The Challenges and Opportunities in Digital Transformation for Education during the COVID-19 pandemic

Yuliana
Udayana University, Denpasar, Bali, Indonesia
e-mail: yuliana@unud.ac.id

Abstract

The COVID-19 pandemic causes changes in the education system. There is digitalization in the education system lately. Learning must be done online to prevent face-to-face communication. This is important to reduce the risks of COVID-19 transmission. However, there are challenges and opportunities in digital transformation in the education system during the COVID-19 pandemic. This paper aims to describe the challenges and opportunities in digital transformation for education during the COVID-19 pandemic. This paper is a literature review. Literature was searched from Google Scholar, PubMed, Scopus, Science Direct, and SINTA journal. Inclusion criteria are reviews and researches. Exclusion criteria are unavailable full-text articles. Results revealed challenges in digital transformation in education systems are infrastructures and skills. Infrastructures mean the availability of gadgets and internet connections from teachers and students. Skills mean competence from students and teachers in utilizing the digital equipment and software during the learning system. Opportunities are wide research scopes, modifications, and creativities that can be explored. In conclusion, challenges in digital transformation are infrastructures and skills aspects from students and teachers. Opportunities are wide research scopes, modifications, and creativities that can be explored during digital transformation. Therefore, teachers and students need to adapt to digital transformation in education systems.

Keywords: COVID-19, digital transformation, education

Abstrak

Pandemi COVID-19 menyebabkan perubahan dalam sistem pendidikan. Ada digitalisasi dalam sistem pendidikan akhir-akhir ini. Pembelajaran harus dilakukan secara daring untuk mencegah terjadinya komunikasi tatap muka. Hal ini penting untuk mengurangi risiko penularan COVID-19. Namun, ada tantangan dan peluang dalam transformasi digital dalam sistem pendidikan selama pandemi COVID-19. Makalah ini adalah tinjauan pustaka. Tulisan ini bertujuan untuk menjelaskan peluang dan tantangan dalam transformasi digital sistem pendidikan selama pandemi COVID-19. Literatur dicari dari Google Scholar, PubMed, Scopus, Science Direct, dan jurnal SINTA. Kriteria inklusi adalah review dan penelitian. Kriteria pengecualian adalah artikel teks lengkap yang tidak tersedia. Hasil penelitian mengungkapkan tantangan transformasi digital dalam sistem pendidikan adalah infrastruktur dan keterampilan. Sarana prasarana berarti tersedianya gadget dan koneksi internet dari guru dan siswa. Keterampilan berarti kompetensi siswa

dan guru dalam memanfaatkan perangkat dan perangkat lunak digital selama sistem pembelajaran. Peluang adalah cakupan penelitian yang luas, modifikasi, dan kreativitas yang dapat digali selama transformasi digital. Kesimpulannya, tantangan dalam transformasi digital adalah aspek infrastruktur dan keterampilan dari siswa dan guru. Peluang adalah cakupan penelitian yang luas, modifikasi, dan kreativitas yang dapat digali selama transformasi digital. Oleh karena itu, guru dan siswa perlu beradaptasi dengan transformasi digital dalam sistem pendidikan selama pandemi COVID-19.

Kata kunci: COVID-19, transformasi digital, pendidikan

INTRODUCTION

The COVID-19 pandemic causes changes in the education system. There is digitalization in the education system lately. Learning must be done online to prevent face-to-face communication. This is important to reduce the risks of COVID-19 transmission. However, there are challenges and opportunities in digital transformation in the education system during the COVID-19 pandemic. In the past decades, Information and Communications Technology (ICT) had critical roles in teaching and learning. Huge investments have been made by most countries to maintain ICT-related educational equipment (Comi et al., 2017; Dhawan, 2020). There are some insights about suitable ICT-related teaching methods on the achievement of the students. Empirical analysis researches that had been done revealed that there were increasing demands on the availability of ICT equipment. Specific software programs are needed to teach and enhance learning (Comi et al., 2017; Putri & Suparmi, 2020). Mathematics subject is better studied by using ICT equipment. However, the practice depends on students and teachers (Ma et al., 2020).

The studies about gender differences in achievement of using Computed assisted learning showed that the math grades increased by 3.5 percentile points. There were no substitution effects using computer-assisted learning and workbook sessions on homework schedules in math. When students have heterogeneity of grade levels, the effects of adaptive CAL could be larger. Technology might personalize education. Adaptive computer instruction can enhance the students' achievement (Comi et al., 2017). This paper aims to describe the challenges and opportunities in digital transformation for education during the COVID-19 pandemic.

DISCUSSION

Along with increasing digitization in all aspects of life, technology for learning and teaching need to be improved at all levels of education. Teachers and students should adapt and learn new kinds of technologies. Face-to-face learning methods should be replaced with online learning methods in the COVID-19 pandemic situation (Bal & Gupta, 2020).

Challenges in digital transformation in education systems are infrastructures and skills. Infrastructures mean the availability of gadgets and internet connections from teachers and students. Skills mean competence from students and teachers in utilizing the digital equipment and software during the learning system.

Opportunities are wide research scopes, modifications, and creativities that can be explored (Muthuprasad et al., 2021; Satuti et al., 2020).

The Challenges in Digital Transformation for Education during the COVID-19 pandemic

Teaching practice by using computers and technology has been implemented by many countries. Researches had been done recently. The results revealed that there was some potential theoretical insight and increasing in the students' achievement. The first challenge is the preparation of the learning materials by the teachers. Slides and tests should be well prepared previously. The materials should be delivered as smoothly as possible. These backstage activities are very crucial. The successfully prepared materials will give many positive impacts on students' learning and achievement. Those slides can make lessons more attractive. Good audiovisual content can attract the students' eagerness and interest in learning. Therefore, digital transformation in education can help teachers to manage their teaching material more effectively (Comi et al., 2017).

Using digital transformation in teaching needs software. There are two kinds of software, namely the widely-used software and adaptive software. Adaptive software is more expensive. It is hard to develop and maintain for a long time. There is no one-size adaptive software for whole students in all categories, therefore, it is difficult to obtain the benefits of the same adaptive software among different students and contexts of teaching. Computer-assisted learning can be used to inform the teachers and parents regarding the progress of the students (Ma et al., 2020).
Challenges in implementing digital transformation in education are difficulties in integrating digital transformation in education into practices. The availability of devices such as laptops, software, tablets, or educational programs is not sufficient to enhance the students' achievement. It needs digital literacy and ICT skills from teachers and students. ICT can be used to prepare learning materials and making the lesson more interactive. Attractive audiovisual content is very important for successful classes. Teachers' assistance in guiding the students using educational software is very critical to boost the students' achievement (Apriani et al., 2020; Comi et al., 2017; Honggonegoro & Nuryanto, 2020).

There are five essential activities in the teaching process such as preparing files, using computers during lessons, media education practices, collaboration among teachers, and communication with students. ICT training and knowledge previously before the class will enhance the students' and teachers' performance during the class. The studies revealed that the teachers' beliefs about using ICT for teaching affected the achievement better than the availability of infrastructures (Comi et al., 2017; Leontyeva, 2018).

One important principle that needs to be implemented is Student-Centered Learning. It is an important challenge while implementing online learning. Issues regarding real-life problems should be presented to increase the students' competency. Teachers can help the students to learn to think critically. This is important when the students are going to work next in the future. The positive impact of critical thinking while maintaining Student-Centered Learning will be attaining a professional attitude in the future career (Puscas, 2015).
E-learning (electronic learning) is the main online learning tool. The teacher is not the main center of learning anymore. Students should do active learning. With e-

learning, students can study anywhere, anytime, and repeatedly. Computers, laptops, or smartphones are the tools to support online learning. Online learning has the advantage of saving travel time (Ferri et al., 2020). E-learning requires internet connectivity, satellite communication, and smartphones. Some of the concepts used are Open Educational Resources (OER), Flipped Classroom (FC), blended learning, and Massive Open Online Courses (MOOCs) (Bal & Gupta, 2020).

OERs have a 5R concept, namely Retain, Reuse, Revise, Remix, and Redistribute. Retain means being able to download content. Reuse means being able to use content in a class or create a video. Revise is being able to modify or translate content. Remix means that you can combine two or more pieces of content to create a new piece of content. Redistribute means being able to share the content with others (Bal & Gupta, 2020).

The Opportunities in Digital Transformation for Education during the COVID-19 pandemic

Digital transformation is useful for enhancing communication and education. Collaboration of school and families are very essential. Integrating the ICT into teaching practice can increase the effectiveness of the learning process. Students can enhance their ICT skills while learning the materials. The students' performances can be enhanced when they are taught how to use the internet critically. The internet can be used to support communication and enhance education. ICT can be adopted and implemented outside the classroom. Looking up information is one of the advantages of using ICT. The teaching style is very essential. Students need to be more active and aware in using ICT for studying and communicating (Comi et al., 2017).

The mobile-based assessment is also considered as ICT implementation and digital transformation in teaching. The subjects that can be taught using digital transformation are medical, biology, engineering, mathematics, science technology, etc. (Alrofouh et al., 2019). Mobile-based learning can also be done using a smartphone. A smartphone can support academic performance when it is used properly (Amez & Baert, 2020). Specific teaching practice can enhance the students' performance (Andrey Zakharov, Martin Carnoy, 2013).

Mobile devices in learning tools are various, such as laptops and mobile phones (smartphones). Those devices become learning tools with great potential in improving the learning process. In a meta-analysis and research synthesis of 110 experimental journal articles, it was revealed that mobile devices are important tools in the classroom and outdoor learning (Sung et al., 2016).

The use of ICT in learning can increase the competency and convenience in learning. Students can do online assessments anytime and anywhere based on the study contract and deadline. Online learning does not need a physical presence. It can be done asynchronously (Kyriazi, 2015; Pokhrel & Chhetri, 2021; Wei et al., 2021).

Some teaching strategies are better than others. The type and amount of specific homework also have important roles. The type of homework and technology used is essential. Students should be given homework and tasks based on their level. Evaluation and assessment of specific ways are also needed to be considered (Andrey Zakharov, Martin Carnoy, 2013). Complex problem solving

needs to be taught to students in enhancing their achievement and comprehension (Abidah et al., 2020; Anix & Fauziyah, 2018; Eichmann et al., 2019).

Digital transformation needs training. The best training is started as early as possible. For example, training at the high school level will be better than at the university level. The active involvement of the students affects the results of the learning. Behavior and competency are required to reach the excellence of intelligence. Students should develop their competencies of independent learning, identifying, and assessing relevant scientific information. Therefore, the success in the learning process needs cooperation and collaboration of all teaching staff. Special courses are important to support the learning activities. Online assessment of learning results requires the assessment of the learning process (Lile & Bran, 2014). Self-assessment and peer-review assessment are mandatory to complete the assessment by the teacher (Lile & Bran, 2014; Santos et al., 2016).

A technology-based assessment (TBA) can be used to assess the students' abilities. This kind of assessment is adopted by large universities and international schools globally. However, online assessment needs the students' engagement and the teachers' belief. A study of 494 science teachers and 1774 students from 32 schools revealed that students' engagement is very essential in learning activities. The students' computer competency also has an essential role in the learning process (Chien & Wu, 2020). Teaching the students to adapt the instruction is an essential skill that should be mastered by the teachers. Motivation and metacognition must support conceptual learning. Some challenges are lack of time and materials and less teaching experience (Izci & Siegel, 2015).

Online education is almost the same as computer-assisted learning (CAL). Instruction was given remotely by the teachers. This system can be done on all levels of education globally. It is popular now due to the coronavirus pandemic. The CAL system give huge positive effects. This system can boost the students' knowledge and competence in using computers. Therefore, rapid implementation of computer-assisted technology in learning can be done globally (Ma et al., 2020). In low- and lower-middle-income countries (LMICs), learning outcomes must be significantly improved. Because typical reform efforts take years to bear fruit, education practitioners in LMICs are looking for new and faster strategies to improve learning outcomes. Computer-assisted instruction (CAI) is one tool that has shown potential. While many studies show that CAI improves learning outcomes, others show little or negative results. There hasn't been enough research done to figure out why these discrepancies exist and, more critically, what conditions must be in place to ensure that CAI contributes to better learning outcomes. The key factors that must be determined when implementing CAI are the operating environment; infrastructure; stakeholder engagement; technological trust; design; student engagement; content curation/creation; classroom integration; teacher and student capacity; also data collection and use (Escueta et al., 2021).

The net impacts of ICT spending in schools, CAI use in schools, and computer use at home on educational outcomes are equivocal in theory. Computer, software, the Internet, and other technology-related expenses and time may be more or less efficient than expenditures on traditional educational inputs. New technologies may either displace more effective instructional and learning techniques and distract students, or they may serve as an excellent learning tool that actively engages students in learning. As a result, it's maybe not unexpected that the

fast-developing empirical literature on the effects of computers, the Internet, and computer-assisted instruction is mixed (Bulman & Fairlie, 2016).

In 2018, the American College of Cardiology Fellows in-Training Section Leadership Council proposed three learning strategies. The strategies are personal learning, adaptive learning with real-world situations with feedback, and flipped classroom. Meanwhile, the Brigham and Women's Hospital Fellowship in Cardiovascular Medicine using Microsoft Teams (Microsoft Corporation, Redmond, Washington) (Almarzoog et al., 2020).

Society has been altered by technology in previously inconceivable ways. Education is no different. There is a lot of interest in using technology to change how children study all across the world. New uses of ed-tech will continue to flood the market in the coming years, giving students, parents, and educators an almost unlimited assortment of alternatives. Education is delivered by text messaging and other new platforms. We discovered that merely giving students access to technology has mixed results. Much of the experimental research suggests that providing a child a computer at the K-12 level is beneficial. Computer-assisted learning and behavioral therapies appear to be two promising areas (Escueta et al., 2021).

Evaluations of behavioral interventions, like computer-assisted learning, generally find beneficial benefits across all stages of the school life cycle, but they are typically smaller than those reported with the most effective computer-assisted learning models. Simultaneously, technology-enabled behavioral interventions, such as large-scale text message campaigns, are typically very inexpensive to implement and offer enormous potential as a cost-effective educational strategy. Researchers should focus their efforts in the future on determining when technology-based behavioral nudges are most effective. An additional study, with the introduction of new technologies such as machine learning, can assist us in determining the cause of the problem. Students enrolled in online-only courses may have poor learning outcomes.

The results of mixed learning, on the other hand, are often comparable to those of entirely in-person courses. This shows that a cost-effective combination of online and in-person learning is possible. A new study is needed to understand how new models, such as MicroMasters programs and nanocredentials, may impact or democratize learning, as the online learning industry is continually expanding. The educational technology industry is fast evolving, and cutting-edge tools and applications are typically regarded as obsolete after only a few years. When it comes to purchasing selections, school administrators frequently expect resale value (Escueta et al., 2021). Another type of online learning that might be useful is MOOC (Massive Open Online Course (MOOC). This type of learning requires active learning and motivation from the students to implement Freedom To Learn Program (Irene et al., 2020).

CONCLUSION AND IMPLICATION

In conclusion, challenges in digital transformation are infrastructures and skills aspects from students and teachers. Opportunities are wide research scopes, modifications, and creativities that can be explored during digital transformation. Therefore, teachers and students need to adapt to digital transformation in education systems.

REFERENCES

Abidah, A., Hidayatulah, H. N., Simamora, R. M., Fehabutar, D., & Mutakinati, L. (2020). The Impact of Covid-19 to Indonesian Education and Its Relation to the Philosophy of "Merdeka Belajar." *Studies in Philosophy of Science and Education*, *1*(1), 38–49. https://doi.org/10.46627/sipose.v1i1.9

Almarzoog, Z. I., Lopes, M., & Kochar, A. (2020). Virtual Learning During the COVID-19 Pandemic: a Disruptive Technology in Graduate Medical Education. *Journal of the American College of Cardiology*, *75*(20), 2635–2638.

Alrofouh, A. M., Lakulu, M. M., & Almaiah, M. A. (2019). A Systematic Review Of Mobile-Based Assessment Acceptance Studies From 2009 To 2019. *Journal of Theoretical and Applied Information Technology*, *97*(20), 2530–2553.

Amez, S., & Baert, S. (2020). Smartphone use and academic performance: A literature review. *International Journal of Educational Research*, *103*(February), 1–8. https://doi.org/10.1016/j.ijer.2020.101618

Andrey Zakharov, Martin Carnoy, P. L. (2013). Which Teaching Practices Improve Student Performance On High- Stakes Exams? Evidence From Russia Basic Research Program. In *Basic Research Program Working Paper Series: Education*.

Anix, E. N., & Fauziyah, F. (2018). Implementasi Performance Based Assessment dalam Pembelajaran Ekonomi. *Oikos: Jurnal Kajian Pendidikan Ekonomi Dan Ilmu Ekonomi*, *II*(1), 57–71.

Apriani, E., Kuswanto, H., Sujati, K. I., & Dewi, N. P. (2020). Students' Perspectives Toward ICT Literacy in The Implementation Freedom to Learn. *The Eight International Conference on Educational Research and Innovation ICERI 2020*, 40.

Bal, S., & Gupta, M. (2020). Technology and E-Learning in Higher Education Technology and E-Learning in Higher Education. *International Journal of Advanced Science and Technology*, *29*(4), 1320–1325.

Bulman, G., & Fairlie, R. W. (2016). *Technology and Education: Computers, Software, and the Internet*.

Chien, S., & Wu, H. (2020). Examining influences of science teachers' practices and beliefs about technology-based assessment on students' performances: A hierarchical linear modeling approach. *Computers & Education*, *157*(July), 103986. https://doi.org/10.1016/j.compedu.2020.103986

Comi, S. L., Argentin, G., Gui, M., Origo, F., & Pagani, L. (2017). Is it the way they use it ? Teachers , ICT and student achievement. *Economics of Education Review*, *56*, 24–39. https://doi.org/10.1016/j.econedurev.2016.11.007

Dhawan, S. (2020). Online Learning : A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems*, *0*(0), 1–18. https://doi.org/10.1177/0047239520934018

Eichmann, B., Goldhammer, F., Greiff, S., & Pucite, L. (2019). The role of planning in complex problem solving. *Computers & Education*, *128*(January), 1–12. https://doi.org/10.1016/j.compedu.2018.08.004

Escueta, M., Quan, V., Nickow, A. J., & Oreopoulos, P. (2021). EDUCATION

TECHNOLOGY: AN EVIDENCE-BASED REVIEW. *National Bureau of Economic Research*, *17*(1), 82–99.

Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency Situations. *Societies*, *10*(86), 1–18.

Honggonegoro, T., & Nuryanto, A. (2020). Readiness of Literacy and Character of Vocational School in Facing The Policy of Freedom to Learn. *The Eight International Conference on Educational Research and Innovation ICERI 2020*, 115.

Irene, S., Dwiningrum, A., & Alwi, A. C. (2020). An Effective MOOC Model to Support Freedom to Learn Program. *The Eight International Conference on Educational Research and Innovation ICERI 2020*, 102.

Izci, K., & Siegel, M. (2015). Making a New High School Chemistry Teacher ' s Struggles with Classroom Assessment Visible. *The 2015 Annual Meeting of the National Association of Research in Science Teaching, Chicago, IL., September*, 1–24.

Kyriazi, T. (2015). Using technology to introduce frequent assessments for effective learning : Registering student perceptions. *Procedia - Social and Behavioral Sciences*, *197*(February), 570–576. https://doi.org/10.1016/j.sbspro.2015.07.195

Leontyeva, I. A. (2018). Modern Distance Learning Technologies in Higher Education : Introduction Problems. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(10), 1–8.

Lile, R., & Bran, C. (2014). The Assessment of Learning Outcomes. *Procedia - Social and Behavioral Sciences*, *163*, 125–131. https://doi.org/10.1016/j.sbspro.2014.12.297

Ma, Y., Fairlie, R., Loyalka, P., & Rozelle, S. (2020). Isolating The "Tech" From Edtech: Experimental Evidence On Computer Assisted Learning in China. *Stanford Institute for Economic Policy Research (SIEPR)*, *20*(009), 1–51.

Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID -19 pandemic. *Social Sciences & Humanities Open*, *3*(1), 1–11. https://doi.org/10.1016/j.ssaho.2020.100101

Pokhrel, S., & Chhetri, R. (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the Future*, *8*(1), 133–141. https://doi.org/10.1177/2347631120983481

Puscas, M. (2015). Teacher Assessment: The Gap Between Formal Regulations , Organizational Objectives And Students' Expectations. *Procedia - Social and Behavioral Sciences*, *197*(February), 354–360. https://doi.org/10.1016/j.sbspro.2015.07.149

Putri, A. N., & Suparmi. (2020). Efektivitas Pembelajaran Daring Program Studi Pendidikan Ekonomi. *EcoGen*, *3*(4), 627–634.

Santos, S., Pereira, C., & Assunção, M. (2016). Online Peer Assessment : Method and Digital Technologies. *Procedia - Social and Behavioral Sciences*, *228*(June), 418–423. https://doi.org/10.1016/j.sbspro.2016.07.064

Satuti, J. R., Sunaryanto, & Nuris, D. M. (2020). Does Student Satisfaction Mediate the Correlation between E-Learning Service Quality, Academic Engagement and Academic Achievement? *Journal of Accounting and Business Education*

(JABE), *5*(1), 38–53.

Sung, Y., Chang, K., & Liu, T. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education*, *94*, 252–275. https://doi.org/10.1016/j.compedu.2015.11.008

Wei, X., Saab, N., & Admiraal, W. (2021). Assessment of cognitive, behavioral, and affective learning outcomes in massive open online courses: A systematic literature review. *Computers & Education*, *163*(March 2020), 1–24. https://doi.org/10.1016/j.compedu.2020.104097