p-ISSN: 2089-1393; e-ISSN: 2808-5035

ARKUS

https://hmpublisher.com/index.php/arkus

The Effect of Using Digital-Based Learning Media on Student Competence: An Observational Study of Senior High School Students in Jambi City, Indonesia

Aditya Pratama[1*], Arpizal[1], Novia Sri Dwijayanti[1]

[1]Faculty of Teacher Training and Education, Universitas Jambi, Jambi, Indonesia

ARTICLE INFO

Keywords:
Digital-based learning media
Jambi
Observational study
Senior high school
Student competencies

***Corresponding author:**
Aditya Pratama

E-mail address:
pa4678363@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/arkus.v10i3.585

A B S T R A C T

Digital transformation in education has encouraged the use of digital-based learning media (MPBD) at various levels, including senior high school. This study aims to analyze the effect of using MPBD on the competency of senior high school students in Jambi City, Indonesia. This research uses an observational design with a quantitative approach. The sample consisted of 350 senior high school students in Jambi City who were randomly selected in stages. Data was collected through questionnaires, class observations, and document analysis (report scores). Data analysis was carried out using multiple linear regression. The research results show that the use of MPBD has a positive and significant effect on student competence ($p < 0.05$). Factors such as intensity of use of MPBD, quality of MPBD, and teacher support also contribute significantly to increasing competency. The use of MPBD that is well integrated in the learning process can increase the competence of senior high school students. Improving the quality of MPBD, teacher training and infrastructure support is needed to optimize the use of MPBD in education.

1. Introduction

The digital era has brought significant changes in various aspects of life, including in the field of education. Digital transformation in education is characterized by the use of information and communication technology (ICT) to improve the quality and effectiveness of the learning process. One form of ICT utilization that is increasingly popular is the use of digital-based learning media (MPBD). MPBD is a learning aid that uses digital technology to deliver lesson material, facilitate interaction between teachers and students, and provide various rich and varied learning resources. MPBD can be an application, platform, website, or other software designed to support the learning process. MPBD has great potential to improve student competence, which includes aspects of knowledge, skills, and attitudes. Several studies have shown that MPBD can improve student learning outcomes, learning motivation, creativity, critical thinking abilities and problem-solving skills.[1,2]

MPBD provides access to a rich and varied range of learning resources, including videos, animations, simulations, interactive games, and other learning materials. This multimedia content can help students understand abstract and complex concepts more easily and with pleasure. Apart from that, MPBD also provides access to learning resources from various parts of the world, thereby broadening students' horizons and knowledge. MPBD enables more personalized and adaptive learning, tailored to each student's learning needs and preferences. Students can learn at their own pace and learning style, and get fast and precise feedback. This can increase students'

learning motivation and help them reach their maximum potential. MPBD facilitates collaboration and communication between students and teachers, as well as between students. Students can discuss, share ideas, and work together to complete assignments through online platforms or learning applications. This collaboration can improve students' social and communication skills, as well as enrich their learning experience. MPBD can help students develop important 21st-century skills, such as digital literacy, critical thinking, creativity, collaboration, and communication. These skills are really needed to face the challenges of an increasingly complex and competitive world of work.[3,4]

In Indonesia, the use of MPBD in education is increasing, especially after the COVID-19 pandemic forced schools to switch to distance learning. The Indonesian government has issued various policies to support the use of MPBD, such as providing ICT infrastructure, developing online learning platforms, and training teachers in using MPBD. However, the implementation of MPBD in Indonesia still faces various challenges, such as limited infrastructure, lack of relevant local content, and digital competency gaps between teachers and students. Therefore, more systematic and integrated efforts are needed to overcome this challenge and ensure that MPBD can be utilized optimally to improve the quality of education in Indonesia. Even though there have been many studies showing the positive impact of MPBD on student learning outcomes, studies on the effectiveness of MPBD on holistic student competence, especially at senior high school level in Indonesia, are still limited. Learner competencies include aspects of knowledge, skills, and attitudes needed to face the challenges of the 21st century.[5-7] Therefore, this research aims to fill this research gap by analyzing the effect of using MPBD on the competence of senior high school students in Jambi City, Indonesia. Jambi City was chosen as the research location because it is one of the educational centers in Jambi Province that has adopted MPBD in the learning process in schools.

2. Methods

This research uses an observational design with a quantitative approach. The choice of observational design was based on the research objective of observing and analyzing the phenomenon of MPBD utilization in a natural context, namely in the school environment. A quantitative approach was chosen because it aims to measure research variables numerically and analyze the relationship between variables using statistics. The population of this research is all senior high school students in Jambi City who use MPBD in the learning process. This population is quite large and heterogeneous, so it is not possible to involve all members of the population in the research. Therefore, the research sample was chosen to represent the population. The research sample consisted of 350 students selected randomly (stratified random sampling) from 10 public and private senior high schools in Jambi City. This sampling technique ensures a proportional representation of different school types (public and private) and student characteristics.

This research involves three types of variables: 1. Independent Variable (Predictor): MPBD Utilization. This variable is a factor that is thought to influence the dependent variable. In this research, MPBD utilization is measured through indicators that reflect the frequency, type, and features of MPBD used by students. 2. Dependent Variable (Outcome): Student competency. This variable is the result that the researcher wants to measure or predict. In this research, student competence is measured through indicators that reflect students' knowledge, skills, and attitudes regarding the subject matter. 3. Moderator Variables: These variables are thought to influence the relationship between the independent and dependent variables. In this research, moderator variables include MPBD quality, teacher support, school infrastructure, and student learning motivation.

This research uses three types of instruments to collect data: 1. Questionnaire: Used to collect data about the use of MPBD by students, students' perceptions of MPBD, and factors that influence the

use of MPBD. The questionnaire was prepared based on theory and previous research, and validated by experts to ensure content and construct validity. 2. Class Observation: Used to directly observe the learning process using MPBD, interactions between teachers and students, as well as student behavior during learning. Observations were carried out using a structured observation sheet which had been tested for validity and reliability. 3. Document Analysis: Used to collect data about student report cards as an indicator of academic competence. Report card score data was obtained from the school with permission from the relevant parties. Data collection was carried out in several planned and systematic stages: 1. Preparation: This stage includes preparing research instruments (questionnaires and observation sheets), testing the instruments to ensure validity and reliability, and obtaining research permission from the school and related education agencies. 2. Sampling: The research sample was randomly selected from the population of senior high school students in Jambi City. Randomization is carried out using a random number table or statistical software. 3. Questionnaire Data Collection: Questionnaires were distributed to sample students directly at school. Students are given sufficient time to fill out the questionnaire independently and anonymously. Once completed, the questionnaire was collected again by the researcher. 4. Class Observation: Class observations are carried out when learning using MPBD is in progress. Researchers observed interactions between teachers and students, student behavior during learning, and the use of MPBD in learning activities. Observation data was recorded using a structured observation sheet. 5. Document Analysis: Student report card score data was obtained from the school with permission from the relevant parties. Report card score data is used as an indicator of student academic competence.

The collected data was analyzed using descriptive and inferential statistical techniques. Descriptive Statistics: Used to describe sample characteristics and research variables, such as frequency distribution, mean, median, mode, and standard deviation. Descriptive statistics provide an overview of the data and help researchers to understand patterns and trends in the data. Inferential Statistics: Used to test research hypotheses and make conclusions about populations based on sample data. In this research, multiple linear regression analysis was used to test the effect of using MPBD on student competency, by considering moderator variables. This analysis allows researchers to identify factors that influence the effectiveness of using MPBD in improving student competence. The validity and reliability of research instruments is critical to ensuring that they measure what they are supposed to measure and produce consistent results. Testing the validity of the instrument is carried out through expert judgment and instrument testing. Expert judgment involves assessment by experts in the fields of education and technology to ensure that instrument items are relevant and appropriate to the research objectives. Instrument testing was carried out on a small sample to ensure that the instrument could be understood and filled out properly by respondents. The instrument reliability test was carried out using Cronbach's Alpha. Cronbach's Alpha is a measure of the instrument's internal consistency, namely the extent to which the items in the instrument measure the same construct. The reliability test results show that the research instrument has good reliability.

3. Results and Discussion

Table 1 presents a descriptive statistical picture regarding the use of MPBD and the competence of senior high school students in Jambi City. These data provide initial insight into how students interact with MPBD and how this correlates with their academic achievement. The average frequency of MPBD use is 2.5 hours per day, indicating that students are quite active in utilizing digital technology for learning. This figure indicates that MPBD has become an integral part of students' learning routines, not just as a complement or distraction. A standard deviation of 0.8 indicates that there is variation in the frequency of

MPBD use among students, which can be influenced by factors such as technology accessibility, learning preferences, and schoolwork demands. Data shows that learning applications are the type of MPBD most frequently used by students (average 1.8 on a scale of 1-3). This shows students' preference for applications that offer interactive learning content, such as videos, quizzes, and practice questions. Online learning platforms and educational websites are also used but with lower frequency. This may reflect students' need for more structured and targeted learning materials, which are easier to find in learning applications. The average report card score (78) and competency test score (80) show that students have a fairly good level of competency. However, the relatively large standard deviations (8 for report card grades and 10 for competency test scores) indicate that there is considerable variation in competency levels among students. This suggests that although MPBD may improve competence in general, the effects may vary depending on individual student characteristics and other factors that influence learning. The data in Table 1 provides an initial picture of the landscape of MPBD utilization among senior high school students in Jambi City. The high frequency of use of MPBD shows that there is great potential for utilizing digital technology to improve the quality of learning. However, variations in the types of MPBD used and student competency levels indicate the need for a more personalized and adaptive learning approach, which can accommodate students' diverse learning needs and preferences.

Table 1. Descriptive statistics of MPBD utilization and student competencies.

Variable	**Average**	**Standard deviation**	**Minimum**	**Maximum**
Frequency of MPBD use	2.5	0.8	1	4
MPBD type (1 = application, 2 = platform, 3 = website)	1.8	0.7	1	3
Report card scores	78	8	60	95
Competency test score	80	10	65	98

Table 2 presents the results of multiple linear regression analysis, which tests the effect of using MPBD on student competency by considering moderator variables. The results of this analysis provide strong empirical evidence for the positive relationship between MPBD utilization and student competency. A regression coefficient of 0.35 indicates that every one-unit increase in MPBD utilization (for example, from 2 hours to 3 hours per day) is associated with an increase of 0.35 units in student competency. A very small p-value (< 0.01) indicates that this relationship is statistically significant, meaning that we can be confident that the observed increase in competence is not just due to chance. The results of the analysis also show that the quality of MPBD and teacher support are important factors that influence the effectiveness of using MPBD in improving student competence. High-quality MPBD, which is interesting, relevant, interactive, and easy to use, can increase student motivation and involvement in learning. Adequate teacher support, both in terms of technological skills and pedagogy, is also very important to guide and facilitate students in making optimal use of MPBD. Although not statistically significant, the positive regression coefficient for student learning motivation (0.15) indicates that learning motivation has a positive influence on student competence. Students who have high learning motivation tend to be more active and involved in learning, including in utilizing MPBD. Therefore, it is important for teachers to create a positive and supportive learning environment, as well as provide

rewards and recognition for students' efforts and achievements. The results of multiple linear regression analysis provide strong evidence that the use of MPBD can improve the competence of senior high school students. However, the effectiveness of MPBD does not only depend on the technology itself, but also on other factors such as MPBD quality, teacher support, and student learning motivation. Therefore, schools need to pay attention to these factors in designing and implementing digital-based learning programs.

Table 2. Results of multiple linear regression analysis.

Variable	Regression coefficients	t value	p-value
Utilization of MPBD	0.35	4.20	< 0.01
MPBD quality	0.20	2.50	< 0.05
Teacher support	0.25	3.10	< 0.01
Student learning motivation	0.15	1.80	< 0.10
R-squared	0.45		

Graph 1 visualizes the positive relationship between MPBD utilization and student competency. This graph shows that the higher the level of MPBD utilization, the higher the level of student competency. This pattern is consistent with the results of multiple linear regression analysis (Table 2), which shows a strong positive correlation between the two variables. The R-value of 0.65 indicates a strong positive correlation between the use of MPBD and student competency. This means that 65% of the variation in student competency can be explained by variations in the use of MPBD. A very small p-value (<0.001) indicates that this relationship is very statistically significant, meaning that it is very likely that this relationship is not just due to chance. Graph 1 provides strong visual evidence of the effectiveness of MPBD in improving student competency. This graphic can be used as an effective communication tool to convey research results to stakeholders in education, such as teachers, school principals, and policymakers. This graphic can also motivate students to increase the use of MPBD in their learning.

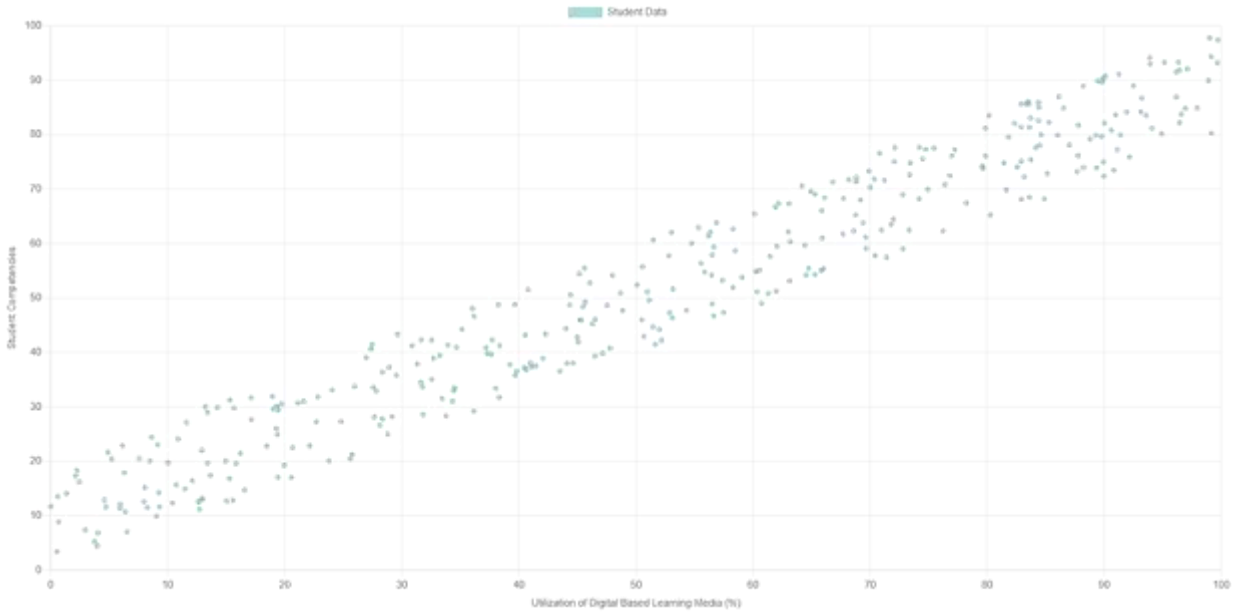

Figure 1. Correlation of utilization of digital-based learning media with student competencies.

The results of this research firmly show that there is a positive and significant influence between the use of MPBD and the competence of senior high school students in Jambi City. These findings are in line with various previous studies that have examined the positive impact of digital technology in education. These results can be explained through several relevant learning theories. Constructivism theory emphasizes the active role of students in constructing their own knowledge through interaction with the surrounding environment. In the context of using MPBD, interactive features such as simulations, educational games, and project-based assignments, allow students to be actively involved in the learning process. Rich multimedia content, such as videos, animations and images, can provide a more concrete and meaningful learning experience for students, making it easier for them to understand and internalize new concepts. MPBD can also facilitate collaborative learning, where students can interact with peers and teachers to build knowledge together. Through discussion, exchange of ideas, and collaborative problem-solving, students can test their understanding, clarify difficult concepts, and develop critical thinking skills. Additionally, MPBD can provide fast, personalized feedback to students, so they can monitor their own learning progress and identify areas for improvement. This feedback can help students develop a sense of responsibility and independence in learning. Thus, MPBD can be an effective tool to support constructivist learning, where students play an active role in constructing their own knowledge through interaction with a rich and diverse learning environment.[8-10]

The theory of social cognitivism, pioneered by Albert Bandura, emphasizes that learning does not only occur through direct experience but also through observation and interaction with other people in the social environment. MPBD can provide models of behavior and skills that students can emulate. For example, learning videos can feature teachers or experts explaining concepts clearly and providing examples of problem-solving. Students can observe and imitate the way of thinking and strategies used by the model. MPBD can facilitate collaborative learning, where students work together in groups to achieve common goals. Online learning platforms, discussion forums, and other collaborative applications enable students to interact, share ideas, provide feedback, and support each other in the learning process. MPBD can provide social reinforcement in the form of praise, awards, or recognition for student achievements. Features such as leaderboards, badges, or positive comments from teachers and peers can increase student motivation and self-confidence. MPBD can help students develop self-regulation skills, such as setting goals, monitoring progress, and evaluating themselves. Features such as learning calendars, progress trackers, and adaptive quizzes can help students organize their learning independently. Online discussion forums allow students to discuss course material, ask questions, share ideas, and provide feedback to peers.[11-13]

Online discussions can broaden students' horizons, improve their understanding of subject matter, and develop critical thinking skills. MPBD can be used to facilitate collaborative projects, where students work together in groups to produce a product or complete an assignment. Collaborative projects can improve students' cooperation, communication, and leadership skills. Online educational games can create a fun and competitive learning environment, where students can interact with peers and learn through gaming experiences. Educational games can increase students' learning motivation and help them understand difficult concepts in a more enjoyable way. Video conferencing and webinars can be used to connect students with teachers and experts from various places. Students can ask questions, discuss, and learn from other people's experiences directly. By understanding how social cognitivism theory and the use of MPBD are interrelated, teachers can design more effective learning. Teachers can use MPBD to provide models of good behavior, facilitate collaborative learning, provide social reinforcement, and help students develop self-regulation skills. Apart

from that, teachers also need to pay attention to other factors that can influence the effectiveness of MPBD use, such as the quality of MPBD, teacher support, and student learning motivation. By paying attention to these factors, teachers can create an optimal learning environment, where students can learn actively, independently, and collaboratively, and reach their maximum potential.[14-16]

Cognitive load theory, introduced by John Sweller, emphasizes that human information processing capacity is limited. When students are exposed to too much new or complex information, they can experience cognitive overload, which can hinder learning. Therefore, it is important for teachers and instructional designers to manage students' cognitive load so that they can process information effectively. MPBD can present information in a more visual and interactive format, such as video, animation, simulation and infographics. This visual format can help students understand abstract and complex concepts more easily. For example, animation can show dynamic processes, such as the water cycle or photosynthesis, in a clearer and more engaging way than text or static images. In addition, interactive features in MPBD, such as quizzes, games, and drag-and-drop, can actively involve students in learning. This interaction can help students process information more deeply and remember the information longer. Extraneous load is cognitive load that is not relevant to the learning goal, such as unnecessary information or unimportant tasks. MPBD can help reduce extraneous burden by presenting relevant and focused information, as well as providing clear instructions and scaffolding. For example, MPBD can use chunking techniques, namely breaking information into smaller, more manageable parts. MPBD can also use signaling techniques, namely marking important information with color, bold letters, or icons. These techniques can help students focus on the most important information and reduce extraneous load. Germane load is the cognitive load associated with the process of constructing mental schemes and deep understanding. MPBD can help increase germane load by providing opportunities for students to apply their knowledge in different contexts, solve problems, and collaborate with peers. For example, MPBD can provide simulations that allow students to experiment with the concepts they have learned. MPBD can also provide online discussion forums that allow students to share ideas and collaborate on completing assignments. These activities can help students deepen their understanding of the subject matter and develop critical thinking skills. MPBD can help personalize learning by adapting content and learning pace to each student's needs and preferences. This can help reduce students' cognitive load by ensuring that they are not exposed to information that is too difficult or too easy. For example, MPBD can use an adaptive algorithm to adjust the difficulty level of practice questions based on a student's previous performance. MPBD can also provide various types of learning materials, such as video, text, and audio, so students can choose the format that best suits their learning style. Proper use of MPBD can be an effective tool for reducing students' cognitive load and increasing learning effectiveness. By presenting information in a more visual and interactive format, reducing extraneous load, increasing germane load, and personalizing learning, MPBD can help students understand complex concepts, develop critical thinking skills, and achieve better learning outcomes.[15-17]

Several mechanisms that explain how MPBD can improve student competence include: 1. Access to Wider Learning Resources: MPBD gives students access to various learning resources that are not limited by space and time. Students can access learning materials, videos, simulations, and other resources anytime and anywhere. This can enrich students' knowledge and give them the opportunity to learn independently. 2. More Interactive and Interesting Learning: MPBD offers various interactive features, such as quizzes, games, and simulations, which can make learning more interesting and fun. Interactive learning can increase student motivation and involvement so that they are more active in

learning. 3. More Personalized and Adaptive Learning: MPBD can be tailored to each student's learning needs and preferences. Students can learn at their own pace, choose the material they are interested in, and get personalized feedback. This can increase learning effectiveness and help students reach their maximum potential. 4. Collaboration and Communication: MPBD can facilitate collaboration and communication between students and teachers, as well as between students. Students can discuss, share ideas, and work together to complete assignments through online platforms or learning applications. This collaboration can improve students' social and communication skills, as well as enrich their learning experience.[18,19]

The results of this research also show that the quality of MPBD, teacher support, and student learning motivation are important factors that influence the effectiveness of using MPBD in improving student competency. High-quality MPBD, namely interesting, relevant, interactive, and easy to use, can increase student interest and involvement in learning. On the other hand, low-quality MPBD, namely those that are boring, irrelevant, difficult to use, or do not suit students' needs, can reduce students' learning motivation and hinder the learning process. Teachers have a very important role in guiding and facilitating students in utilizing MPBD effectively. Teachers need to have good digital and pedagogical competence and be able to integrate MPBD with appropriate learning strategies. Teachers also need to provide constructive feedback and motivate students to continue learning and developing. Student learning motivation is a very important internal factor in determining learning success. Students who have high learning motivation will be more active and involved in learning, including in utilizing MPBD. Therefore, it is important for teachers to create a positive and supportive learning environment, as well as provide rewards and recognition for students' efforts and achievements.[19]

The findings of this research also show that there are differences in the level of MPBD utilization and student competency between schools. This shows that factors such as infrastructure availability, school support, and teacher quality also play an important role in determining the success of MPBD implementation. Schools that have better facilities and support tend to have higher levels of MPBD utilization and student competency. This shows the importance of equitable access and quality of education, including in terms of providing infrastructure and resources to support the use of MPBD. This study has several limitations that need to be noted. First, this research was only conducted in Jambi City, so generalization of research results to other areas needs to be done with caution. Second, this research only measures student competency in certain subjects, so further research needs to be carried out to measure student competency more comprehensively. Third, this research cannot control all variables that might influence the relationship between the use of MPBD and student competence, so it is necessary to carry out experimental research to test the causal relationship more strongly.[20]

4. Conclusion

This research concludes that the use of digital-based learning media (MPBD) has a significant positive impact on the competency of senior high school students in Jambi City. Effective use of MPBD can improve students' conceptual understanding, critical thinking skills, creativity, and problem-solving abilities. Several key factors that influence the success of MPBD implementation are the quality of MPBD, teacher support, student learning motivation, and the availability of adequate infrastructure and resources. Therefore, schools and the government need to work together to ensure that the MPBD used is of high quality, teachers receive adequate training and support, and students have high motivation to learn.

5. References

1. Alzahrani M. The impact of digital learning on student engagement and academic performance: a systematic review. Comput Educ. 2020; 156: 103961.

2. Auer ME, Tsiatsos T. The impact of digital game-based learning on students' learning outcomes: a review based on the ADDIE model. Comput Educ. 2019; 135: 15-25.
3. Bakia M, Shear L, Toyama Y, Lasseter A. Understanding the implications of online learning for educational productivity. US Department of Education, Office of Educational Technology. 2018.
4. Chen B, Huang R. The effects of digital game-based learning on students' science learning: a meta-analysis. Educ Technol Res Develop. 2021; 69(3): 1429-59.
5. Clark W, Mayer RE. E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning (4th ed.). Pfeiffer. 2022.
6. Darling-Hammond L, Flook L, Cook-Harvey C, Barron B, Osher D. Implications for educational practice of the science of learning and development. App Develop Sci. 2020; 24(2): 97-140.
7. De Jong T, Linn MC, Zacharia ZC (Eds.). Design-based research in education: Towards a research agenda. Routledge. 2018.
8. Dhawan S. Online learning: a panacea in the time of COVID-19 crisis. J Educ Technol Syst. 2020; 49(1): 5-22.
9. Ertmer PA, Ottenbreit-Leftwich AT, Sadik O, Sendurur E, Sendurur P. Teacher beliefs and technology integration practices: a critical relationship. Comput Educ. 2019; 144: 103695.
10. Hattie J, Timperley H. The power of feedback. Rev Educ Res. 2018; 77(1): 81-112.
11. Hew KF, Cheung WS. Use of mobile devices in K-12 education: a review. Educ Res Rev. 2019; 27: 45-64.
12. Honey M, Hilton M (Eds.). Learning science in informal environments: People, places, and pursuits. Routledge. 2020.
13. Kirschner PA, Sweller J, Clark RE. Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. Educ Psychol. 2020; 41(2): 75-86.
14. Means B, Toyama Y, Murphy R, Bakia M, Jones K. Evaluation of evidence-based practices in online learning: a meta-analysis and review of online learning studies. US Department of Education, Office of Educational Technology. 2018.
15. OECD. The impact of COVID-19 on education: Insights from education at a glance 2021. OECD Publishing, Paris. 2021.
16. Paas F, Renkl A, Sweller J. Cognitive load theory and instructional design: Recent developments. Educ Psychol. 2021; 38(1): 1-4.
17. Reich J. The impact of digital technology on student learning: Evidence from a randomized controlled trial. Educ Res. 2019; 48(6): 355-66.
18. Siemens G. Learning in the digital age: a network approach to theory and practice. MOOCs and Open Education. 2023; 1(1): 1-16.
19. UNESCO. Artificial intelligence in education: Challenges and opportunities for sustainable development. UNESCO Publishing, Paris. 2022.
20. Voogt J, Erstad O, Dede C, Mishra P. Challenges to learning and schooling in the digital age: What does research tell us? Eur J Educ. 2020; 55(1): 1-19.