and teaching methods tend not to try new things in their teaching (No Title, 2022). However, innovation in learning requires a high level of curiosity and never being satisfied with what has been achieved. Therefore, it is very important to have a high level of curiosity when undertaking learning innovation. Complacency will only stifle innovation.

Supporting factors

Adequate technological infrastructure

Adequate technological infrastructure, such as fast and stable internet access, adequate computer and mobile devices, and modern learning software, is essential to support the implementation of learning innovations in the digital age. Although it is acknowledged that not all regions in Indonesia have access to the internet and technology, most regions in Indonesia already have access to technology and the internet, making this a very supportive factor in implementing learning innovations in the digital age.

Teachers who are creative and skilled in the use of technology

Teachers who are creative and skilled in the use of technology will find it easier to develop and implement learning innovations in their teaching. Teachers who are able to use technology effectively can also provide a more engaging and interactive learning experience for students.

Students familiar with technology:

Students who are familiar with technology and proficient in software and hardware will find it easier to follow technology-based learning. Students familiar with technology are also more active in learning and can more easily participate in interactive learning activities.

Support from parents and the community

Support from parents and the community is very important in encouraging the implementation of learning innovations in the digital age. Parents and the community can provide moral and material support in the form of donations or sponsorships for the procurement of infrastructure and software needed for the implementation of learning innovations.

Supportive policies and regulations

Supportive policies and regulations from the government and educational institutions can facilitate the implementation of learning innovations in the digital age. These policies and regulations can help accelerate the process of developing technological infrastructure and provide assistance or subsidies for the procurement of the necessary software and hardware.

With these supporting factors, it is expected to facilitate the implementation of learning innovations in the digital era and improve the quality of learning and student learning outcomes. The results of this study show that learning innovation is important to improve students' learning outcomes in the digital era. Various learning innovations such as developing interesting and interactive learning materials, technology-based learning, project-based learning, problem-based learning, and game-based learning can improve learners' learning outcomes. Learning innovations also make learning more fun and interactive for learners, thus helping learners to understand the material better. In addition, students are also more motivated to learn better.

CONCLUSION

Learning innovation in the digital era emphasizes the development of interactive and engaging materials, such as the use of multimedia, simulations, and educational games. This aims to increase student motivation and engagement in the learning process. According to research, the use of interactive learning media can improve learning quality and student learning outcomes. Digital innovation allows learning to be done anytime and anywhere, giving more flexibility for students who have time or location constraints. It also gives students from diverse backgrounds the opportunity to access quality education without geographical barriers. With technologies such as artificial intelligence, learning can be tailored to individual needs, allowing students to learn according to their rhythm and learning style. This increases students' understanding and engagement in the learning material.

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