

Improvement of Student Learning Motivation through Word-Wall-based Digital Game Media

<https://doi.org/10.3991/ijim.v16i06.25729>

Desy Safitri¹(✉), Suci Awalia¹, Tunjungsari Sekaringtyas¹, Sri Nuraini¹, Ika Lestari¹,
Yustia Suntari¹, Arita Marini¹, Rossi Iskandar², Ajat Sudrajat³

¹Universitas Negeri Jakarta, Jakarta, Indonesia

²Universitas Trilogi, Jakarta, Indonesia

³Universitas Terbuka, Tangerang Selatan, Indonesia
desysafitri@unj.ac.id

Abstract—The development of technology influences education. Digital-based learning media, one of which is digital games make learning fun. It is also known that digital games themselves positively influence increasing student motivation in the learning process. For this reason, the target of this study is to validate the effectiveness of digital game-based media in increasing motivation to learn science. The population group consisted of 129 students from Cluster I, North Sukabumi Village schools. Research sampling was carried out by simple random sampling to calculate the number of samples. The Slovin formula was used, which resulted in 98 students as the sample. This study used experimental research methods with a single group pretest-posttest, as for the instrument in a questionnaire using a Likert scale. The type of data analysis used in this research is an inferential analysis using a t-test. This study indicates that digital game media positively influences students' learning motivation. The literature review comprises 40 studies. This study also shows that students experience increased learning motivation using this digital game media. Because with this digital game media, students become more motivated to follow and understand the learning material being taught.

Keywords—digital game, learning motivation, word-wall

1 Introduction

The role of Information and Communication Technology (ICT) in education vigorously sustain the visibility of notional outlook. It can accelerate the learning system or penetrating of the information trained by the teacher and allows favorable inter-relationship between teachers and students in the learning classroom. The use of ICT can accelerate access to education services throughout the world. Educational technology is a breakthrough utilizing ICT development to facilitate teaching and learning. However, the challenges in education today are access to education in suburban areas and technological developments having to be balanced with skills and abilities. The school digitization program will be supported and increased by increasing teacher

competence, especially in ICT mastery. This is because teachers are critical to the success of the school's digitalization program to accelerate the creation of superior human resources.

Various research related to educational technology has been conducted in recent years. ICT use in the last few years in developed countries has been increasing, especially in education [1]. Various technologies have been successfully developed to increase efficiency and effectiveness in teaching. The function of ICT in teaching powerfully carries the perceiving of suppositional ideas thought, can aid the instruction practice or mastering the subject matter drilled by the instructor, and allows enthusiastic interdependence between teachers and learners in doing lessons. Over the last two decades, many explorations have analyzed the interconnection between ICT use and didactic aftermath [2]. ICT executes enormous values and merits in bracing a notable excellence of the intellectual system. Students can retrieve all knowledge or matter apprehension supplied through the newest technological equipments. Another study indicates teachers' attitudes toward teaching innovation and the direct use of those current teaching techniques to gain knowledge of process [3]. Powerful coaching ICT usage encourages college students to domesticate their superb attitudes closer to the subject. The strong points of making use of ICT in order to shore up the fulfillment of academic work can improve the quality of learning, expand entry to education and learning, be of service to evoke notional conception, promote acquaintance with the things being studied, display learning materials to be more stimulating, and allow reciprocity between studying and items being studied. If you notice to the service of finding a use for ICT, of course, the operation of ICT in schooling and the circumstances cannot be avoided. Schools must constantly make an effort to reach the requirement of these ICT provision.

Educators have needed to adapt to online coaching strategies in any respect education tiers and unexpectedly adapt and circulate coaching content material and substances to the new brand online area to ensure that scholars can preserve what they are getting to know throughout the pandemic [4]. In addition, each instructor and college student needed to discover ways to employ the numerous varieties of online software programs utilized in distance education. One of the terrible effects of the pandemic is that many students had been pressured to preserve their training online from domestic following the bodily closure of school and face-to-face lessons [5]. Due to the pandemic, the transition from face-to-face to online training has added virtual inequality to the fore for economically deprived students. Implementing an innovative teaching method equipped with a mobile learning environment influences the student learning outcomes [6–8]. Smart mobile equipment with the mobile application can assist the students in comprehending numbers. Technology can provide convenience in finding information in various forms. This certainly makes it easier for students to obtain various information. New grounds for constructing agree with and self-assurance in technology are needed [9]. For this reason, educators are now required to be able to involve technology in every learning process. With the hope, the involvement of this technology in the learning process can be more interesting so that later it can increase the motivation of students in participating in the learning process.

New generation students are closely related to the digital era and always use Information and Communication Technology (ICT) in their day by day viability [10]. One of the technologies that can be developed in education is digital-based technology. With

this technology, we can create learning to be more interesting. For students who have been used to playing games since they were young, learning through games can be more fun [11]. Reasonably, it is mandatory to invent a game that is fun and educational for the teaching and learning process by utilizing technology, namely a digital game. Innovation in online learning continues to be carried out to create effectiveness in learning. Website games can be word preparation, word search, word matching, crossword puzzles. The available features are easy to access and easy to play. There is also a time that shows the duration we play the game. Students can access this game without registering first. This educational game website is exciting, with a colorful and pleasant appearance.

Some educators may consider digital game-based learning to attract students' attention, especially those who like to play games and make them interested in learning [12]. Students can learn while playing games anywhere and anytime with only a smartphone with this digital game. In addition, the learning process will be fun because it is interspersed with games in it. Digital games can build students' confidence when they do well; it also teaches students that their success depends on the effort they put into the game [13]. Game designs are also created as attractive as possible not to get bored quickly and still feel interested in playing the game. Besides being attractive, the activities in the game must also be able to stimulate students to transfer the knowledge they understand in their daily lives.

For digital game development, researchers use the word-wall.net website. Word-wall is a website that makes it easy to create learning based on mini-games. Allowing teachers to design interactive games and printed materials for their students, teachers straightforwardly gain access to the content they desire, and the word-wall will automate the rest. The Word-wall website also has many exciting features and games, making it easier for users to develop them according to their learning needs. For example, for science learning, various games can be made in which there are several materials and questions related to the science material. So that later science learning will be more enjoyable.

Other research has shown that science achievement is uniquely linked to developing a broader approach to learning skills that can benefit students across all fields of study [14]. Because of the importance of scientific achievement for learning skills, it is necessary to have an academic motivation in each student to participate in the learning process. Academic motivation refers to the stimulation needed to do assignments, to achieve goals, and of course, to get academic achievement as a result [15]. Thus, motivation is needed in learning in order to achieve learning objectives. Lack of motivation can cause individuals to give up on activity [16]. So, it is feared that this can lead to less than optimal learning. For this reason, researchers want to investigate further digital game-based learning to increase motivation to learn science in elementary schools.

Several previous studies that have examined digital games as learning media turn out to give a positive response. Games are proven to increase students' motivation and learning goals and increase students' desire to develop their understanding [17–18]. For this reason, researchers want to develop word-wall-based digital game media in science subjects in elementary schools in order to increase students' learning motivation. However, previous studies have developed a word-wall-based digital game, so researchers need to develop these media to realize quality education in the digital era.

The shortcomings in the development of this media are limited development following the features provided on the website. However, the advantage in developing this media that the researcher wants to show is the ease of developing and accessing this media, so that this development research is expected to be a solution for teachers who want to create educational digital games in an easy, fast, and adaptable way to their needs. Therefore, the purpose of this research is to answer various problems, including:

- a) How to develop word-wall-based digital games to increase motivation to learn science in fourth-grade elementary school students?
- b) How can the influence of word-wall-based digital game media increase motivation to learn science in fourth-grade elementary school?
- c) Is there a significant difference between the average pretest and posttest scores of the use of word-wall-based digital game media on student motivation outcomes?

1.1 Digital game-based learning (DGBL)

In modern persistence, digital game-based learning has captivated much mindfulness among academics and has turned out to be a desired fact-finding concern [19]. This learning model is attractive because it is learner-centered learning which uses games to achieve learning objectives. This model is also considered capable of presenting an active and fun learning environment. Digital game-based learning is a learning model that takes advantage of games as a medium to convey and improve students' understanding of learning material. Many related surveys show that digital game-based learning positively determines learners' ambition and attitudes to study [20–21]. Now digital game-based learning is widely practiced by educators, especially elementary school educators, because the learning packaging is quite interesting, namely through digital games. Teachers can design material explanations through presentations that can involve students. Students can respond in short answers and give opinions through voting and answering quizzes on this website. The features provided on website games tend to be unique and anti-mainstream, so they are suitable as learning media. Digital Game-Based Learning (DGBL) is a complex pedagogic practice [22]. This learning model includes various games, subjects, school levels, and teaching. In addition, digital game-based learning is relevant to the maneuvering of particular games for learning that expect results but, in this model, also emphasizes other elements, such as metacognition and transfer of knowledge for students. So that in addition to the fun learning experience that students get, understanding and knowledge of the material also needs to be considered.

1.2 Games digital

Digital games have been found for a long time but have not been developed as educational media. The presence of games was initially not in line with education because it was considered to only harm students. Nevertheless, now, digital games can be a part of learning. This is supported because digital games have exciting storylines, clear goals, and tasks to be completed, making lecturing more heterogeneous and potentially increasing student interest in learning and constructiveness [23]. So it is not surprising why digital games are now widely used by educators in achieving educational goals.

Research appears that digital games have been plied by the whole of the age groups and can further the interests of students to be successful in collaboration, problem-solving, and innovativeness [24–26]. For this reason, educators need to collaborate with digital games with their teaching, given that the game is liked and in demand by students. Coupled with the Management of the suitable material in the game, it will make learning fun and meaningful.

In terms of digital game development, several platforms provide digital game development specifically for learning. In this study, researchers used the Word-wall.net platform. Word-wall is a website that can be accessed through a browser for free anytime and anywhere. Word-wall is designed to make it easier for teachers to create digital game-based learning media without coding. Word-wall also gives users the freedom to create games with learning materials that will be taught according to their needs. Various games can be used in word-wall, including Quiz, Match Up, Open the Box, Find the Match, Group Sort, Missing Word, Gameshow Quiz, Wordsearch, and many others. Therefore, the variety of games that can be made can be more diverse so that students will not quickly feel bored in playing the game.

The adeptness to give instructions about game-based learning technology in digital games has magnetized the consciousness of many investigators because of its advantages for young students, covering escalating their incitement and inflating their involvement in ingenious-based occurrences [27]. Because with digital games, students are presented with a new and fun learning atmosphere, and students are taken as if they were playing a game, even though it is part of learning. It also brings exciting new experiences for students. So it is not surprising that digital game media is used to increase students' learning motivation, especially elementary school students.

1.3 Learning motivation

Motivation is essential in learning. Motivation is something that encourages students to take part in a lesson. Motivation is hoped that good and meaningful learning outcomes will be realized with motivation. Teachers must yield more approving stimulus to students inside and outside the learning factors that provides products to students and strengthens the values in their teaching [28]. Motivation is fundamental in learning scheme for the reason that the presence of inducement encourages the morale of acquirements, and contrarily, the inadequacy of ambition will lessen the thoughts of academic work. The students will always remain motivated to follow a lesson and apply their knowledge in their daily lives.

Motivation does not come by itself, and motivation needs to be built within a person. Many factors cause students to have no motivation to learn, including the community environment, parents, infrastructure, and teachers who are less than optimal in teaching [29]. Motivation affects how much students will learn from a learning activity or how much students apply in capturing the information conferred to them. Students stirred up to become competent will resort to prominent cognitive abilities to learn the material to assimilate and capture it well. Student learning spur is the dominant component in the prosperity of student academic achievement. Teachers who are less than optimal in teaching here mean teachers who teach only with a one-way/ lecture model and do not

use interesting approaches, methods, and learning models. This can trigger a lack of student motivation which leads to their feeling of saturation in participating in learning so that in the end, the learning objectives themselves fail to be realized.

Based on the literature review above, it can be found that the purpose of this research is to share information with readers so that they can utilize and develop technology as an innovation in exciting and meaningful learning. The technology here develops digital games to increase student learning motivation, especially in science subjects.

2 Method

This experimentation was organized in 2021 at elementary schools at the North Sukabumi Village in West Jakarta in Indonesia.

2.1 Design of research

This research is incorporated in an experimental study that uses a pre-experiment one group pretest-posttest with the research design seen in Table 1. This arrangement demands one group left an initial test (pretest) before being handed treatment, after being offered, and then providing with a final test (posttest). The success of this study was controlled by contrasting the ends of the pretest and posttest. The initial stage in this research is to determine the sample, which then breaks it down into a one-class study. The following points is to present with a pretest to measure learning motivation before being given treatment using this digital game media. Furthermore, the sample was treated using digital game media. Then for the last stage, the sample was given a posttest to measure the results of student responses after using this digital game media.

Table 1. Word-wall-based digital game media research design

Pretest	Treatment	Post-Test
O ¹	X	O ²

Notes: O¹ = Pretest supplied before treatment; O² = Posttest provided after treatment; X = Treatment using digital game media.

2.2 Population and sample

The population is all fourth-grade students in the North Sukabumi regional cluster for the 2020/2021 academic year, with 129 people. A sampling of the research was carried out by simple random sampling, and to reach a decision of the sample size, the Slovin formula was used, which required 98 samples for this study.

2.3 Research instruments

The instrument used to collect information in data collection in this development research is a questionnaire test. This questionnaire test consists of questions related

to self-motivation with science subjects. The indicators are intrinsic motivation, self-efficacy, self-determination, and class motivation [30–31]. Respondents respond by choosing alternative answers that already exist. To determine the level of students' learning motivation towards digital games, pretest and posttest were used, which were given to fourth-grade elementary school students. Students filled out pretest questions before using digital games and filled out posttests after using digital games. The gathered data will then be examined using descriptive statistical calculations. The hypothesis test to be overseen is the t-test. The t-test is designed to test whether the average value of the pretest and the average value of the posttest has a significant difference.

2.4 Data analysis

The normality test was run on the pretest and posttest scores exercising the Kolmogorov Smirnov formula and was directed wielding the Asymp rule. Sig or p-value at 5% alpha significance level. If $p > 0.05$, then the data is normally distributed. Normality calculation using SPSS version 22.0. After the normality test was completed, the homogeneity test was then guided. To test the homogeneity of the statistical test of variance in the group distribution studied. The homogeneity test was administered on the pretest and posttest scores with the rules if the significance value being larger than 0.05 level of significance. The homogeneity test worked with the paired sample t-test is to find out whether there is a difference in the mean of the two samples (two groups) related. The homogeneity calculation was supervised with SPSS version 22.0.

Analyzing data treated in hypothesis testing in this study is the t-test. The t-test is determined to test the mean value of the pretest, and posttest scores have a significant difference. This operating procedure was accomplished applying SPSS 22.0. Clarification of the t-test results to discern the value of Sig. (2-tailed), then grouped with a significance level of 0.05. The data prerequisite are significant if the p-value is less than the 5% significance level. This test is carried out to find out whether in the treatment there is a significant difference or not.

2.5 Digital game design

Researchers will develop this digital game for science subjects with material on the plant body parts. This game is designed to resemble a quiz show game, where the student's task is to answer several quizzes/questions interspersed with games in it. The final result of this game product is in the form of a link that can later be shared by the teacher through online learning platforms, such as class group chat, google classroom, or google form. Students can also directly access the game through a browser without installing other additional applications.

2.6 Digital game development

Researchers will develop this digital game for science subjects with material on the plant body parts. This game is designed to resemble a quiz show game, where

the student's task is to answer several quizzes/questions interspersed with games in it. The final result of this game product is in the form of a link that can later be shared by the teacher through online learning platforms, such as class group chat, google classroom, or google form. Students can also directly access the game through a browser without installing other additional applications.

For the development stage of this game, you can directly access it at the address <https://word-wall.net/>. This website provides many facilities for educators to create educational games. The final product of this game is in the form of a link that will be shared with students, and then from that link, students can access games that have been developed previously.

Before starting to make games, researchers need to analyze the materials used later will be loaded in this game. After preparing the material, you can directly access the website <https://word-wall.net/>, then click the login tab. After logging in, click the create activity tab, you will be shown several game templates that can be used for free or paid. The game templates include Game Show Quiz, Match Up, Random Wheel, Group Sort, Open The Box, Find The Match, Random Cards, Matching Pairs, Missing Words, and many others.

In this game, the researcher chose the Game Show Quiz template. Then after choosing a game template, the researcher will be directed to the page for adding material which will later be contained in the game show quiz earlier. For questions that will be made can be in the form of text or depiction and the answers. In adding questions here, we are given the freedom to reach 100 questions.

After compiling the questions and answers, click done. Then, the game will automatically be created, and researchers will be presented directly to the game's home page. On this page, researchers can also regulate the game's provisions, such as time limits for answering quizzes, choices in answering quizzes such as X2 Score, 50:50, and Extra Time, and bonus rounds that can be changed according to the researcher's provisions.

After everything is set, the games are ready to publish and distribute to students. The game link will automatically be displayed and directly shared with students by clicking share.

3 Results and discussions

3.1 Digital game development result

The result of this game is in the form of a link that can be accessed on the following page <https://word-wall.net/play/14748/603/960>. Furthermore, the following are some descriptions related to the display of digital game media based on the word-wall website that researchers have developed:

Games that have been successfully developed will generate a link; students will use this link to access games that have been made previously. After clicking the link,

students will be directed to the login page and then asked to type each student's name. This is done so that researchers can monitor each student's work results. Figure 1 presents the game login page.



Fig. 1. The game login screen on the word-wall website

After students type their names and click Start, students will be directed to the games page. Each question will be given four answer choices, and students need to choose one correct answer among the four choices. After answering, students will know whether the answer is right or wrong. If the answer is wrong, the correct answer will automatically be displayed. It aims to provide opportunities for students to construct their knowledge of the problem.

There is a menu of options on the game page in the lower-left corner. The contents of the menu are Start Again and Resume. At the same time, the game instructions automatically appear to provide directions on how to play the game. Furthermore, regarding game design, this game is designed to resemble a game show quiz. To make it feel like a real quiz game show, you are given three choices in answering the quiz. The choices include X2 Score, 50:50, and Extra Time, where these three things are closely related to quiz answers and quiz scores. In addition, each student finishes answering two questions. A Bonus Round will be held. This bonus round shown in Figure 2 is a kind of game to train memory skills; this is intended as a transition so that students do not get bored easily in playing this game.

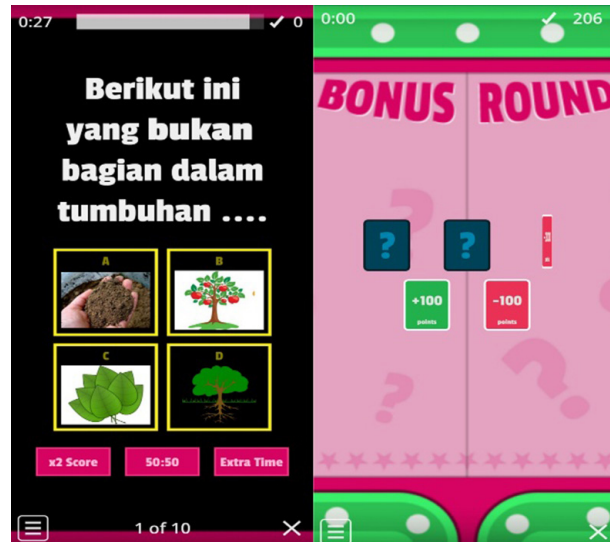


Fig. 2. Game appearance and features

After the student has completed all the questions in the quiz, the Score obtained by the student will be displayed. There are also three options in the display, including Leaderboard, Show Answer, and Start Again. In the Leaderboard, the score ranking of all students who have answered the quiz will be displayed. Show Answer will display the questions and answers that students have chosen previously, and for Start Again is to start playing the game show quiz again. Figure 3 displays the achievements page in this game.



Fig. 3. Achievement page view

3.2 The effect of digital games on students' learning motivation

Starting point from the results of test in analyzing data specification checked to establish normality and homogeneity level of the research data, the pretest and posttest scores were attained by students before and subsequent to treatment using digital games. The Kolmogorov-Smirnov normality test shown in Table 2 finds a use for a formula conducted employing the Asymp rule. Sig or p-value at the 5% alpha significance level. If $p > 0.05$, then the data is normally distributed. This normality calculation uses SPSS version 22.0 computer assistance. The normality test results finalized handling SPSS version 22.0 can be noted in the following table.

Table 2. The results of the normality test

		Unstandardized Residual
N		98
Normal Parameters	mean	.0000000
	Std. Deviation	1.83171414
Most Extreme Differences	Absolute	.073
	Positive	.044
	Negative	-.073
Test Statistics		.073
asympt. Sig. (2-tailed)		.200

The test results demonstrate that if $p > 0.05$, then the data is normally distributed as the results of $p = 0.200 > 0.05$, the pretest and posttest data are claimed to be normally distributed. Next will be a homogeneity test. The homogeneity test presented in Table 3 was guided on the pretest and posttest scores with the rules if the calculated significance value was greater than the significance level of 0.05 (5%). The calculation of homogeneity shown with the support of the SPSS version 22.0 computer program can be observed in the following table.

Table 3. The results of homogeneity of variances test

Levene Statistics	df1	df2	Sig.
1,957	7	90	.070

Based on the SPSS results above, it is informed that the significance value is 0.070, which is evidence of bigger than 0.05, so it can come to an end that the tested data manifests the same variance (homogeneous). Owing to the fact that the data from the calculation products of the normality and homogeneity tests are revealed normal and homogeneous, then what is found a use for testing the product's efficacy is parametric statistics through t-test wielding the paired sample test formula.

The results of the t-test can be noticed in the Table 4. Based on the upshot above, the value of Sig. (2-tailed) of $0.000 < 0.05$, because the value of Sig. (2-tailed) is equal to 0.000, smaller than 0.05. It can bring to a close that digital games can heighten or positively affect students' learning motivation in science subjects.

Table 4. The results of t-test

Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
			Lower	Upper			
-16,214	6,804	,687	-17.578	-14,850	-23.591	97	.000

4 Findings and discussion

This study was designed to govern the usefulness of using word-wall-based digital game media on the learning motivation of fourth-grade elementary school students in science subjects in Cluster I, North Sukabumi Village, Indonesia.

The terminations of this study signify that the use of digital media games has succeeded in increasing students' learning motivation. Several other researchers have previously shown that digital games positively affect students' learning motivation. It is proven that digital games can make progress cognitive expertness such as problem-solving, retention, intentness, and spatial capacity [32]. This is what underlies researchers to develop digital game-based learning, given the pragmatic impression given in the game. In addition, similar developments have been carried out by several other researchers before. Learning that uses digital games as learning media has an enthusiastic direction on students' learning motivation [33–35]. The use of digital games can increase the efficiency and effectiveness of learning. Educators need to develop digital games that are adapted to the situation and conditions of students in an integrated, systematic, and effective manner. This is because of the fun experience felt by students when running the game, thus triggering the emergence of motivation in the students themselves to participate in the learning process.

In developments in education, there is such a thing as game technology. Game technology is one of the unique forms of learning that allows teachers to make student work more attractive [36]. As a learning approach, digital educational games are appraised modern learning devices and learning media by bringing education to a new scope. This kind of game can analyze some learning connected with cognitive or affective such as self-efficacy, self-concept, and others [37]. This game is also considered attractive by combining problems that exist in the real world into a game. The implementation of digital educational games can also increase student learning interest. Therefore, educators must utilize and develop this digital game as the latest learning media innovation.

In this study, researchers developed a game for science subjects with material on the parts of plants. This game is designed to resemble a game show quiz interspersed with games in it. According to research, play mode can fetch extra enjoyment because the game provides prompt response [38]. The students will not quickly feel bored in carrying out these activities because of the feedback given, besides creativity in designing games also needs to be considered. The creativity that needs to be built as the basis for the game can usually be developed by a creative designer [39]. Therefore, this game is designed with an attractive design so that students feel happy playing it and can play and construct their knowledge.

The researchers developed game-based learning in their research because games are fun activities to do, especially for elementary school-age students. Game-based learning is considered a prospective mode to improve conviction and increase inspiration by integrating difficult task, spirit of inquiry, and originality into a particular issue [40]. These things can make the game even more attractive to be used. Several studies have shown that digital game-based education and the use of technology when using these games can increase children's creativity [41]. Teachers can use digital educational games as learning media in the classroom. The implementation of digital educational games as learning media is critical to support the success of students' learning concerning increasing interest in learning. There is a tendency in individuals to be interested in or enjoy the material being taught. Interest in learning is vital to be developed in students considering the effort made by someone to achieve specific goals is very dependent on interest. A strong interest in learning will lead to a considerable, serious effort, and do not give up quickly in learning. Students who have a hefty delight in learning will always wish for learning and quickly getting to know the material to prop up learning affluence. So, in addition to increasing children's motivation, children's creativity can also increase due to the use of this digital game.

The researcher realizes that there are still many shortcomings in his research, especially in the problem of game features themselves. Due to the limited features provided by the word-wall website, researchers could only develop it according to the available features. Even actually, there are some features that researcher want to develop more, for example, in the sound section in the game. However, that does not mean that because these limitations make game development results less than optimal, it is still following the game's primary goal. That motivates and stimulates student interest by encouraging students to play [42–43]. In learning using digital educational games, students are faced with gameplay, namely topics and ideas as rules, actions, decisions, and consequences that allow students to engage with these topics and ideas through interactions and simulations so that interest in learning about certain materials can grow well. In learning to use games, identified practicality, deduced ease of use, and attitudes towards use can increase interest in learning. Learning using educational games makes students very enthusiastic, happy, and interested in the material, increasing interest in learning. So that the expected results of this research also remain appropriate, namely increasing student motivation through playing games.

Other researchers are also expected to continue the development of this digital game, and it is highly recommended to use game-based learning in other subjects and use educational technology facilities in all school subjects [44–45]. Because the use of digital game media has been proven to increase students' learning motivation in science subjects, it is not impossible if applied to other subjects. It will also positively influence, especially in increasing student learning motivation.

5 Conclusion

Based on the research conducted, it can be concluded that the use of digital games has a positive effect on students' learning motivation due to the presentation of attractive media, and also supported by the way the teacher builds a pleasant learning atmosphere.

This digital game is also relatively easy for all people, including elementary school students. Furthermore, most importantly, digital games provide new experiences in the student learning process. In its application, this digital game only acts as a medium that can help increase student learning motivation. This media cannot significantly increase students' learning motivation if not applied with the exemplary learning scenario. Other than that, selecting the type of game with the material also needs to be considered so that the learning objectives can still be achieved. With this, student learning motivation can be realized to the fullest.

Researchers have also developed digital games to the maximum following the features provided by the word-wall website. The development of this media is also limited to only being shared on a learning platform in a class to access the game. For further research, it is expected to develop more of this media and implement it not only in science subjects but also for all subjects. In addition, it is also expected to expand the reach of this game media by utilizing or creating a particular platform so that the developed media can be reached and accessed by any student without exception.

6 Acknowledgment

Universitas Negeri Jakarta funded this research. Researchers greatly thank undergraduate students at Universitas Negeri Jakarta for participating in this research.

7 References

- [1] Falck, O., Mang, C., & Woessmann, L. (2013). Virtually no effect? Different uses of classroom computers and their effect on student achievement. *Oxford Bulletin of Economics & Statistics*, 80(1): 1–38. <https://doi.org/10.1111/obes.12192>
- [2] Gutierrez, M.F., Gimenez, G., & Calero, J. (2020). Is the use of ICT in education leading to higher student outcomes? Analysis from the Spanish Autonomous Communities. *Computers & Education*, 157: 1–15. <https://doi.org/10.1016/j.compedu.2020.103969>
- [3] Poultsakis, S., Papadakis, S., Kalogiannakis, M., & Psycharis, S. (2021). The management of digital learning objects of natural sciences and digital experiment simulation tools by teachers. *Advances in Mobile Learning Educational Research*, 1(2): 58–71. <https://doi.org/10.25082/AMLER.2021.02.002>
- [4] Karakose, T., Yirci, R., & Papadakis, S. (2021). Exploring the interrelationship between COVID-19 phobia, work-family conflict, family-work conflict, and life satisfaction among school administrators for advancing sustainable Management. *Sustainability*, 13(15): 8654. <https://doi.org/10.3390/su13158654>
- [5] Karakose, T., Yirci, R., Papadakis, S., Ozdemir, T.Y., Demirkol, M., & Polat, H. (2021). Science mapping of the global knowledge base on management, leadership, and administration related to COVID-19 for promoting the sustainability of scientific research. *Sustainability*, 13: 9631. <https://doi.org/10.3390/su13179631>
- [6] Papadakis, S. (2021). *Advances in mobile learning educational research (A.M.L.E.R.): Mobile learning as an educational reform*. *Advances in Mobile Learning Educational Research*, 1(1): 1–4. <https://doi.org/10.25082/AMLER.2021.01.001>

- [7] Marini, A., Safitri, D., Nuraini, S., Rihatno, T., Satibi, O., & Wahyudi, A. (2020). Applying model of mobile web based on character building in teaching learning process to improve student character. *International Journal of Advanced Science and Technology*, 29(6): 1121–1124.
- [8] Ibrahim, N., Safitri, D., Umasih, Marini, A., & Wahyudi, A. (2020). Application of web-based character building model for improving student character at study program of history education in Universitas Negeri Jakarta. *International Journal of Advanced Science and Technology*, 29(6): 1471–1474.
- [9] Petousi, V., & Sifaki, E. (2020). Contextualizing harm in the framework of research misconduct. Findings from discourse analysis of scientific publications. *International Journal of Sustainable Development*, 23(3–4): 149–174. <https://doi.org/10.1504/IJSD.2020.115206>
- [10] Anastasiadis, T., Lampropoulos, G., & Siakas, K. (2018). Digital game-based learning and serious games in education. *International Journal of Advances in Scientific Research and Engineering (ijasre)*, 4(12): 139–144. <https://doi.org/10.31695/IJASRE.2018.33016>
- [11] Baran, M., Maskan, A., & Yasar, S. (2018). Learning physics through project-based learning game techniques. *International Journal of Instruction*, 11(2): 221–234. <https://doi.org/10.12973/iji.2018.11215a>
- [12] Serrano, K. (2019). The effect of digital game-based learning on student learning: A literature review. *Graduate Research Papers*. 943.
- [13] Skala, J. L. (2019). The effects of digital games on engagement and motivation. The St. Catherine University repository. 1–37.
- [14] Bustamante, A. S., White, L. J., & Greenfield, D. B. (2018). Approaches to learning and science education in Head Start: Examining bidirectionality. *Early Childhood Research Quarterly*, 44: 34–42. <https://doi.org/10.1016/j.ecresq.2018.02.013>
- [15] Partovi, T., & Razavi, M. R. (2019). The effect of game-based learning on academic achievement motivation of elementary school students. *Learning and Motivation*, 68: 1–9. <https://doi.org/10.1016/j.lmot.2019.101592>
- [16] Bulić M., & Blažević I. (2020). The impact of online learning on student motivation in science and biology classes. *Journal of Elementary Education*, 13(1): 73–87. <https://doi.org/10.18690/rei.13.1.73-87.2020>
- [17] Chen, X., Zou, D., Cheng, G., & Xie, H. (2020). Detecting latent topics and trends in educational technologies over four decades using structural topic modeling: A retrospective of all volumes of computers & education. *Computers & Education*, 151. <https://doi.org/10.1016/j.compedu.2020.103855>
- [18] Taub, M., Sawyer, R., Smith, A., Rowe, J., Azevedo, R., & Lester, J. (2020). The agency effect: The impact of student agency on learning, emotions, and problem-solving behaviors in a game-based learning environment. *Computers & Education*, 147. <https://doi.org/10.1016/j.compedu.2019.103781>
- [19] Tatnall, A. (2020). *Encyclopedia of education and information technologies*. Springer, Switzerland. <https://doi.org/10.1007/978-3-030-10576-1>
- [20] Yang, K. H., & Lu, B. C. (2021). Towards the successful game-based learning: Detection and feedback to misconceptions is the key. *Computers & Education*, 160. <https://doi.org/10.1016/j.compedu.2020.104033>
- [21] Nuraini, S., Safitri, D., Rihatno, T., Marini, A., Putra, Z. E. F. F., & Wahyudi, A. (2020). *International Journal of Advanced Science and Technology*, 29(8s): 97–102.
- [22] Ferguson, R., Coughlan, T., Egelanddal, K., Gaved, M., Herodotou, C., Hillaire, G., Jones, D., Jowers, I., Kukulska-Hulme, A., McAndrew, P., Misiejuk, K., Ness, I.J., Rienties, B., Scanlon, E., Sharples, M., Wasson, B., Weller, M., & Whitelock, D. (2019). *Innovating Pedagogy 2019*. The Open University

- [23] Acquah, E. O., & Katz, H. T. (2020). Digital game-based L2 learning outcomes for primary through high-school students: A systematic literature review. *Computers & Education*, 143. <https://doi.org/10.1016/j.compedu.2019.103667>
- [24] Alcivar, C. M. M., Quimi, T. L. I., & Barberan, M. F. Z. (2020). The motivation and its importance in the teaching-learning process. *International Research Journal of Management, IT & Social Sciences*, 7(1): 138–144. <https://doi.org/10.21744/irjmis.v7n1.832>
- [25] Marini, A., Safitri, D., Lestari, I., Suntari, Y., Nuraini, S., Nafiah, M., Saipiatuddin, S., Arum, W. S. A., Sudrajat, A., & Iskandar, R. (2021). Mobile web-based character building for enhancement of student character at elementary schools: An empirical evidence. *International Journal of Interactive Mobile Technologies*, 15(21): 37–51. <https://doi.org/10.3991/ijim.v15i21.24959>
- [26] Safitri, D., Lestari, I., Maksum, A., Ibrahim, N., Marini, A., Zahari, M., & Iskandar, R. (2021). Web-based animation video for student environmental education at elementary schools. *International Journal of Interactive Mobile Technologies*, 15(11): 66–80. <https://doi.org/10.3991/ijim.v15i11.22023>
- [27] Behnamnia, N., Kamsin, A., & Ismail, A. B. (2020). The landscape of research on the use of digital game-based learning apps to nurture creativity among young children: A review. *Thinking Skills and Creativity*, 37. <https://doi.org/10.1016/j.tsc.2020.100666>
- [28] Majeed, B. H., Jawad, L. F., & ALRikabi, H. T. S. (2021). The impact of teaching by using STEM approach in the development of creative thinking and mathematical achievement among the students of the fourth scientific class. *International Journal of Interactive Mobile Technologies*, 15(13): 172–188. <https://doi.org/10.3991/ijim.v15i13.24185>
- [29] Manesis, D. (2020). Digital games in primary education. *Game Design and Intelligent Interaction*. <https://doi.org/10.5772/intechopen.91134>
- [30] Kaimara, P., & Deliyannis I. (2019). Why should I play this game? The role of motivation in smart pedagogy. *Didactics of Smart Pedagogy*, 113–137. https://doi.org/10.1007/978-3-030-01551-0_6
- [31] Welbers, K. (2019). Gamification as a tool for engaging student learning: A field experiment with a gamified app. *E-Learning and Digital Media*, 16(2): 92–109. <https://doi.org/10.1177/2042753018818342>
- [32] Ramli, I. S. M., Maat, S. M., & Khalid, F. (2020). Game-based learning and student motivation in mathematics. *International Journal of Academic Research in Progressive Education and Development*, 9(2): 449–455. <https://doi.org/10.6007/IJARPED/v9-i2/7487>
- [33] Akour, M., Alsghaier, H., & Aldiabat, S. (2020). Game-based learning approach to improve self-learning motivated students. *International Journal of Technology Enhanced Learning*, 12(2): 146–160. <https://doi.org/10.1504/IJTEL.2020.10027116>
- [34] Chebotareva, I. N., Pashutina, O. S., & Liaskovets, A. V. (2020). Motivational and educational value of game-based learning technology in law students training. *Advances in Social Science, Education and Humanities Research*, 447. <https://doi.org/10.2991/assehr.k.200723.017>
- [35] Kirstavridou, D., Kousaris, K., Zafeiriou, C., & Tzafilkou, K. (2020). Types of game-based learning in education: A brief state of the art and the implementation in Greece. *The European Educational Researcher*, 3(2): 87–100. <https://doi.org/10.31757/euer.324>
- [36] Lin, C. H., Huang, S. H., Shih, J. L., Covaci, A., & Ghinea, G. (2017). Game-based learning effectiveness and motivation study between competitive and cooperative modes. *IEEE 17th International Conference on Advanced Learning Technologies (ICALT) 2017*, July 3–7 2017, Timisoara, Romania. 123–127. <https://doi.org/10.1109/ICALT.2017.34>
- [37] Eyupoglu, T. F., & Nietfeld, J. L. (2019). Intrinsic motivation in game-based learning environments. *Game-Based Assessment Revisited*, 85–102. https://doi.org/10.1007/978-3-030-15569-8_5

- [38] Gil-Doménech, D., & Berbegal-Mirabent, J. (2019). Stimulating students' engagement in mathematics courses in non-STEM academic programmes: A game-based learning. *Innovations in Education and Teaching International*, 56(1): 57–65. <https://doi.org/10.1080/14703297.2017.1330159>
- [39] Gong, S. (2020). On the cultivation of middle school students' creativity. *English Language Teaching*, 13(1): 134–140. <https://doi.org/10.5539/elt.v13n1p134>
- [40] Kiili, K., Moeller, K., & Ninaus, M. (2018). Evaluating the effectiveness of a game-based rational number training - In-game metrics as learning indicators. *Computers and Education*, 120: 13–28. <https://doi.org/10.1016/j.compedu.2018.01.012>
- [41] Grammenos, D., & Antona, M. (2018). Future designers: Introducing creativity, design thinking & design to children, *International Journal of Child-Computer Interaction*, 16: 16–24. <https://doi.org/10.1016/j.ijcci.2017.10.002>
- [42] Chapman, J. R., & Rich, P. J. (2018). Does educational gamification improve students' motivation? If so, which game elements work best? *Journal of Education for Business*, 93(7): 314–321. <https://doi.org/10.1080/08832323.2018.1490687>
- [43] Prott, D., & Ebner, M. (2020). The use of gamification in gastronomic questionnaires. *International Journal of Interactive Mobile Technologies*, 14(02): 101–118. <https://doi.org/10.3991/ijim.v14i02.11695>
- [44] Alhalafawy, W. S., & Zaki, M. Z. (2019). The effect of mobile digital content applications based on gamification in the development of psychological well-being. *International Journal of Interactive Mobile Technologies*, 13(08): 107–123. <https://doi.org/10.3991/ijim.v13i08.10725>
- [45] Owens, D. C. (2019). Overcoming motivational barriers to understanding and accepting evolution through gameful learning. *Evolution Education Re-considered*, Springer: Cham, Switzerland, 167–184. https://doi.org/10.1007/978-3-030-14698-6_10

8 Authors

Desy Safitri is a lecturer from the Social Studies Education study program, Faculty of Social Science, Universitas Negeri Jakarta, Jakarta, Indonesia. She is also chief of this study program.

Suci Awalia is a college student from the Elementary School Teacher Education study program, Faculty of Education, Universitas Negeri Jakarta, Indonesia. Her main research interest is related to education at elementary school.

Tunjungsari Sekaringtyas is a lecturer from the Elementary School Teacher Education study program, Faculty of Education, Universitas Negeri Jakarta, Indonesia. Her main research interest is related to education at elementary school.

Sri Nuraini is a senior lecturer with a doctoral degree in Sports Science, Sports Recreation and Sport Education study program, Faculty of Sports Science, Universitas Negeri Jakarta, Indonesia. Her main research interest is related to Sport Science, Sports Recreation, and Sport Education.

Ika Lestari is a lecturer with a doctoral degree from the Elementary School Teacher Education study program, Faculty of Education, Universitas Negeri Jakarta, Indonesia. She is also an evaluator for opening study programs at Higher Education in Indonesia.

Yustia Suntari is a lecturer with a master's degree from the Elementary School Teacher Education study program, Faculty of Education, Universitas Negeri Jakarta,

Indonesia. His main research interest is related to education at elementary schools. She is studying at Universitas Negeri Jakarta to get a doctoral degree.

Arita Marini is a professor from the Elementary School Teacher Education study program, Faculty of Education, Universitas Negeri Jakarta, Jakarta, Indonesia. She is also an assessor at the national accreditation body for higher education at the Ministry of Education and Culture Republic Indonesia.

Rossi Iskandar is a lecturer from the Elementary School Teacher Education study program, Faculty of Education, Universitas Trilogi, Jakarta, Indonesia. He is studying at Universitas Negeri Jakarta to get a doctoral degree.

Ajat Sudrajat is a lecturer with a doctoral degree from the Civics Education study program, Faculty of Teacher Training and Education, Universitas Negeri Terbuka, Indonesia. He is also an assessor of elementary schools in Indonesia.

Article submitted 2021-07-25. Resubmitted 2021-12-21. Final acceptance 2022-01-11. Final version published as submitted by the authors.