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Digital learning models: experience of online learning during the pandemic

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ABSTRACT

During the global pandemic of COVID-19, the learning model has been "forced" to transition from conventional to distance learning. At the beginning of its implementation, digital-based learning received many complaints from teachers, parents, and students. Gradually, they can adapt to distance learning that utilizes many digital devices. Through quantitative and qualitative research approaches, this paper aims to describe the online learning model in schools and Islamic boarding school (*pesantren*) based on their experience during COVID-19. From these studies, several digital-based learning models can be identified. First, social media-based learning. Social media-based learning is carried out by optimizing the use of WhatsApp as the main media in learning. Second, learning through virtual classrooms, which is face-to-face learning between teachers and students in a digital space. Third, education platform-based learning, where the learning process is conducted through internal school or government platforms. Fourth is blended learning, which is learning partly online and offline. This fourth lesson aims to accommodate the learning needs of students or teachers who have obstacles such as signal difficulties and weak economies. The findings contribute to the availability of references for digital learning models that can be applied in the future.

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1. INTRODUCTION

The COVID-19 pandemic, recognized as the world's worst health crisis, has impacted all aspects of life. In the education aspect, drastic changes are felt throughout the school, where face-to-face learning undergoes a forced transition to distance learning. This policy, which is implemented almost all over the world, is the beginning of the emergence of learning innovations with all the limitations encountered. Among the many limitations that occur in distance learning are pedagogical, technical, and financial barriers [1]. In addition, the absence of direct communication with students hurts their understanding of the educational materials [2]. However, over time, the limitations of distance learning began to be overcome with various innovations created by each school.

Despite the negative impact on the achievement of learning objectives, a positive impact can also be felt from distance learning, which mostly applies to online learning. The development of online learning can help students in carrying out learning due to distance and time constraints [3]. Digital-based learning innovations that emerged amid the COVID-19 pandemic crisis became a breakthrough in education. The students feel happy and enthusiastic because the online experience provides a new atmosphere in the digital era [4]. On the other hand, digitally-based learning experiences require all educational institutions, teachers and students to adopt technology and improve their digital skills in line with emerging global trends and realities in education [5].

Studies related to distance education based on online learning tools as far back as 2023 can be classified into at least three types. First, some studies conduct various learning analyses, including classroom experience description [6], evaluation [7], strengths, weaknesses, opportunities, and threats (SWOT) [8]–[10], satisfaction tests [11], teacher and student experience surveys [12], [13], online and offline blended learning trials [14], and international/global collaborative learning analysis [15], [16]. Second, research that describes and tests learning methods during the pandemic ranging from home learning [17], technology interventions [18], learning for sick students [19], workshop models [20], online classroom humanization and character education methods, to the use of alternative learning applications [21]. Third, research that is descriptive of technological innovations or applications [21]–[24] or online learning innovations per subjects that have enormous challenges, such as sports [25], art [26], dance [27], and nursing lessons [28].

Based on previous studies, online learning during the COVID-19 pandemic is a good experience to change the mindset of teachers and students towards conventional learning and give them awareness about the importance of information technology skills and digital literacy. Many learning innovations have emerged due to the sudden implementation of distance learning. This study completed the study of distance learning innovations and filled the gap of learning innovation studies that were more partial to a particular subject or method. This paper reveals online learning innovations during COVID-19 through the identification and classification of digital-based online learning models.

Distance learning, in this case, is categorized as innovative because it creates new learning spaces and stimulates the creative ideas of teachers and students as individuals. This learning is characterized by involving the use of the internet and digital technology to facilitate the teaching and learning process. In innovative learning, the classroom experience is redefined with innovative ideas that make teaching and learning methods more efficient and effective. Besides the demands of the times, such learning methods have great potential to improve education, empower self-reliance, and strengthen human resource development [28]–[30]. Online learning has disadvantages in certain fields or subjects, such as in science, because it cannot reach critical thinking but only offers instant problem-solving. Therefore, observational research and screening for innovations in methods and applications need to continue to help policymakers formulate a responsive online learning platform [14], [31].

Online learning is becoming popular because of its potential to provide more flexible access to content and teaching anytime and from anywhere. Online learning is defined as learning that partially or completely uses the internet network [32]. Online learning is increasingly recognized by the public with the implementation of distance learning during the COVID-19 pandemic, where almost all schools in the world closed and implemented independent learning from home. In practice, online learning causes the frequency of digital technology use during learning. Digital technology-based learning, multimedia presentations, and social networking tools facilitate participants' educational experiences and achievements in an online learning environment [33]. There are at least two factors that can affect the frequency of using digital technology during teaching, namely, teacher skills and digital technology available in schools [34].

This paper provides some important contributions to the availability of references on digital-based online learning models that have been practiced during COVID-19. In addition, this paper also describes the online learning experience experienced by teachers, students, parents, and school administrators, which is valuable information, especially for education providers, as a consideration for policy formulation. Learning innovations that have been realized from online learning experiences can be a reference for distance learning management because it does not rule out the possibility of this model being part of learning innovations in the future.

2. METHOD

This paper is based on an online survey conducted during the COVID-19 period with teachers, students, Islamic boarding school owners, and parents in Indonesia at different times. The survey of teachers was conducted at the beginning of the implementation of the distance learning policy through convenience sampling that was able to reach 17,661 teachers in four provinces in Indonesia, namely Central Java, East Java, Specila Region of Yogyakarta, and Bali. Meanwhile, the Islamic boarding school (*pesantren*) community survey was conducted at the end of 2020 with a target *pesantren* consisting of 15 owners (*kyai*), 73 teachers

from 16 *pesantren*, 208 parents, and 106 students in Yogyakarta. This research applies convenience sampling and does not target a specific sample size. The number of samples was considered sufficient when the deadline for distributing questionnaires was completed which can lead to unequal participation opportunities and limited generalizability [35]. As an implication of the application of convenience sampling, this study has limitations in the description of findings that only describe the conditions of the sample. The survey data was not analyzed inferentially but was instead averaged to illustrate the trends in respondents' answers. Consequently, instrument validity tests were not conducted as in surveys that follow strict statistical principles. In this study, validation was only carried out through discussions with the research team, who have an interest and concern in the field of education. In addition, data was also obtained through qualitative research with interview and observation techniques to several *pesantren* in Yogyakarta and several madrasas in Central Java, consisting of elementary school, junior and high schools. This qualitative data reinforces research findings through the distribution of limited questionnaires.

The research was conducted at the beginning of the COVID-19 pandemic when the instrument was distributed online due to the social distancing policy. The instrument consisted of several questions related to the readiness of teachers in madrasas or schools for distance learning and the types of media they use. Furthermore, a survey of *pesantren*, including *pesantren* owners, students, teachers, and parents, was also conducted online, asking about their readiness and experience in distance learning. Meanwhile, qualitative data collection was conducted through interviews to obtain information about distance learning experiences in *pesantren* and emergency curriculum practices in several madrasas. To fulfil the need for the validity of qualitative instruments, the constructed questionnaire applied a credibility check. This is based on the importance of evaluating qualitative research based on its credibility, suitability, and auditability, rather than applying traditional quantitative criteria [36]. Credibility checks are conducted to ensure that the questionnaire includes relevant questions, represents the research topic, and can obtain accurate information from respondents. This research utilized the cross-examiner methods for this purpose, where the questionnaire was evaluated by multiple independent researchers to ensure that the questions are relevant, clear, and able to elicit the necessary insights [37].

The data obtained from the online survey was analyzed by calculating the percentage of answers on each item. Percentage calculations can be a useful tool in quantitative analysis to present information clearly and provide valuable insights. This percentage is used to determine the tendency of answers that appear as a representation of participants' responses related to distance learning during the pandemic. Meanwhile, data from interviews and observations were analyzed through the stages of data collection, data reduction, data presentation, and conclusion drawing.

3. RESULTS

3.1. Online learning practices in the COVID-19 period

Distance learning implemented at the beginning of the COVID-19 pandemic forced a drastic change in the learning model, from face-to-face learning to distance learning that eliminates meetings between teachers and students. Most schools implement online distance learning, which requires the support of digital devices and adequate infrastructure such as cellphone/laptop quota and internet network. In practice, online learning has many obstacles, such as learning devices and internet connections and limited internet quota [38], decreased student motivation and lack of parental support [39], low digital literacy [40], [41], and economic constraints [42], [43]. A survey of 17,661 teachers in four provinces in Indonesia shows that despite the sudden implementation of the distance learning policy, most teachers (82.20%) are ready to do it. Likewise, with students, based on teachers' recognition, 71.49% of students stated that they are ready to implement distance learning [38]. Distance learning is also implemented in *pesantren*-based schools. Not much different from teachers in public schools, most *pesantren* owners and teachers also stated that they are ready to implement distance learning. Similarly, students (*santri*) and their parents, most of them stated that they are ready to implement distance learning [44]. The enthusiasm of educational actors towards distance learning as a new experience in the world of education triggers the desire to innovate in learning.

At the beginning of the implementation of the distance learning policy, there was not much that teachers could do to produce innovations quickly. Teachers choose to use learning media that is simple and easily accessible to students so that the delivery of material and assignments can continue even though it is sober. An online survey of teachers in schools and *pesantren* shows that WhatsApp is the favorite media used by most teachers in online learning. In public schools, the results of the online survey show that more than 36% of teachers use WhatsApp as a learning medium. Meanwhile, in the *pesantren* environment, more than 32% of teachers and students also utilize WhatsApp as a learning medium.

WhatsApp is an application that can connect us with the community and the whole world [45]. WhatsApp as a social media allows us to do many communication activities through the available features,

such as sending direct messages and groups, making private and group calls, sending voice messages, private and group video calls, and sending documents in the form of files, photos, and videos. These features can all be utilized in online learning that is tailored to the needs and learning materials. Many studies prove that WhatsApp social media is widely used for online learning at all levels of education [46]–[48]. On the one hand, online learning using WhatsApp is considered less effective [49], and on the other hand, learning using WhatsApp can increase students' knowledge in the learning process [50]. Regardless of the effects felt by teachers and students, the use of WhatsApp is very supportive of online learning activities with all its features.

Apart from being based on WhatsApp social media, online learning in some schools uses other media that are quite supportive, such as Google Forms, email, Google Drive, Lyne, and Skype. However, the use of these media in learning is not as massive as WhatsApp, which is the preferred social media because of its complete features and ease of use. In principle, the use of social media in online learning depends on the needs and conditions of each school. After COVID-19 attacked for some time, online learning, which originally relied on WhatsApp, began to shift by creating virtual classes that could bring teachers and students together in cyberspace. The implementation of virtual classes that occur in online learning usually uses several available online platforms, such as Google Classroom [51], Zoom Meeting [52], [53], Google Meet [53], [54], and WebEx [53]. The advantage of using a virtual classroom over WhatsApp is that there is direct communication between teachers and students as is usually the case in face-to-face learning. Teachers and students are freer to interact in the learning process.

Apart from social media, the government has provided a web-based education platform for online learning. For example, e-learning *Madrasah*, which is the official platform for all madrasas in Indonesia, provides learning features that can be utilized by teachers and students. For schools under the Ministry of Education and Culture, the government has provided a *Rumah Belajar* platform for teachers and students. However, neither platform has been fully utilized as learning media during COVID-19. Out of 17,661 teachers, only 6.31% reported using e-learning madrasa in distance learning [38]. Currently, the number of madrasas that use the e-learning madrasa platform has reached more than 33%, while teachers who use it reach more than 37%.

In addition to the official education platform created by the government, some schools have also developed education platforms to facilitate online learning during COVID-19. Two *pesantren*-based madrasas in Yogyakarta have developed education platforms during COVID-19, which are not only accessible to teachers and students but also to parents. Madrasah Mualimin and Madrasah Al-Jauhar Yogyakarta, which are both *pesantren*-based, have their own e-learning platforms. Both platforms have been effectively used to support the online learning system as a medium of learning as well as consultation between teachers, students, and parents [44].

Online distance learning is not necessarily accessible to all people and regions. Signal constraints occur in some rural areas that are not covered by internet signals. On the other hand, students who come from low-income families find it difficult to provide quota to join online learning. Therefore, in these conditions, schools usually implement a mixed online and offline learning policy. Online learning is intended for students who do not have signal and quota constraints, while offline learning is intended for those who are constrained by signal and quota.

3.2. Digital learning models during the COVID-19 period

The experience of distance learning during COVID-19 has provided many lessons for educational actors about learning models that can be an alternative in certain conditions. Improving digital skills and literacy inevitably occurs in various ways, both through tutorials on YouTube channels, training, peer learning, and increasing abilities autodidactically. Online learning also makes teachers and students wiser in using gadgets. Before the crisis, digital technology was used for institutional and peer-to-peer communication, while today, it is used for network development and learning skills [55]. It should also be understood that the success of digital-based learning will be largely determined by teacher competence as well as technical materials and equipment [56]. Based on the experience of digital-based online learning, several learning models emerged because of the learning-from-home policy due to the pandemic COVID-19. There are at least four digital-based learning models that have been practiced, namely social media-based learning, virtual classroom-based learning, education platform-based learning, and blended learning.

3.2.1. Social media-based learning model

This model occurred at the beginning of the school closure policy. Face-to-face learning suddenly transitioned into distance learning with all the limitations. WhatsApp became the medium chosen by many schools to keep learning going, even without face-to-face meetings. Many studies prove that WhatsApp social media is widely used for online learning at all levels of education [46]–[48]. The online survey that we have conducted is in line with previous studies on the widespread use of WhatsApp social media as an online learning medium [38], [44], as shown in Figure 1.

WhatsApp, with all its features, can facilitate learning needs that do not allow meetings between teachers and students. Many students gave positive responses to the use of WhatsApp in online learning [57]. Not only that, the use of WhatsApp has also seen a massive expansion from informal to formal spaces. In fact, WhatsApp usage and perceived benefits have surpassed email [58]. WhatsApp also trains students' ability to publish their work in groups [59]. The results of the survey and qualitative study show that various features of WhatsApp have been used in online learning either in schools, madrasas, or *pesantren*, as shown in Table 1.

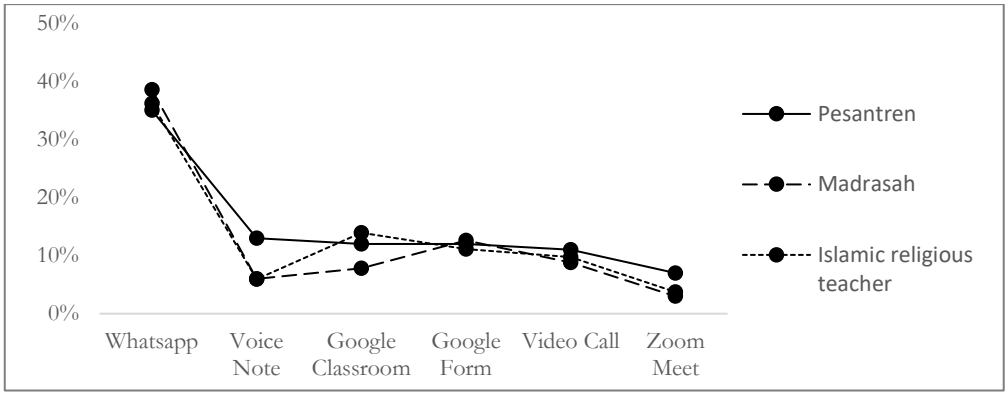

Figure 1. Online learning media during COVID-19

Table 1. Practical use of WhatsApp in online learning

Feature	Usage in learning
Send messages (private and group)	Used to send materials and assignments in the form of text, files (word, PDF, PPT), images/photos, videos, recordings, and others.
WhatsApp group	Used as a discussion room in certain classes about materials and assignments.
Voice note	Used to send material, for example, songs. In *pesantren*, voice note is used by students to send memorization of the Quran (*murojaah tahfidz*) to their teacher (*ustadz*).
Video calls (private and group)	This facility is widely used in learning in *tahfidz pesantren*, especially for students who will deposit the memorization of the Quran to their *ustadz* and is used for *tahfidz* exams.
Call (private and group)	This feature is used to communicate directly through voice messages between teachers and students, either individually or in groups. In online learning, this feature is rarely used.

3.2.2. Virtual classroom-based learning model

This model comes a while after distance learning has been implemented, where schools and teachers have started to develop innovations in learning. Virtual classrooms can be more effective in building interactive communication between teachers and students as they can meet face-to-face, even in a digital space. Most students gave positive responses to the use of virtual classrooms [60]. However, the success of virtual classroom learning is highly dependent on student motivation, willingness to learn, and constructive feedback [61].

Several digital platforms can be used to implement virtual classroom-based learning models; some of the most widely used platforms are Google Classroom [51], Zoom [52], [53], Google Meet [53], [54], and WebEx [53]. Some previous research states that the virtual classroom platform that is widely used in online learning and favored by students is Zoom [52] and Google Meet [62]. Virtual classrooms can stimulate students' ability to communicate, especially when lecturers provide questions or instructions to work on and provide question-and-answer interaction [63]. However, several obstacles were encountered in using Zoom including unstable online connections, security issues, limited pedagogical resources, and background noise [64]. This causes reduced involvement of students and teachers in the teaching and learning process [65].

In Indonesia, the virtual classroom-based online learning model is implemented in almost all levels of education, from elementary, junior high, and senior high school to higher education. There are changes in learning habits between social media-based learning and virtual classroom-based learning. In the social media-based learning model, students and teachers do not apply a rigid schedule, and it is flexible, with a deadline for completing assignments of one to six days. At the same time, the virtual class-based learning model has imposed a strict schedule as in face-to-face classes. In virtual classroom-based learning, students and teachers are also required to wear uniforms, the same as when face-to-face classes run normally. However, the duration of virtual classes is very short, ranging from 1 to 2 hours. Despite the short duration, the virtual class has fulfilled the need for direct communication and interaction between teachers and students.

3.2.3. Education platform-based learning model

This online learning model utilizes electronic learning management systems (eLMS) that are available online. In Indonesia, two ministries that oversee schools and madrasas have developed education platforms, e-learning *Madrasah* for madrasas and *Rumah Belajar* for schools. Many features are available on both platforms that are expected to fulfil the learning needs of teachers and students. E-learning *Madrasah* allows teachers to conduct video conferences with students without a time limit and free of charge. E-learning *Madrasah* also provides assessment facilities through computer-based exams that are directly processed into report cards. In addition to these two facilities, e-learning *Madrasah* also provides features for teaching material and digital books. Similarly, the Rumah *Belajar* platform created for schools offers features such as virtual classes, learning resources, question banks, virtual labs, electronic schoolbooks, and other educational features.

Several studies have reported that the use of e-learning in madrasas is considered beneficial as a tool in the teaching and learning process [66], [67] and able to increase student learning activities [67]. Several studies also agree that the use of the *Rumah Belajar* platform is very useful with the availability of learning resource features that are most often utilized by teachers and video content and interactive learning materials (*bahan belajar interaktif*/BBI) that many students like. The *Rumah Belajar* platform can also be a learning solution during COVID-19 or in disaster areas [68].

3.2.4. Blended learning model

Blended learning is defined as a mix of online and face-to-face instruction [13]. In Indonesia, the blended learning model implemented during the COVID-19 pandemic is widely adopted by schools with certain conditions. For example, in schools in rural areas where access to the internet is difficult, blended learning is carried out by applying partly online via WhatsApp and partly limited face-to-face. Furthermore, schools where some of the students are boarding school students implement offline learning for them, which is also carried out on a limited basis. Blended learning is also a solution used by schools to provide convenience for poor students who cannot afford internet quotas.

The blended learning model can be a solution for schools with conditions that do not allow for full client learning. In addition, blended learning has also been practiced during the COVID-19 recovery period, where online learning gradually began to transition back to face-to-face learning. However, it is also necessary to note the weaknesses of blended learning based on previous research results. Among these weaknesses is incompatibility with all subjects, lack of interaction between students and teachers, inability to receive feedback, the inefficiency of technological means, and lack of training [69].

3.3. Digital learning models post the COVID-19 period: a learning innovation

Digital-based online learning implemented during COVID-19 provides a good experience of the use of digital technology in learning as well as accelerating the change in conventional learning models to digital learning. During the COVID-19 pandemic, face-to-face learning was forced to transition to online learning which was mostly based on digital learning. After the end of the pandemic, digital-based online learning is no longer a compulsion, but rather a choice of current and future learning models. The 'forced' experience of teaching with digital technology as part of distance learning can gradually give place to a harmonious integration of physical and digital tools and methods in the interest of more active, flexible and meaningful learning [70]. E-learning design can be a catalyst for deeper learning design improvements at an organizational level [71].

The online learning experience during the pandemic has had a positive impact on current and future learning innovations. Koff [72] highlights the positive impact of certain technologies and the importance of social constructivism approaches in digital learning. He identified improved student learning from classroom response systems, Twitter discussions, blogging, and video production. There is potential for increased student engagement, Adeyinka-Ojo and Ikumoro [73] underlining the need for continuous adoption and acceleration of digital technology in education. However, it is undeniable that face-to-face learning is still very important to meet the need for direct interaction between teachers and students. Therefore, several studies suggest online learning can be modified and combined with offline learning into a blended learning method that can be adopted and utilized by schools post-COVID-19 [74]. Opportunities for the utilization of digital media in learning on current and the future can be seen in the massive utilization of virtual spaces such as Zoom, Webex, and others. In addition, the development of eLMS has also been carried out by many educational institutions. This fact shows the readiness of digital-based learning transformation in education.

4. DISCUSSION

Based on several studies, almost all educational institutions in Indonesia have implemented online distance learning. As a new experience in learning methods, there are many challenges and obstacles experienced by schools, teachers, students, and parents. Indonesia is an archipelagic country with a poor population of up to 9%, the main obstacles to online learning are internet networks and internet quota fulfilment. Both obstacles are closely related to the economic conditions of students in the lower middle class. Meanwhile, another obstacle is the limited infrastructure supporting learning in the form of digital devices such as cell phones or laptops. The lack of digital literacy also contributes to the non-optimization of online distance learning.

In Indonesia, online distance learning has been running for about a year. Due to the many obstacles encountered at the beginning of the implementation of online learning, various policies have been issued by the government to ensure that all levels of society receive quality education and learning services. Two ministries that handle educational institutions, namely the Ministry of Education and Culture and the Ministry of Religious Affairs, issued regulations on learning from home and the implementation of the emergency curriculum. The policy aims to make the learning process run effectively and efficiently amidst the existing limitations. Some alternative learning models that can be carried out by schools are face-to-face learning, limited face-to-face, or distance learning, both online and offline. The selection of learning models is adjusted to the conditions and capabilities of each school.

The distance learning experience implemented during COVID-19 has led to several learning model innovations. There are at least four online learning models implemented in Indonesia, namely social media-based online learning, virtual classroom-based online learning, education platform-based online learning, and blended learning. School and student infrastructure support determine the online learning model applied. For example, schools located in urban areas can implement online learning entirely based on virtual classrooms. Schools that have strong infrastructure support and human resources usually develop an eLMS for all learning and administration activities. Meanwhile, schools in rural areas implement social media-based learning by utilizing WhatsApp as a communication medium between teachers and students. Even in areas that do not have internet access, offline distance learning is implemented with various restrictions.

The digital-based learning model obtained through the distance learning experience during COVID-19 is a valuable innovation in the world of education. Virtual classrooms, for example, can bring students and teachers together directly through cyberspace through Google Classroom [51], Zoom [52], [53], Google Meet [53], [54], dan WebEx [53]. The interaction that occurs in a virtual classroom is the same as a real classroom in face-to-face learning. The online learning model has also been carried out through the development of eLMS through various educational platforms, either created by the government or school-created educational platforms. The use of eLMS has had a beneficial effect during the COVID-19 pandemic on learning as a continuous engagement [75].

The use of digital technology in online learning is influenced by teacher skills and digital technology available in schools [34]. In fact, most teachers (71.60%) who filled out the survey stated that they had never attended computer and information technology training [38]. Even so, they stated that they were ready and enthusiastic about carrying out online learning. Teachers feel motivated to improve their digital skills and use digital technology to teach [76]. In fact, a survey shows that 92.68% of teachers are trying to improve their skills in conducting distance learning as one of the strategies to overcome psychological disorders [77]. Teachers' motivation to improve digital technology skills is an opportunity to open the possibility of online learning being part of current and future learning.

In addition to teacher skills, the use of digital technology is also influenced by digital technology available in schools. In Indonesia, several schools, madrasas, and *pesantren* have provided learning management systems that can be accessed by all civitas, as well as parents. Two platforms developed by the government, namely e-learning *Madrasah* and *Rumah Belajar*, provide support to teachers and students in the distance learning process. The use of learning management systems is recognized as useful as a tool in the teaching and learning process [67] and able to improve student learning activities [13]. Several studies also agree that the *Rumah Belajar* platform is very useful with the availability of learning resource features that are most often used by teachers and the availability of learning video content [68].

The results make a significant contribution to alternative digital-based learning models as one of the innovations in the field of education. This study is very relevant to the needs and demands of education in the current and the future, where all aspects of life already depend on digital devices. Indirectly, the experience of online learning during the pandemic is an acceleration of the transformation of the conventional education world towards digital-based learning. Therefore, this good experience needs to be continued through the development of an eLMS in all educational institutions as an inseparable part of the learning process. Through the development of this eLMS, the blended learning model is very likely to be applied to meet offline meetings between teachers and students and habituate the use of digital technology in learning.

5. CONCLUSION

The distance learning experience has led to many learning innovations, most of which are conducted online. The COVID-19 pandemic crisis that causes limitations in all aspects requires schools and teachers to continue to provide education rights for students. From the experience of distance learning during COVID-19, digital-based learning models were created that can be applied in normal conditions, outbreaks, or disaster conditions. Among the models that we have identified are four, namely: i) social media-based online learning; ii) virtual class-based online learning; iii) education platform-based online learning; and iv) blended learning. The digital learning model has had a beneficial effect during the COVID-19 pandemic on learning as a continuous engagement.

This study provides a valuable scientific contribution by offering information about digital-based learning models that can be adopted as alternative learning methods now and in the future. Additionally, a policy recommendation from this research is that the government should promote more widespread utilization of information technology by educational institutions. However, the study is limited to the types of digital-based learning derived from online learning experiences during COVID-19. Further research is necessary to enhance digital learning models implemented post-pandemic for more effective and efficient learning innovations.

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