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Investigating the effects of e-learning, digital transformation, and digital innovation on school performance in the digital era

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A B S T R A C T

In the digital era that continues to develop, information technology has brought significant changes to various aspects of human life. One of the clearest impacts is in the field of education. In this era, learning is no longer limited to physical classrooms and textbooks, instead, electronic learning or e-learning has become a popular alternative for accessing knowledge and learning online. This research aims to analyze the relationship between e-learning variables and school performance, the relationship between digital transformation variables and school performance and the relationship between digital innovation and school performance. The study uses a quantitative method approach and data analysis using the Partial Least Square -Structural Equation Modeling (PLS-SEM) approach. Research data was obtained by distributing an online questionnaire form via social media platforms. The questionnaire was designed to contain statement items on a Likert scale from 1 to 7. The respondents for this research were 467 school principals in Indonesia who were determined using the sample determination method, namely simple random sampling. The stages of research data analysis are validity testing, reliability testing and hypothesis testing or significance testing. The independent variables in this research are e-learning, digital transformation and digital innovation, the dependent variable in this research is school performance. The results indicate that e-learning, digital transformation, and innovation had positive and significant effects on school performance.

1. Introduction

In the digital era that continues to develop, information technology has brought significant changes to various aspects of human life and one of the clearest impacts is in the field of education (Sun et al., 2008). In this era, learning is no longer limited to physical classrooms and textbooks, instead, electronic learning or e-learning has become a popular alternative for accessing knowledge and learning online (Al-Fraihat et al., 2020). Educational transformation in the digital era refers to fundamental changes in approaches, methods, and use of technology. The digital era has brought significant changes in the way we learn, teach, interact, and access information. E-learning is a learning method that utilizes information and communication technology to provide learning material to students virtually. Types of e-learning include distance learning better

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known as distance learning, hybrid learning, and blended learning (Davies & Graff, 2005). The implementation of e-learning has created a paradigm shift in the world of education, presenting various challenges, weaknesses, and advantages. In the ever-growing digital era, information technology has brought significant changes to various aspects of human life. One of the clearest impacts is in the field of education. In this era, learning is no longer limited to physical classrooms and textbooks, instead, electronic learning or e-learning has become a popular alternative for accessing knowledge and learning online. Educational transformation in the digital era refers to fundamental changes in approaches, methods, and use of technology. The digital era has brought significant changes in the way we learn, teach, interact, and access information. E-learning is a learning method that utilizes information and communication technology to provide learning material to students virtually. Types of e-learning include distance learning better known as distance learning, hybrid learning, and blended learning. The implementation of e-learning has created a paradigm shift in the world of education, presenting various challenges, weaknesses, and strengths. To be able to face digital learning, information, media, and technology skills are needed. Today, we live in an environment aided by technology and media, characterized by easy access to information, rapid changes in technological tools, and the ability to collaborate and make individual contributions on an unprecedented scale. Effective citizens and workers must be able to demonstrate various functional and critical thinking skills, such as information literacy, media literacy, and information and communication technology literacy. Based on these conditions, the learning orientation in the education sector must change. Previously, learning was carried out face-to-face in class, so now the world of education has challenges for learning that uses digital means, with various problems that may occur but will give rise to students' criticality and creativity (Siswanto et al., 2013).

Digital transformation is the deep transformation of business and organizational activities, processes, competencies, and models, for maximum transformation of the changes and opportunities of the technological mix and its accelerated impact on society, in a strategic and prioritized way (Zhang et al., 2006; Guo & Xu, 2021). With digital transformation, infrastructure and technology are needed, so every technology-enhanced learning method requires the right information technology infrastructure and platform to be implemented. Digital transformation can be interpreted as a process of using digital technology that is already available, such as virtualization technology, mobile computers or the cloud which is integrated with other media (Nousopoulou et al., 2022). Apart from that, digital transformation is a process that aims to improve an entity by triggering significant changes to its properties through a combination of information technology, computing, communication, and connectivity. The transformation that will be carried out by an institution will ideally have guidelines so that the expected goals can be achieved. Management functions in the form of planning, organizing, actuating, and controlling can be applied as a basis and guideline so that a program or activity can be implemented (Watkins et al., 2004). Through the existence of a management function before implementing a digital transformation in schools, it is hoped that the transformation that will be implemented can be more focused and targeted. Even though we have clear guidelines and stages, the implementation of learning transformation towards modern education by utilizing online platforms has many challenges and obstacles due to unpreparedness in various aspects. One party that feels the big impact of digital transformation is the basic education level. According to Noesgaard and Ørngreen (2015), learning strategies are methods or stages/procedures of learning activities carried out by a teacher in the learning process for students to achieve certain learning goals. Chen et al. (2016) argued that learning strategies are different ways to achieve different learning outcomes under different conditions. Senjaya et al. (2020) stated that learning strategy is an approach to managing learning/instructional activities to convey learning material or content systematically so that the expected competencies can be mastered by students effectively and efficiently; Next, Quddus et al. (2020) explained that in learning strategies there are components that an educator must pay attention to achieve satisfactory learning outcomes. The components of learning strategies are (1) sequence of learning activities, (2) learning methods, (3) learning media, and (4) learning time. From the various opinions above, it can be concluded that learning strategies are methods, techniques, and a series of activities considering learning components, namely: (1) sequence of learning activities, (2) learning methods, (3) learning media, and (4) learning time which have been planned to achieve better learning goals.

In the current digital era, e-learning is one of the learning methods offered by many universities and training institutions (Razak et al., 2023). Through e-learning, these institutions hope to be able to reach and provide the best educational services for their users. Several previous studies have identified various factors that influence the effectiveness of e-learning, factors that impact learning outcomes, levels of student satisfaction, and levels of engagement in online learning. They detail how these factors can influence e-learning success. In addition, it shows that learning models using e-learning can provide significant benefits in increasing the effectiveness of learning and providing the flexibility needed in the educational process. The results of these two studies help us understand the complexity of learning and its potential to improve the learning experience. This research aims to analyze the relationship between e-learning variables and school performance, the relationship between digital transformation variables and school performance and the relationship between digital innovation and school performance.

2. Literature review

2.1 Digital Transformation

Digital transformation is the use of new digital technologies to enable improvements in the way businesses and services operate more effectively (Navaridas et al., 2020). Digital transformation is also a transformative cycle that relies on capacity

and innovation to create or change business processes, functional cycles, and meetings to generate new value. Emerging new values create gatherings of associations, organizations, or institutions to provide new experiences (Wang et al., 2020). This new experience can be recognized as the value obtained by users in digitalization efforts to become more effective and efficient in processes and outputs, such as the convenience of virtual meetings, virtual teaching, and building virtual business networks. In line with Razak et al. (2023), digital transformation is a holistic effort to improve core processes and services that focus on satisfying user needs, building new frameworks in service delivery, and creating new forms of relationships. Thus, if an organization wants to transform digital, then the organization must have digital-based skills, mindset, and culture. Ultimately, digital transformation will improve organizational performance to achieve sustainable organizational and environmental goals.

3.2 Organizational Performance

Organizational performance is a measure of how well an organization can meet its goals and objectives compared to its main competitors (Melo et al., 2023). In principle, organizational performance is focused on the organization's capability and ability to efficiently utilize available resources to achieve achievements that are consistent with the stated goals and consider their relevance to their users. One of the resources that is realized is adopting and integrating digital technology and innovation as a strategic organizational competitive need to provide the greatest positive effect on the organization (Nagoya et al., 2021). In line with research conducted by Asbari et al. (2023), organizations can achieve sustainable organizational performance excellence by gathering resources that produce economic value and can maintain efforts to increase competitiveness.

3.3 Digital Innovation

Innovation is finding new or better solutions to organizational needs by creating positive changes in efficiency, productivity, quality, competitiveness, and customer relationships. According to Agélii et al. (2019), innovation is a significant driver for organizations to create value and maintain competitive advantage in an increasingly complex and rapidly changing environment. Furthermore, Fichman et al. (2014) emphasized that innovation at the organizational level is defined as technology, strategy or management practices that organizations use as a restructuring or significant improvement in a process. In the context of an increasingly competitive world of education, innovation is the main driver for educational organizations that want to create value and sustainable competitive advantage. Park and Choi (2019) explained that innovation can create synergy between various activities in an organization which can encourage novelty and contribute to competitiveness. Thus, innovation is a key competency for organizations to survive in a dynamic and competitive environment, maintain competitive advantage, and improve organizational performance (Tang et al., 2023).

3.4 e-learning

The definition of e-learning itself is very broad, even a portal that provides information about a topic can be included in the scope of e-learning (Lim et al., 2007). However, the term e-learning is more accurately intended as an effort to transform the teaching and learning process in schools or campuses into a digital form bridged by internet technology. According to Harandi (2015), e-learning is part of a teaching and learning method that allows teaching materials to be delivered to students using the internet, intranet, or other computer network media. According to Giesbers et al. (2013), there are several principles for implementing e-learning in learning, namely: (1) Personalization means that e-learning users accelerate students' interest in learning according to their needs, (2) security means facilities in e-learning is a system for storing data, documents, assignments and exams safely on a server, (3) independent learning means that e-learning allows students to review the desired material, (4) tracking means that e-learning users allow educators to explore activities that carried out by students either individually or in groups, (5) third-party applications meaning the use of computer technology equipped with the internet and its applications which are a reliable weapon for developing interesting material. Jethro et al. (2012) state: e-learning learning strategy is the delivery of electronic learning material with an integrated learning strategy on computer devices, to allow access from anywhere and at any time. From the various definitions above, it can be concluded that e-learning learning strategies are the stages of selected learning activities, which include components of learning sequences, methods, media and learning time, where the learning media used is computer media, cellphones, and internet networks to support implementation of the teaching and learning process aimed at increasing knowledge and skills.

3.5 Relationship between E-learning and School Performance

E-learning is effective in improving student learning outcomes in vocational high schools, which can be linked to similar research that has been conducted previously. One relevant research is research by Govindasamy (2001) who also found that the use of eLearning was effective in improving student learning outcomes. Research by Jethro et al. (2012) also found that e-learning is effective as a learning medium at the secondary school level. These findings are in line with the main findings of my study and support the conclusion that e-learning has benefits in improving learning outcomes. Another relevant research is research by Harandi (2015) which examined the effectiveness of e-learning on student learning outcomes in vocational schools. Marlina et al. (2021) showed that e-learning has a positive impact on student learning outcomes. These findings

support the main findings and strengthen the evidence that e-learning can improve student learning outcomes in a variety of educational contexts.

Hypothesis 1: *e-learning has a positive effect on school performance.*

3.6 The Relationship between Digital Transformation and School Performance

At the organizational level, digital transformation is a powerful weapon for organizations to build and maintain competitive advantages in the digital era. Digital transformation plays a vital role in ever-evolving organizational operations to increase customer satisfaction and reduce operational costs (Melo et al., 2023). The implications of digital transformation show that digitalization can positively influence organizational performance. Carvalho et al. (2022) stated that successful digital transformation depends on whether an organization can develop several capabilities in various fields and these capabilities differ depending on the sector and the specific needs of the organization. The existence of digital integration in each value chain can reduce coordination costs, operational costs and other costs through increased communication, transparency and monitoring which ultimately results in increased organizational performance (Chen et al., 2016). Digital transformation allows organizations to leverage digital connections to gain access to human resources, data, information, and knowledge. The transformation process involves innovation as the ability to adapt to face new challenges as well as changes in attitudes to accept new practices and innovative initiatives in organizational operations. This means that organizations need to have the ability to manage and utilize digital technology in the innovation process. Digital transformation can increase innovation. Digital transformation can accelerate the innovation process by integrating the power of existing resources and technology in the organization (Navaridas et al., 2020). Thus, digital transformation enables the creation of innovations among business partners in the value chain that can open up opportunities to improve and expand services.

Hypothesis 2: *Digital transformation has a positive effect on organizational performance.*

3.7 The Relationship between Digital Innovation and School Performance

Innovation at the organizational level is defined as a technology, strategy, or management practice used by organizations or other users who have adopted digital technology or not, or as a significant restructuring or improvement in a process (Agélii et al., 2019). Innovation improves organizational performance through improving product/service quality, introducing new products/services promptly, and responding to customers appropriately (Tang et al., 2023). Previous research proves that there is a positive relationship between innovation and organizational performance. The research results of Scott et al. (2017) found evidence that organizations that utilize innovation and digital potential get big profits in running and facilitating organizational activities. It is not surprising that organizations with great innovation demonstrate their ability to develop new capabilities and respond to the ever-evolving business climate for the progress of their organization.

Hypothesis 3: *Innovation has a positive effect on school performance.*

4. Method

This research uses a quantitative method approach and data analysis using the Partial Least Square -Structural Equation Modeling (PLS-SEM) approach. Research data was obtained by distributing an online questionnaire form via social media platforms. The questionnaire was designed to contain statement items on a Likert scale of 1 to 7. The respondents for this research were 467 school principals in Indonesia who were determined using the sample determination method, namely simple random sampling. The stages of research data analysis are validity testing, reliability testing and hypothesis testing or significance testing. The independent variables in this research are e-learning, digital transformation and digital innovation, the dependent variable in this research is school performance. This research model is structured as in Fig. 1.

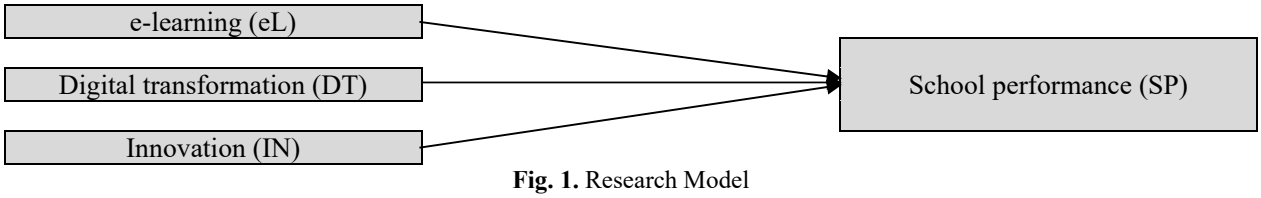

Fig. 1. Research Model

5. Result and Discussion

5.1 Validity and Reliability Test

The discriminant validity test can be fulfilled if the correlation value of the variable to the variable itself is greater than the correlation value of all other variables. Apart from that, another way to fulfil the discriminant validity test can be seen in the cross-loading value, if the cross-loading value of each variable statement item to the variable itself is greater than the item correlation value. In general, reliability is defined as a series of tests to assess the reliability of statement items. Reliability

testing is used to measure the consistency of measuring instruments in measuring a concept or measure the consistency of respondents in answering statement items in questionnaires or research instruments. Test reliability can be done through composite reliability. A variable can be said to be reliable when it has a composite reliability value ≥ 0.7. This validity test is by assessing the validity of the question item by looking at the average variance extracted (AVE) value. AVE is the average percentage of variance extracted (AVE) values between question items or indicators for a variable which is a summary of convergent indicators. For good requirements, if the AVE of each question item is greater than 0.5.

Table 1
Convergent validity and composite reliability testing

Variable	Item	Loading	CR	AVE
eLearning	eL1	0.865	0.812	0.612
	eL2	0.813		
	eL3	0.843		
Digital Transformation	DT1	0.865	0.906	0687
	DT2	0.809		
	DT3	0.816		
Digital Innovation	DI1	0.894	0.934	0.614
	DI2	0.808		
	DI3	0.853		
School Performance	SP1	0.814	0.934	0.676
	SP2	0.786		
	SP08	0.798		

This research analyzes the HTMT (Heterotrait-Monotrait) ratio with the Fornell-Larcker approach to test discriminant validity between constructs. The results show that the external model meets the conditions for discriminant validity with an HTMT value of no more than 0.90.

Table 2
Discriminant validity HTMT ratio and Fornell-Larcker method

	eL	DT	DI	SP	eL	DT	DI	SP
eL					**0.876**			
DT	0.765				0.533	**0.809**		
DI	0.653	0.834			0.532	0.803	**0.81**	
SP	0.612	0.609	0.812		0.512	0.675	0.654	**0.832**

5.2 Hypothesis test

Hypothesis testing uses full model structural equation modelling (SEM) analysis with SmartPLS. Hypothesis testing by looking at the calculated Path Coefficient value in inner model testing. A hypothesis is said to be accepted if the statistical T value is greater than the T table 1.96 (α 5%), which means that if the statistical T value for each hypothesis is greater than the T table then it can be declared accepted or proven (See Fig. 2).

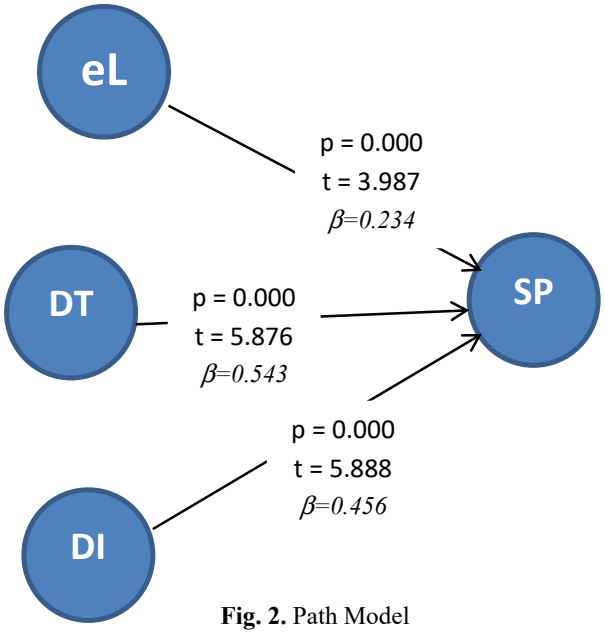

Fig. 2. Path Model

Table 3
Outputs of path analysis

Hs	Path	β	*p-value*	*t-value*	supported
H_1	eL→SP	0.234	0.000	3.987	Yes
H_2	DT→SP	0.543	0.000	5.876	Yes
H_3	DI→SP	0.456	0.000	5.888	Yes

PLS-SEM is used to confirm whether the hypothesis is valid after the measurement model has been evaluated. If the p-value <0.05 and t-value >1.96 then the hypothesis is accepted. The results of the hypothesis test analysis showed that all hypotheses had a p-value <0.05 and a t-value >1.96.

5.3 The relationship between e-learning and school performance

Based on structural equation modelling analysis, the p-value of 0.000 is smaller than 0.050, so it can be concluded that e-learning has a positive and significant effect on school performance. E-learning is very effective for students to use at any time. Teachers and students can communicate during learning via Gmail, WhatsApp, Telegram or other learning media such as Google Classroom (Al-Fraihat et al., 2020) Teachers can help students by conveying material. The most prominent advantage of learning using computers, in this case e-learning, is the ability of students to learn independently. Due to the more personal/individual nature of computers, they can help students learn independently with or without direct guidance from their teacher (Davies & Graff, 2005). The five main benefits of e-learning are discussed in this article. Firstly, saving time and costs is a very attractive aspect. E-learning allows students and teachers to access learning materials from anywhere, reducing the need for physical travel and associated costs (Zhang et al., 2006). This is not only efficient but also creates a more inclusive learning environment. Furthermore, the flexibility and accessibility of e-learning are also very visible in the article's explanation. This factor opens the door to learning that can be tailored to individual needs, allowing each learner to learn at their own pace.

5.4 The relationship between digital transformation and school performance

Based on structural equation modelling analysis, the p-value of 0.000 is smaller than 0.050, so it can be concluded that digital transformation has a positive and significant effect on school performance. With these results, it can be concluded that the first hypothesis is supported. The results of this research are in line with research by Melo et al. (2023) that digital transformation has proven to be productive in improving organizational performance. The role of digital technology makes an organization's internal operations run quickly and easily. In this case, digital transformation is not only effective for streamlining business operations processes but also presents opportunities for value creation and business growth, thereby improving organizational performance to achieve competitive advantage. Digital transformation not only facilitates business operations but also encourages innovation in products, services, and business models (Nousopoulou et al., 2022). Innovation is a strategic goal of digital transformation to encourage organizations to gain greater profits through digitalization. Digital transformation refers to a process of change that is based on creative innovation through digital technology. Chen et al. (2016) an organization that has a strong digital orientation can open opportunities to improve and expand the organization's operations and services. By implementing digital technology in schools, the learning process can become more interactive, interesting and easily accessible to all students equally. Apart from that, school administration and management activities have also become more integrated. With this digital transformation, work will be faster. The technology that exists today means there is a lot of help to be had (Navaridas et al., 2020). The easiest example is the internet, where communication will run smoothly and quickly. So, the work will be faster. Digitalization of education is of course very important in the learning process. Seeing students who feel bored and fed up when taking part in learning, digitalization plays a role in creating more interesting learning skills and styles and can also provide learning innovation (Navaridas et al., 2020). With the digitalization of education, educators and students will get material through digital platforms such as the Internet. This can also have an impact on equalizing access to education.

5.5 The relationship between digital innovation and school performance

Based on structural equation modelling analysis, the p-value of 0.000 is smaller than 0.050, so it can be concluded that innovation has a positive and significant effect on school performance. This means that innovation has a positive and significant effect on organizational performance. The results of this research are in line with Agélii et al. (2019) findings that innovation is one of the key factors that influence organizational performance. Innovation drives convenience, novelty, and broad reach, and contributes to competitiveness which ultimately influences organizational performance. Other research from Agasisti et al. (2020) has also proven that innovation will make organizations more efficient and create positive dynamics that affect improving organizational performance. This emphasizes that innovation is seen as a key competency for organizations to survive in a dynamic and competitive environment, maintain competitive advantage, and improve performance. According to Fichman et al. (2014), innovation can increase organizational efficiency, add potential value, and bring intangible resources to be more responsive to customer needs and able to develop more capabilities that lead to better organizational performance. Some examples of innovation include distance learning programs, school-based management, multi-grade teaching,

contextual learning, and active, creative, effective and fun learning (Zhe et al., 2021). One of the general benefits of digital technology is that it helps work in creating, changing, storing, conveying information and sharing that information quickly, precisely, with quality and efficiency.

E-learning itself aims to promote the dissemination of learning materials through electronic media or the Internet (Davies & Graff, 2005). E-learning allows employees to play a role in searching for new information and knowledge, has lower costs than direct training, and has unlimited access, making it very profitable for both employees and the company. The effect of using e-learning as a training strategy for companies can be associated with increased performance. The use of e-learning is seen as one of the keys to improving the performance, quality and accessibility of education and training. Research results by Jethro et al. (2012) show that e-learning provides a wide peer network, more up-to-date learning resources, and lower training costs. This means that the intention to continue using e-learning as a training strategy will have a significant impact on individual employee performance. Research by Wang et al. (2011) shows that the use of technology to provide learning through e-learning systems to employees is very helpful in making their performance better when things such as alignment between individual needs and company interests can be achieved. Research by Noesgaard and Ørngreen (2015) states that e-learning has an important influence on performance. The implementation of an e-learning culture among employees that is integrated attractively will lead to high-performance results and the long-term success of the company. Research by Watkins et al. (2004) shows that implementing an e-learning system in the company can help achieve company goals, maintain the company, and maintain optimal employee performance. Through e-learning, employees can learn freely as a training and development medium to improve their performance. The school prepares online learning in the form of materials, questions and e-books which are prepared to increase employee knowledge, in the form of videos, classes, meetings with experts, and collaborating with other companies to exchange ideas and increase employee relations. All forms of online learning are prepared by the school to improve the quality of employee performance and to improve the quality of learning and school services. The very rapid development of information and communication technology has encouraged various educational institutions to utilize E-learning systems to increase the effectiveness and flexibility of learning. Even though many research results show that the effectiveness of learning using an E-learning system tends to be the same when compared to conventional or classical learning, the advantage that can be obtained with E-learning is in terms of flexibility (Mohammadyari & Singh, 2015). Through E-learning, learning materials can be accessed at any time and from anywhere, besides that the materials can be enriched with various learning resources including multimedia and can quickly be updated by the teacher.

The positive impact of digitalization in the field of education is the creation of technology that can provide us with information efficiently, making it easier and faster for us to carry out the learning process. This can be helped through information on good teaching methods, as well as the latest learning materials that are widely distributed. With digitalization, the process of getting news or information will be easier. When compared with the previous situation, the difference will be seen very much in the speed of receiving information (Noesgaard & Ørngreen, 2015). This means that we do not t need to spend a lot of time to get the latest news or information. Looking at all regions, most users have switched to digital, because this is very helpful and provides benefits for users in conveying information, accessing things, and so on. Improved learning through digitalization will give rise to various new learning methods that directly facilitate the learning process between educators and students (Lim et al., 2007). With easy internet access, this has given rise to new teaching which is carried out in the form of multimedia and the internet. The term e-learning is one of the applications of utilizing the internet in the learning process. School digitalization is the key to opening the door to a more interesting and innovative educational future. Digital transformation is important in business development. Because, with digitalization, your business can be more productive, and have more intimate relationships with other companies, business innovation can be increased, the risk of fraud is reduced, and operational costs can be significantly reduced (Nousopoulou et al., 2022).

Educational innovation in the digital era is not only about technology but also about developing relevant skills for the future. Education must prepare students to think critically, solve problems, communicate effectively, and collaborate in a global environment (Marlina et al., 2021). Education programs in Indonesia have begun to integrate these skills into their curriculum. Educational innovation in Indonesia can have a much wider impact. By sharing experiences and best practices in digital education, Indonesia can become a model for other countries seeking to modernize their education systems. This can help create a generation that is ready to face the future challenges of an increasingly complex world. Educational innovation in welcoming the digital era is an important step in preparing a generation that is ready to face the future. With progressive measures such as distance learning and the introduction of technology in education, Indonesia has become a pioneer in this field (Harandi, 2015). The impact does not only apply to Indonesia but also has the potential to influence the future of education throughout the world. With a strong commitment to continuing to innovate and adapt to technological changes, Indonesia can play a central role in shaping global education that is relevant to the digital era. In the digital era, technology is developing rapidly and has a big impact on various sectors, including the education sector. Education, which previously only relied on books and teachers, can now be maximized with digital technology which makes the learning process easier. Thus, technological innovation and education in the digital era are very important to create a generation of Indonesians who are globally competitive (Agélii et al., 2019). One of the technological and educational innovations in the digital era is the use of online learning platforms.

The managerial implication based on the findings from data analysis in this research is that schools can be more effective in creating and also making better use of digital learning or e-learning systems to maximize the performance of human resources in schools. Further research in the field of e-learning can be sharpened by involving a more diverse and representative sample, covering various levels of education and scientific disciplines. By delving deeper into longitudinal research designs, researchers can observe student development over a longer period, making it possible to see whether the positive benefits of e-learning on learning outcomes remain consistent or change over time. The importance of paying attention to contextual factors, including student characteristics, the learning environment, as well as the support provided by teachers or educational institutions, will help in a deeper understanding of how to optimize e-learning in various educational contexts. In addition, the use of various data collection methods such as interviews, observations, or case studies will provide a more comprehensive picture of how e-learning can influence student learning outcomes. In developing research, considering technological aspects is also crucial. Paying attention to the features provided by e-learning platforms, ease of use, and accessibility, will help researchers understand in more depth the contribution of technological factors to the effectiveness of e-learning. E-learning can also be an option that can be combined with offline learning so that it is hoped that it can maximize the achievement of better results. Through this approach, further research in the field of e-learning is expected to provide richer and more holistic insight into the dynamics and potential use of e-learning in the context of modern education.

6. Conclusion

The results of this research are that e-learning has a positive and significant effect on school performance, digital transformation has a positive and significant effect on school performance, and innovation has a positive and significant effect on school performance. We should be more active in preparing society to face digital transformation, approaching the digital transformation of education as one of the main concerns. Need to consider how can. If all education is ready to implement changes, especially in digital transformation, it will produce students and graduates who are ready to face a world full of digitalization for future progress. The contribution of this research is to provide a better understanding of the factors that influence the effectiveness of E-learning and provide suggestions for the development of better E-learning platforms. In this case, the development of an E-learning platform must pay attention to technological characteristics that can support successful learning. In addition, it is necessary to carry out regular evaluations of the effectiveness of using the E-learning platform to ensure that learning objectives are achieved and make a significant contribution to science. Thus, this research can make a significant contribution to the development of E-learning and science in general. For future articles, it is recommended to expand the scope of the research by involving a larger sample from various departments. In addition, research can be carried out using different methods or a combination of methods to obtain more accurate and valid results. In addition, research can be focused on developing more interactive and adaptive E-learning platforms to increase learning effectiveness. Finally, it is recommended to consider other factors that may influence the effectiveness of E-learning, such as psychological and social factors, to provide a more comprehensive understanding of the use of E-learning platforms.

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