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# How Digital Applications As Mathematics Learning Media in the Automation Era

Taufiqulloh Dahlan[1], Darhim Darhim[2], Dadang Juandi[3]

[1,2,3]*Universitas Pendidikan Indonesia*
*Corresponding author :taufiqulloh@upi.edu*

**Abstract**

This review discussed the issues of applying digital technology to improve student learning outcomes in Mathematics during long-distance learning. The authors believe the ability of digital technology to create and innovate learning is disrupted by the pandemic when all parties hope that learning continues. For this reason, the authors have collected scientific evidence about the innovation and allure of digital technology in supporting the learning process, especially the pandemic-disrupted teaching solution in virtual Mathematics classes. The authors searched for data related to the two variables above electronically on hundreds of topics that have been published in many journals of technology and Mathematics education both nationally and internationally in the form of articles, books, proceedings, magazines, and various webinars released between 2010 and 2022. Data collected then was analyzed in order to be able to answer the questions and hypotheses of this research. We examined the data in a phenomenological approach; the data collection system then researched it to find relevant evidence to answer questions with valid and reliable. The authors analyzed the data with a coding system, critical evaluation, in-depth interpretation, and relevant conclusions. Finally, based on the discussion of the data findings, we concluded that digital applications had been applied in teaching Mathematics because these applications can innovate the results of learning Mathematics in the era of automation even though it is still disturbed global emergence. Therefore, the researchers hope that the findings of this scientific evidence can support the literature for similar research in the future.

**Keywords:** digital application, Mathematics, learning media, automation era

## Introduction

The Covid-19 pandemic is hitting the world, and all human activities have stopped, including educational activities. At the same time, when every country's policies decide to close schools and open classes virtually, the popularity of digital technology has become popular, especially in developing countries(Corlett et al., 2020). Likewise, Mathematics learning can utilize digital technology so that learning is greatly helped when students, teachers, and homeroom teachers no longer meet face-to-face at school. It must be admitted that the decision to close schools and open classes online revealed the recognition of the parties, both students, teachers, school leaders, and also parents and guardians of students facing problems optimizing virtual learning(Jena, 2020). However, the solution is helped by applying technology in specific learning such as mathematics which is a strength, one of the most challenging and demanding subjects.

Along with the increasing number of cases explained by Covid-19, at the same time, the government has increased the prohibition of large gatherings of people or face-to-face meetings so that all people can imagine how helpful the teachers, especially Mathematics, are with the application of technology. To continue student learning, such as handling lesson assignments with digital applications, an essential learning method during the pandemic peaks in 2021 (Hendri, Handika, Kenedi, & Ramadhani, 2021). Multimedia technology in learning is familiar, especially in a country that

uses various multimedia for various learning activities daily; however, for a country like Indonesia, where the application of technology has not yet become a solution that dominates the day-to-day learning system. Such studies have proven that multimedia has helped students in mathematics learning, whereas technological innovation has successfully helped students do assignments and introduce impossible material without technology(Rochman & Pertiwi, 2020).

Digital technology as learning is also an essential part of everyday life, including complex learning such as Mathematics(Alabdulaziz, 2021). However, learning technology can help students understand and apply technological means in solving difficulties such as their tasks. The facts prove that the application can not be used correctly if it is not supported by sufficient technology and skills to use digital applications to solve educational problems students face in solving maths problem-solving tasks. These problems should not be logically only faced by students, but teachers, especially parents of students, face the same problems where they cannot necessarily use the digital application infrastructure to solve learning problems such as mathematics(Kaput, 2004).

Like other governments affected by the pandemic, the Indonesian government has taken steps to provide direction and learning solutions during the pandemic, which can be done through a remote system or online education, especially during emergencies and restrictions on public movement. The point is that the government wants students, teachers, and parents at home to continue to adapt to rather difficult conditions where technological application solutions can provide a little enlightenment so that education is not so disrupted(Prahmana, Hartanto, Kusumaningtyas, & Ali, 2021). In other cases, the government also instructs policies for distance education, but the government has not been able to support problems such as the procurement of technological facilities and equitable internet access. This is also one of the problems faced, meaning that it is faced by teachers and students and the problems faced by the government where there are still many students who cannot access online learning due to the lack of facilities they have. Therefore, the problem has not been solved, as technical support is critical(Phungrassami, 2021).

The rationale and consideration for the use of digital applications in learning during the pandemic are because of the innovation and power possessed by digital applications, both in the form of books, test applications, book notes, and a series of electronic-based learning applications that have been proven to help improve the way teaching works in a disrupted era. pandemic(Priyono, Moin, & Putri, 2020). Based on the many uses that technology applications have, the government, through recommendations and in-depth studies, finally includes technological devices as a solution for distance learning which should not only be in the future for the sake of but also in the norm of digital applications for learning Mathematics(Criado, Sandoval-Almazan, & Gil-Garcia, 2013).

The world wide web supports the selection of digital applications; the use of the internet is auspicious in supporting education which is now separated, no longer in classrooms but in remote classrooms or, in other words, virtual classrooms with very dynamic delivery and sharing of learning materials. and also the distribution system is very suitable for application(Woolliscroft, 2020). Indeed, innovation was not initially seen as something with great potential due to field evidence that many educators and schools are still using technological sophistication for applications with various reasons for the ineffectiveness of bags and principles so that technology turns into the best solution to support learning(Toquero, 2020) even though helping students learn from home and also working parents is a very effective solution because the principle of the benefits of digital technology can help the use of various multimedia which is proven to guarantee effectiveness and continuous teaching practice which has previously been used by various educational businesses where electronic solutions are indeed really effective and efficient(Dhawan, 2020).

The increasing findings of studies in mathematics education technology and digital technology in teaching and education, in general, have made it a belief that writers in many countries that have experienced many arithmetical changes cannot be ruled

out(Mulenga & Marbán, 2020). In particular, the consideration of the latest mathematics teaching experts has been included as a core point of completeness of technology and information in the world of science so that we are increasingly convinced of the needs and solutions for the computerized era of education in Indonesia today. In recent years, advancements in educational technology, including those that have firmly supported the constructivist approach to education, have been added to the development of teaching and modern innovation and creativity. It is to be understood that in the new mechanical policy where the teaching of Mathematics is currently making a new difference(Bereiter & Scardamalia, 2014). However, we do not think there is no agreement by the education councils on using technology targeted in the reliable field of Mathematics or targets to distinguish great educators who can use adequate technology applications. Many studies in the field of Mathematics teaching technology show that each teacher's perspective on educational technology impacts student learning outcomes effectively both during pandemics and other regular times(Adnan & Anwar, 2020).

Like other subjects, mathematics education also allows students to practice various mathematical codes and symbols that are part of a series of learning that can be completed with technology(Fhloinn & Fitzmaurice, 2021). On this basis, an analogy is recommended in mathematics learning where the Mathematic learning program has been computerized, which may be able to replace conventional education in achieving the best mathematics learning outcomes besides making students motivated to continue learning because the current mass of conventional learning cannot be continued in other words when ordinary instruction cannot achieve maximum results, especially the constraints of the pandemic(Naidoo, 2020). So technology-based learning is an electronic educational strategy that is easy to do in various places, and there is no time limit like conventional learning methods. Look at the historical background of technology, and its general use can be used for several subjects where it depends on the ability of teachers, parents, and experts in providing direction to learning mathematics which has a very high correlation to success(Rusli, Rahman, & Abdullah, 2020).

Besides that, the education curriculum in Indonesia also involves various components of the informatics system that must be allocated to various educational programs, including mathematics, in order to encourage students to be able to use various applications by choosing various courses so that learning continues even though online applications(Juliya & Herlambang, 2021). With the diverse applications of mathematics in various other disciplines, the development and accessibility and the capacity to use the web and various online shortcut application capabilities can help teachers transfer mathematical knowledge to students. With the development of electronics in all fields, the learning environment has begun to divide so that students now get various choices that use high innovation and creativity in teaching various sciences, especially mathematics(Kalogiannakis & Papadakis, 2017). For now, when internet applications have been installed with various games, it would be fast if the teacher was able to introduce various game applications that were subject to learning applications, then this one can help teachers so that students continue to use various electronic applications to support and help them learn when learning at home is still essential(Kebritchi, 2010). When students hold elephants, they cannot be separated from online games and games. This is a positive thing when teachers and educators adapt games and lessons. This is one of the challenges when teachers still view digital applications as just fun. Whereas such a mobile application will certainly add various skills in measuring world-class geometry, the game will undoubtedly turn into an educational board. This keeps students motivated while enjoying the fascinating world of applications, which is currently unimaginable how the national curriculum adopts various games that can be accessed through educational applications(Groff, 2013). Therefore, by looking at the scientific evidence above, how electronic applications can support learning in Mathematics both when education is polluted with epidemics and when education enters a new average era.

Therefore, the purpose of this literature review is to find various scientific evidence from game platforms and other online applications that can be adopted into education, especially physics during a pandemic, to understand and apply the role and policies of

the Indonesian government in supporting distance learning during the pandemic(Rayuwati, 2020). So for that, we want to add to the evidence of how online learning can be assisted by various applications, which of course is not the goal to beat traditional teaching, which is currently an obstacle, so to complement the views and scientific responses of educators and students about technology-based learning systems in mathematics education can be proven and is a scientific solution(Jannah, Prasojo, & Jerusalem, 2020).

**Method and Material**

The procedure for carrying out this study starts from problem formulation, with the aim of the study being to complete the hypotheses and the question of how to apply digital as a medium for learning mathematics in the era of automation and pandemics(Pathak & Dutta, 2010). The search for data has been carried out with a search system on the literature by visiting the publications of technology and mathematics education journals such as scientific articles, magazine books, and websites that discuss mathematics education and application technology issues in an era disrupted by a pandemic. After all the data has been collected, the data review begins with a critical evaluation, profound interpretation, and concluding relevant to the study question(Madelain et al., 2016). In our search, we use keyword typing systems such as digital applications, media learning, mathematics education, pandemic era, automation era. We depend on secondary data from scientific publications published between 2010 and 2022 to get more accurate and valid data. Starting from the formulation of the problem to the final report, we want to format this report in the form of a descriptive qualitative article under the phenomenological approach of searching for as much data as possible to get answers to the questions of this study. We follow the format for reporting a qualitative study that addresses the issue of technology and mathematics education in an era of disruption and automation. These are the procedures and methods of carrying out the study, from problem formulation to final reporting(Gruber et al., 2021).

**Result and discussion**

- **Math as a logical discipline**

Math subjects cannot be isolated from the universe of instruction, particularly in improving science and innovation. What is more, we frequently experience science in daily existence, isn't that so? For instance, working out reserve funds in trading exchanges, including the days in a year, even in different things in day-to-day existence, was essential(Li & Schoenfeld, 2019). Given the significant job of math in regular day-to-day existence, it is normal for science to be a necessary subject instructed at each degree of training, beginning from Basic Schools up to colleges. Learning is viewed as a characteristic interaction to change oneself, both in information, activity, and conduct. (Slameto, 2003)says that learning is a progression of mental and proactive tasks to acquire an adjustment of conduct because of individual encounters in connecting with their current circumstance concerning mental, full of feeling, and psychomotor. Learning assets are sources or a wide range of learning materials utilized without help from anyone else or with different understudies; what capacity to acquire information and improve understudies by involving different apparatuses that increment understudy information in learning (Beswick, 2012).

- **Best Maths Learning Apps**

Now is not the time for us to have difficulty dealing with math problems. Just use these apps! Mathematics is the queen of science. Almost all areas of life can not be separated from mathematics(Vergnaud, 2020). However, it becomes a complicated specter for many people because it requires logical and systematic thinking. Are students one of those who have challenging time-solving math problems? Are students confused about looking for an app to learn math? Keep learning the ten best math learning apps that students can try.

First, Homework - Math Solver allows students to learn math quickly without being complicated. For example, if students have difficulty answering questions $3x + 5 = 8$, this application can help learners. This application has been downloaded more than 47 thousand and is suitable for learning mathematics. Because homework - Math Solver is equipped with problem-solving(Divjak & Tomić, 2011).

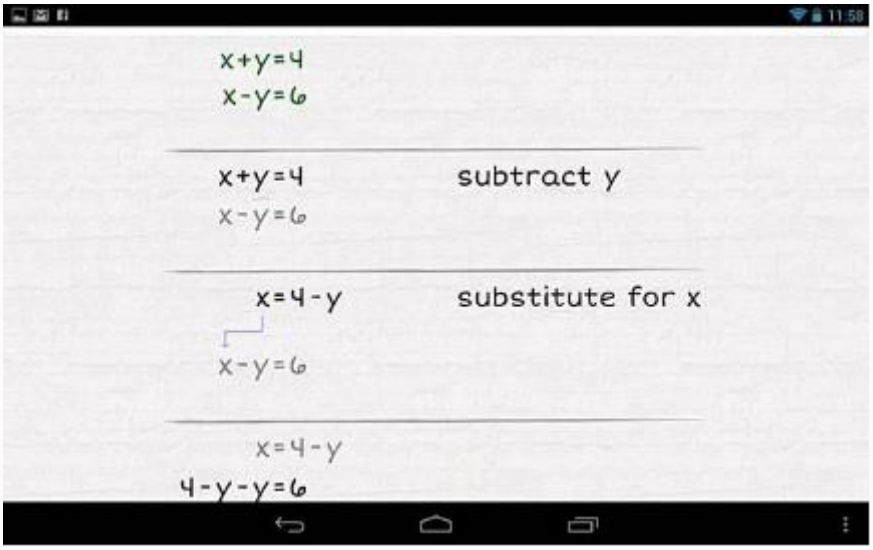


**Figure 1.** Homework – Math Solver

Second, Math Tricks - the following math learning application is Math Tricks devoted to calculating math problems. This application is claimed to present simple formulas, making students calculate math problems faster. 15 scores or grades ranging from 0 - 650 and above (Gardner, 2014). To use this app, students just need to click here. Are students interested in downloading this application to learn math?

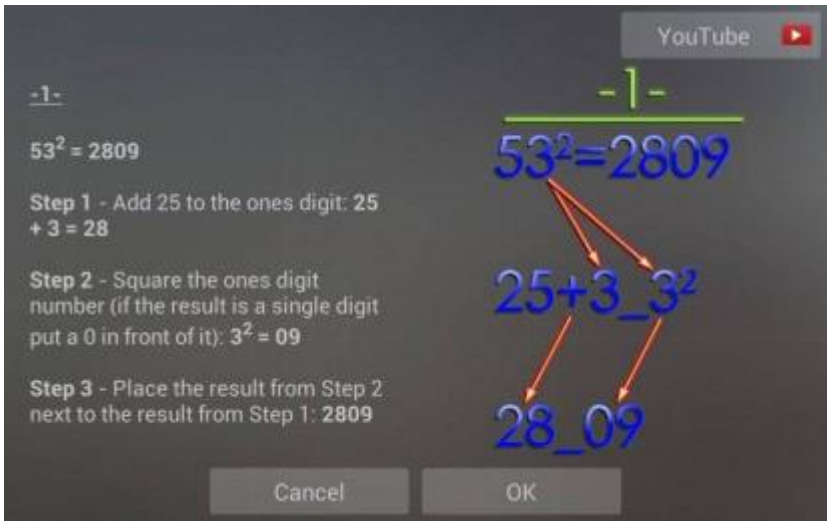


**Figure 2** Photomath – Camera Calculator

Third, Photomath - Camera Calculator - Are students making math problems in the app? Maybe they can install the Photomath - Camera Calculator app, asking students to solve math problems with the camera snap. It is easy, students take a picture of the question students want to solve, and this application will bring up the answers students want to succeed. Instead of being curious, it is better to download the application(Abdillah, Mahsup, Syaharuddin, & Pramita, 2021).


**Figure 3,** Photomath - Camera Calculator

**Fourth, MalMath: Step by step solver -** MalMath needed: A step-by-step solution that provides math problems. Students just need to type in the questions and then solve the questions step by step. It will appear automatically, starting from integrals, trigonometry, logarithms to algebra. Mismatch: A step-by-step solution suitable for high school students who have trouble solving math problems. Is it interested in downloading this high school math learning app?(Goncharenko, Yermakova-Cherchenko, & Anedchenko, 2020).


**Figure 4,** MalMath: Step by step solver

**Fifth, Mathway**

Mathway provides answers and has help for students who want to offer math in detail. This application will help students answer the easiest to the most complex math problems. Users simply enter a math problem, then Mathway will provide a complete answer by answering it(Hadjinor, Asotigue, & Pangandamun, 2021). This application that more than 44 thousand Android users have downloaded is worthy of application—interested in downloading this best math learning application?

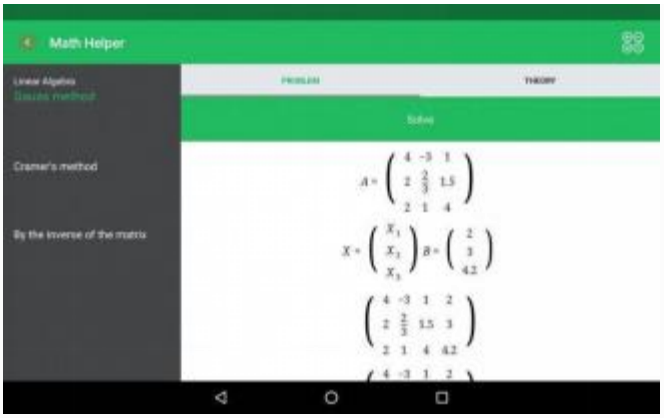


**Figure 5,** Mathway

**Sixth Mathematics - t**his one application has a calculator-like design. Users enter a math problem, and this application will display the answers to the questions. Starting from Sin, Cos, Tan, Linear, to Vector(Arevalillo-Herráez, Arnau, Ferri, & Santos, 2017). Although not available in Indonesian, Mathematics provides other languages such as English, German, French, Spanish, Italian, and Portuguese. Want to have an application that can solve math problems without being complicated? Just download the Math app.

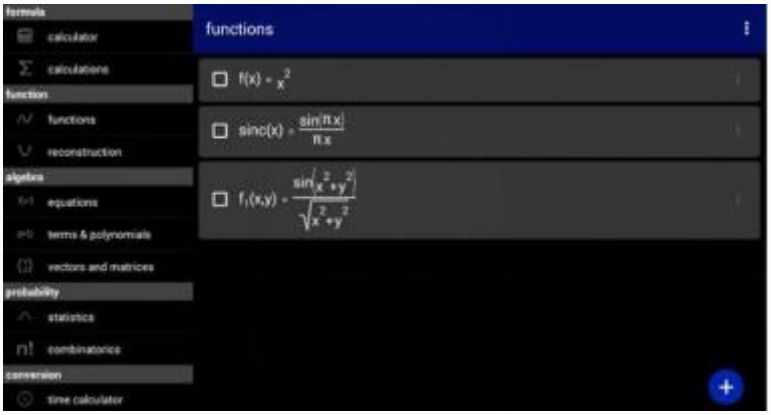


**Figure 6** Mathematics application

- **Digital media in education**

The word media comes from Latin, whose singular form is medium. In this case, we will limit the notion of media in the world of education only, namely, the media used as a tool and material for learning activities. (Goldman-Segall, 2014). states that the media is a form of existence of various components in the student environment that can stimulate students to study. From several definitions, it can be concluded that the media is a tool for beneficial aids for students and educators in the learning and teaching process. Teaching media are all physical materials and tools that may be used to implement teaching and facilitate student achievement towards goals or teaching goals. (Puspitarini & Hanif, 2019)explain several benefits of learning media: clarifying the message so that it is not too verbal, overcoming the limitations of space, time, and senses, and can cause the same perception of a problem. Learning media can increase direct interaction between learners, and learning resources enable learners to learn independently according to their visual talents and abilities, audio & kinesthetic. Physical adaptation necessitates the provision of supporting resources in the form of tools and equipment to aid in the delivery of classroom lectures.

The characteristics of learning media are generally allocated to In its interest; the media is a tool to explain what is in the book lessons in words, symbols, or even numbers(Chen & Bryer, 2012). Media utilization learning is not limited to a precise science but is used in all science. Then from the software point of view, it is defined as the ability to create a virtual world where users can interact with computers. Interactivity is related to two-way communication, is mutual in action, is mutually active and interconnected, and has a reciprocal relationship with one another (Anderson, 2012). Hence, intelligent learning sight and sound can be deciphered as interactive media applications utilized in the learning system. Interactive media learning intends to station messages (information, abilities, and mentalities) and invigorate understudies' decisions, sentiments, consideration, and readiness. Hence, they deliberately learning is occurring, intentional, and controlled Microsoft Mathematics is an instructive program, made for the Microsoft Windows working framework, that assists clients with tackling math and science issues(Goodwin & Highfield, 2013).

Microsoft built and initiated this application primarily targeted students as a study aid. Microsoft Mathematics is a new software that can help students complete math and science assignments more quickly and easily teach important basic concepts. Microsoft Mathematics highlights can assist understudies with taking care of perplexing issues in fundamental polynomial math, polynomial math, geometry, analytics, physical science, and science. Utilizing Microsoft Mathematics, understudies can tackle conditions bit by bit while acquiring a superior comprehension of the essential ideas(Goodwin & Highfield, 2013).

- **Developed product analysis**

In general, the consumers of this application are all stakeholders of mathematics learning, namely students, teachers, and mathematics teachers(Minichiello, Hood, & Harkness, 2018). Specifically, the consumers of this application are grade 12 students. The characteristics of this application are mathematics formula books. According to observations, students were asked not to memorize the material but to understand it. However, it feels like just understanding will not be enough to make students able to determine what formula is suitable to use for specific questions. Like it or not, students must memorize the formulas contained in the mathematics subject matter. However, memorizing various Math formulas is not as easy as it seems. So this application has the characteristics *of mathematics formula books* which later students are expected to memorize the mathematical formulas given. The material for this application is grade 12 mathematics, namely: Sequences and Series, Limits, Derivatives, Integrals, Transformations, Statistics, Probability, and Trigonometry(Zhang, Zhou, Wang, & Song, 2021).

- **Developing Early Products**

This application was made utilizing one of the makers, to be specific, www.appsheet.com. AppSheet gives a codeless application improvement stage that permits clients to make versatile tablet and web applications utilizing information sources like Google Drive, DropBox, Office 365, bookkeeping page stages, and other cloud-based information bases. Fostering the underlying item starts with making a bookkeeping page in MS Excel, which contains a depiction of the application, material that contains equations, and instances of inquiries that will later be utilized as a menu in the application(Petrović, Roblek, Radenković, & Nejković, 2020).

- **Arithmetic application**

The point of convergence of the number-crunching gamification was exclusively centered on fostering the students' expansion limits(T M Scholz, 2017). Showing duplication required a unique method as the normal redundancy recollecting was not feasible, taking into account the pre-tests to spread out a check of data. A pre-preliminary increment table from 0 to 10 was managed to choose primary data (PK) before the intervention. In particular, the accentuation was on the 7X, 8X, and 9X tables. These timetables were the most difficult to rule for this grade and age level. The pre-test gave an early phase to

quantify how much learning the students experienced(Tobias M Scholz, 2017). The educator perceived the students to have a spot with three capacity groupings (low-performing, moving nearer or typical, and satisfying suspicions). It was familiar with the students as the Game Master and uncovered the investigation thought. The students quickly figured we would play PC games, and Gamification used game parts with close to no PCs or expensive programming.

As the Game Master, students had an image that tended to them like a wizard with a magical wand and red hair. Before beginning the regular assessment, they came to the homeroom as often as possible so they would be OK with it. We had chosen to perceive the students inside the three different limit get-togethers. The low-performing students essentially propelled us as they emitted an impression of being removed and, as often as possible irksome during class time(Geertz, 2012). The mediation was two months after all parental consent and official documentation was obtained. The class time was around the one-hour length, and students went to the homeroom a couple of times every week when the school plan allowed taking into account extracurricular activities organized close to the completion of the school year. When they saw us, the students would call students Game Master and be anxious to think about the wizardry I was bringing to class. We began by making a demeanor. The extension is an active procedure requiring contact between the extension worker and the individual to establish a behavior change process.

We noticed a hall where the lights could be turned down. We dressed as a wizard with a cap and cape on our underlying two openings to wizardry math. Their attire was novel for the students and made energy, a gamification technique(During, 2021). Gummi worms gave force, and each time we met as a social occasion, the students took in another number-related magic trick that would give them an excellent way to deal with learning and recall their duplication. After learning another mathematical trick, each student would complete an expansion worksheet containing 12 requests that tended to the increment point of convergence of the day and PK questions. The accompanying time we got together, two or following three days, the students would complete another little trial of similar expansion requests to spread out the support of the past learning. Every open door I came to the school, several social events would experience the number-related divination and review and learn more increment stunts. Student receptiveness to the mediation was clashing due to remarkable school events, school journeys, and class participle(Perrotta, Featherstone, Aston, & Houghton, 2013).

**Conclusion**

This final section will summarize the study's findings that discuss how digital applications are used as a medium for learning mathematics in the pandemic era and the era of all automation. We believe that the exposure to the findings referred to by the field study evidence is where the existence of digital technology applications that have renovated and innovated learning, especially mathematics education, during the pandemic. We believe in exposure to evidence from previous studies where learning during a pandemic is disrupted, or various digital technology applications are carrying out distance learning. Are we sure that the core of the problem does not happen? We have answered this with the principle of high validity and reliability. As for what we can conclude, among others, that teaching mathematics is a complicated field of study, so with the presence or application of digital technology, it will undoubtedly give its color both in terms of teaching and learning. Encourage students to continue to be motivated to study mathematics even with little support from teachers and parents during the pandemic.

Then we will see how this learning application is a popular application used, such as the homework application with the name match solver, a math trichome application, the Photo Match application calculator camera, and a step-by-step camera MalMatch. Mathematical Problems, Mathematical Stamps, and a series of other applications have colored the findings of this technology and mathematics study. Next, we also explain how digital media is in education, both during the pandemic and in the average era, which is an era where everything is digital. Next, we present a little analysis of

products developed and used in teaching mathematics.

Moreover, we also mentioned how the application product in the early stages of development towards mathematics learning was all-around in nature. Furthermore, an arithmetic application is prevalent in learning mathematics at school and college. Those are among others what we describe in the results section, and we have reviewed and discussed so that we believe our findings are supported by the results of previous studies in the hope that this work has answered the core of the problem and will also be a precious input and contribution to research development efforts in the field.

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**Reference**

Abdillah, Abdillah, Mahsup, Mahsup, Syaharuddin, Syaharuddin, & Pramita, Dewi. (2021). Pemanfaatan Aplikasi Matematika Berbasis Android sebagai Media Belajar Matematika Siswa SMA/SMK. *JPMB: Jurnal Pemberdayaan Masyarakat Berkarakter*, *4*(1), 17–22.

Adnan, Muhammad, & Anwar, Kainat. (2020). Online Learning amid the COVID-19 Pandemic: Students' Perspectives. *Online Submission*, *2*(1), 45–51.

Alabdulaziz, Mansour Saleh. (2021). COVID-19 and the use of digital technology in mathematics education. *Education and Information Technologies*, *26*(6), 7609–7633.

Anderson, Harlene. (2012). Collaborative relationships and dialogic conversations: Ideas for a relationally responsive practice. *Family Process*, *51*(1), 8–24.

Arevalillo-Herráez, Miguel, Arnau, David, Ferri, Francesc J., & Santos, Olga C. (2017). Gui-driven intelligent tutoring system with affective support to help learning the algebraic method. *2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, 2867–2872. IEEE.

Bereiter, Carl, & Scardamalia, Marlene. (2014). Knowledge building and knowledge creation: One concept, two hills to climb. In *Knowledge creation in education* (pp. 35–52). Springer.

Beswick, Kim. (2012). Teachers' beliefs about school mathematics and mathematicians' mathematics and their relationship to practice. *Educational Studies in Mathematics*, *79*(1), 127–147.

Chen, Baiyun, & Bryer, Thomas. (2012). Investigating instructional strategies for using social media in formal and informal learning. *International Review of Research in Open and Distributed Learning*, *13*(1), 87–104.

Corlett, Richard T., Primack, Richard B., Devictor, Vincent, Maas, Bea, Goswami, Varun R., Bates, Amanda E., Koh, Lian Pin, Regan, Tracey J., Loyola, Rafael, & Pakeman, Robin J. (2020). Impacts of the coronavirus pandemic on biodiversity conservation. *Biological Conservation*, *246*, 108571.

Criado, J. Ignacio, Sandoval-Almazan, Rodrigo, & Gil-Garcia, J. Ramon. (2013). Government innovation through social media. *Government Information Quarterly*, Vol. 30, pp. 319–326. Elsevier.

Dhawan, Shivangi. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22.

Divjak, Blaženka, & Tomić, Damir. (2011). The impact of game-based learning on the achievement of learning goals and motivation for learning mathematics-literature review. *Journal of Information and Organizational Sciences*, *35*(1), 15–30.

During, Simon. (2021). *Modern enchantments*. Harvard University Press.

Fhloinn, E. Ní, & Fitzmaurice, O. (2021). How and why? Technology and practices used by university mathematics lecturers for

emergency remote teaching during the COVID-19 pandemic. *… An International Journal of the IMA*. Retrieved from https://academic.oup.com/teamat/article-abstract/40/4/392/6380163

Gardner, Martin. (2014). *Mathematics, magic and mystery*. Courier Corporation.

Geertz, Clifford. (2012). *Available light*. Princeton University Press.

Goldman-Segall, Ricki. (2014). *Points of Viewing Children's Thinking: A Digital Ethnographer's Journey http://www. pointsofviewing. com*. Psychology Press.

Goncharenko, Tatiana, Yermakova-Cherchenko, Nataliia, & Anedchenko, Yelyzaveta. (2020). Experience in the Use of Mobile Technologies as a Physics Learning Method. *ICTERI Workshops*, 1298–1313.

Goodwin, Kristy, & Highfield, Kate. (2013). A framework for examining technologies and early mathematics learning. In *Reconceptualizing early mathematics learning* (pp. 205–226). Springer.

Groff, Jennifer. (2013). Technology-rich innovative learning environments. *OCED CERI Innovative Learning Environment Project*, *2013*, 1–30.

Gruber, June, Prinstein, Mitchell J., Clark, Lee Anna, Rottenberg, Jonathan, Abramowitz, Jonathan S., Albano, Anne Marie, Aldao, Amelia, Borelli, Jessica L., Chung, Tammy, & Davila, Joanne. (2021). Mental health and clinical psychological science in the time of COVID-19: Challenges, opportunities, and a call to action. *American Psychologist*, *76*(3), 409.

Hadjinor, Soraim I., Asotigue, Arnold B., & Pangandamun, Jamil A. (2021). Solving Trigonometric Problems Using Mathway Application in Teaching Mathematics. *Asian Journal of Research in Education and Social Sciences*, *3*(3), 87–97.

Hendri, Sherlyane, Handika, Refiona, Kenedi, Ary Kiswanto, & Ramadhani, Dini. (2021). Pengembangan Modul Digital Pembelajaran Matematika Berbasis Science, Technology, Enginiring, Mathematic untuk Calon Guru Sekolah Dasar. *Jurnal Basicedu*, *5*(4), 2395–2403.

Jannah, Miftahul, Prasojo, Lantip Diat, & Jerusalem, Mohammad Adam. (2020). Elementary School Teachers' Perceptions of Digital Technology Based Learning in the 21st Century: Promoting Digital Technology as the Proponent Learning Tools. *Al Ibtida: Jurnal Pendidikan Guru MI*, *7*(1), 1–18.

Jena, P. K. (2020). Online learning during lockdown period for covid-19 in India. *International Journal of Multidisciplinary Educational …*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3691545

Juliya, Mira, & Herlambang, Yusuf Tri. (2021). Analisis problematika pembelajaran daring dan pengaruhnya terhadap motivasi belajar siswa. *Genta Mulia: Jurnal Ilmiah Pendidikan*, *12*(1).

Kalogiannakis, Michail, & Papadakis, Stamatios. (2017). Combining mobile technologies in environmental education: a Greek case study. *International Journal of Mobile Learning and Organisation*, *11*(2), 108–130.

Kaput, J. J. (2004). *Technology becoming infrastructural in mathematics*. Copenhagen, Denmark, July.

Kebritchi, Mansureh. (2010). Factors affecting teachers' adoption of educational computer games: A case study. *British Journal of Educational Technology*, *41*(2), 256–270.

Li, Yeping, & Schoenfeld, Alan H. (2019). Problematizing teaching and learning mathematics as "given" in STEM education. *International Journal of STEM Education*, Vol. 6, pp. 1–13. Springer.

Madelain, Vincent, Nguyen, Thi Huyen Tram, Olivo, Anaelle, De Lamballerie, Xavier, Guedj, Jérémie, Taburet, Anne Marie, & Mentré, France. (2016). Ebola virus infection: review of the pharmacokinetic and pharmacodynamic properties of drugs considered for testing in human efficacy trials. *Clinical Pharmacokinetics*, *55*(8), 907–923.

Minichiello, Angela, Hood, Joel R., & Harkness, Derrick Shawn. (2018). Bringing user experience design to bear on STEM education: A narrative literature review. *Journal for STEM Education*

*Research*, *1*(1), 7–33.

Mulenga, Eddie M., & Marbán, José M. (2020). Is COVID-19 the gateway for digital learning in mathematics education? *Contemporary Educational Technology*, *12*(2), ep269.

Naidoo, Jayaluxmi. (2020). Postgraduate mathematics education students' experiences of using digital platforms for learning within the COVID-19 pandemic era. *Pythagoras*, *41*(1), 568.

Pathak, Parth H., & Dutta, Rudra. (2010). A survey of network design problems and joint design approaches in wireless mesh networks. *IEEE Communications Surveys & Tutorials*, *13*(3), 396–428.

Perrotta, Carlo, Featherstone, Gill, Aston, Helen, & Houghton, Emily. (2013). Game-based learning: Latest evidence and future directions. *Slough: NFER*.

Petrović, Nenad, Roblek, Vasja, Radenković, Maša, & Nejković, Vesna. (2020). Approach to Rapid Development of Data-Driven Applications for Smart Cities using AppSheet and Apps Script. *AIIT 2020 International Conference on Applied Internet and Information Technologies*, 77–81.

Phungrassami, H. (2021). Environmental problem shifting analysis of pollution control units in a coal-fired powerplant based on multiple regression and lca methodology. *Sustainability (Switzerland)*, *13*(9). https://doi.org/10.3390/su13095142

Prahmana, Rully Charitas Indra, Hartanto, Dody, Kusumaningtyas, Dian Artha, & Ali, Raden Muhammad. (2021). Community radio-based blended learning model: A promising learning model in remote area during pandemic era. *Heliyon*, *7*(7), e07511.

Priyono, Anjar, Moin, Abdul, & Putri, Vera Nur Aini Oktaviani. (2020). Identifying digital transformation paths in the business model of SMEs during the COVID-19 pandemic. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(4), 104.

Puspitarini, Yanuari Dwi, & Hanif, Muhammad. (2019). Using Learning Media to Increase Learning Motivation in Elementary School. *Anatolian Journal of Education*, *4*(2), 53–60.

Rayuwati, Rayuwati. (2020). How educational technology innovates distance learning during pandemic crisis in remote areas in Indonesia? *International Research Journal of Management, IT and Social Sciences*, *7*(6), 161–166.

Rochman, Chaerul, & Pertiwi, Catherien Suci Ramdhini. (2020). Learning at Covid-19 pandemic era: Science technology engineering and mathematic competencies and student character. *SEJ (Science Education Journal)*, *4*(2), 129–142.

Rusli, R., Rahman, A., & Abdullah, H. (2020). Student perception data on online learning using heutagogy approach in the Faculty of Mathematics and Natural Sciences of Universitas Negeri Makassar …. *Data in Brief*. Retrieved from https://www.sciencedirect.com/science/article/pii/S2352340920300469

Scholz, T M. (2017). *Big data in organizations and the role of human resource management: A complex systems theory-based conceptualization*. Retrieved from https://www.econstor.eu/bitstream/10419/182489/1/978-3-631-71905-3.pdf

Scholz, Tobias M. (2017). *Big data in organizations and the role of human resource management: A complex systems theory-based conceptualization*. Frankfurt a. M.: Peter Lang International Academic Publishers.

Slameto. (2003). *Belajar dan Faktot-Faktor yang Mempengaruhinya*. RajaGrafindo Persada.

Toquero, C. M. (2020). Challenges and opportunities for higher education amid the COVID-19 pandemic: The Philippine context. *Pedagogical Research*. Retrieved from https://eric.ed.gov/?id=EJ1263557

Vergnaud, G. (2020). A classification of cognitive tasks and operations of thought involved in addition and subtraction problems. *Addition and Subtraction*. https://doi.org/10.4324/9781003046585-4/classification-cognitive-tasks-operations-thought-involved-addition-subtraction-problems-g%C3%A9rard-

vergnaud

Woolliscroft, J. O. (2020). Innovation in response to the COVID-19 pandemic crisis. *Academic Medicine*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7188042/

Zhang, J., Zhou, D., Wang, R., & Song, L. (2021). Core Content Selection and Textbook Design for High School Mathematics. *School Mathematics Textbooks …*. https://doi.org/10.1142/9789814713955_0001