Voyage Journal of Educational Studies (VJES) *Vol. 4 Issue 3*
ISSN (Online): 2790-7171, ISSN (Print): 2790-7163 *July to September 2024*

Effect Of Digital Game Based Learning on Students' Academic Achievement at Primary Level

Farah Abdul Qadir

Ms Scholar, Department of Teacher Education, International Islamic University, Islamabad (PAKISTAN)
Farahmalkani22@gmail.com.

Hafsa Shujat

Ms Scholar, Department of Educational Leadership and Management, International Islamic University, Islamabad (PAKISTAN)
Hafsashujat98@gmail.com

Aqsa Wajid Abbasi

MS Scholar, Department of Teacher Education, International Islamic University, Islamabad (PAKISTAN)
Aqsaaqsaabbasi0@gmail.com

Abstract

Games have been a part of human societies throughout recorded history. They can be card games, board games, dice games, different sports, etc. This study looked into the effects of digital game-based learning (DGBL) using Digital games, which could help change the current education system and give everyone a chance to learn something useful. Students, video game designers, curriculum developers, and educators can benefit from this study's findings. This study aims to measure the effect of digital games on students' academic achievement. A quantitative approach and one group pretest-posttest design were employed. The population of this study consisted of 177 students of 5th class studying in 7 schools in all campuses of Dr. AQ khan School System during the session 2023 – 24. A simple random sampling technique was employed to select Dr. AQ khan school system H-13 Islamabad the sample for this research study consisted of 20 students of 5th-grade studying the subject of Mathematics. The validity of the tools was determined through the expert's opinion. The study was conducted for four weeks. A pretest was administered to the experimental group at the start and then taught to the grade 5th class through digital games, and a posttest was administered at the end. Quantitative data were analyzed using mean, percentage, and paired sample t-test. Data analysis involved obtaining scores from pretest, posttest, and retention test. Which shows students performed better in post-test than pretest whereas retention scores were consistent with the post-intervention scores, suggesting a lasting effect of DGBL on learning.

Keywords: *Digital game-based learning, Academic Achievement, Grade*

Introduction

In today's rapidly evolving educational landscape, technology integration has paved the way for innovative approaches to teaching and learning. Among these approaches, digital game-based learning (DGBL) has garnered considerable attention for its potential to enhance student academic achievement.

Primary-level students present a unique set of challenges owing to their developmental characteristics. Young learners exhibit varying attention spans, learning preferences, and energy levels. Traditional teaching methods often struggle to maintain sustained engagement in this demographic. However, recent research suggests that DGBL can effectively address these challenges by capitalizing on children's innate affinity for play (Cheong et al., 2022). By integrating game mechanics such as rewards, challenges, and progression, DGBL creates an environment where students are motivated not only by extrinsic factors but also by the inherent enjoyment of learning.

DGBL's immersive environments promote learning by challenging students with meaningful tasks that necessitate critical thinking and problem-solving skills (Connolly et al., 2020). These tasks are embedded within a narrative context that simulates real-world scenarios, enabling students to apply learned concepts in practical situations. Consequently, DGBL cultivates a sense of purpose and relevance, heightening students' motivation to acquire and apply knowledge.

Moreover, research by De Freitas and Maharg (2022) highlights the potential of DGBL in fostering collaborative learning. Digital games often require players to work together to achieve common goals, promoting teamwork and communication skills. This collaborative aspect not only enhances social interaction among students but also helps them develop a deeper understanding of the subject matter.

Another notable study by Annetta et al. (2022) reveals that DGBL can effectively support differentiated instruction. Digital games can be tailored to meet the diverse learning needs and paces of individual students, providing personalized feedback and adaptive challenges. This adaptability ensures that all students, regardless of their learning abilities, can benefit from the educational content.

When technology is used in education, students are more interested and less likely to drop out. The number of students who stop attending school has always been a big problem in Pakistan (AlifAilaan & SDPI, 2016). Currently, 24 million children in Pakistan between the

ages of 5 and 16 are not in school. This is 47% of all children in Pakistan, and almost half are girls. (Alif Ailaan & SDPI, 2016). These children do not go to school or drop out because (a) their parents do not want to send them, (b) the schools are too far away, (c) they are poor and cannot pay for school, (d) their culture encourages girls to get married young, (e) they are beaten by teachers, (f) teachers do not show up to work, and (g) their education is not excellent (Alif Ailaan & SDPI, 2016; Chaudhry, 2016). Students who quit school after two or three years do so because they are not interested in what is going on in the classroom (Finn, 1989; Ulmanen et al., 2014). In OECD countries, 25% of students had less emotional growth at school, and 20% were regularly absent. These lower levels of engagement led to low achievement and a bad attitude toward learning, which caused students to quit school. Therefore, Pakistan's current method of learning by rote memorization leads to a lack of interest in learning, which could cause students to drop out of school. (UNESCO, 2014)

Problem Statement

Pakistan's current method of learning by rote memorization leads to a lack of interest in learning, which causes students to drop out of school (UNESCO, 2014). Digital game technology in Pakistan is growing as technology advances. It is an innovative educational tool to enhance students' learning experiences. Therefore, it is necessary to investigate the DGBL effect on the students' academic achievement.

This study focuses on student learning through digital game-based learning. It explores to what extent learning through digital games would be effective. This study was focused explicitly on primary-level students.

Objectives of the study

This study has the following objectives:

1. To find out the effect of digital game-based learning on students' academic achievement.
2. To compare the pretest and post-test scores of students' academic achievement.
3. To measure students' retention after the posttest with a follow-up test.

Research Questions

Considering the objectives mentioned above, the following research questions were developed and then investigated in the study:

1. What is the effect of digital game-based learning on students' academic achievement.

2. Is there any significant difference between the pretest and post score of 5th-grade primary students?

Hypothesis

1. **H_{01}** There is no significant difference in the academic achievement of students that are learning through digital games.

Literature Review

Digital Game-Based Learning

Digital game-based learning (DGBL) refers to using digital games as a means of instruction and learning in educational settings. It involves integrating game elements, mechanics, and principles into learning to enhance students' engagement, motivation, and learning outcomes. DGBL encompasses various educational games, including commercial off-the-shelf games adapted for educational purposes and custom-designed educational games created explicitly for learning objectives. (Huizenga et al., 2017)

In a nutshell, DGBL gives students or players ways to fully engage with the content and learn through interaction and simulation instead of traditional schooling, textbooks, assignments, and so on.

The potential benefits of DGBL in primary education are numerous. It can foster active learning and student-centered approaches, allowing students to own their learning journey. DGBL has the potential to enhance students' problem-solving skills, critical thinking abilities, and creativity by providing interactive and immersive learning experiences. It also promotes the development of digital literacy and 21st-century skills, which are crucial in today's technologically advanced world. (Anastasiadis et al., 2018)

By looking at many scholarly articles, research papers, and pertinent sources, the literature review seeks to provide a thorough overview of the current level of knowledge in this field. The literature review aims to detect trends, patterns, and gaps in the current literature by analyzing and synthesizing the results from various studies. This study will add to our understanding of how DGBL affects students' learning. The literature review aims to offer insightful knowledge to help direct future studies, instructional strategies, and decision-making on DGBL in primary educational settings.

A Review of the Literature Regarding the Use of Digital Games in the Subject of Mathematics

Chang et al. (2015) researched to investigate how playing an educational game like [The Math App] influences the mathematical ability of middle school students. Students in the game intervention condition gained an understanding of fractional concepts using [The Math App]. When doing the analysis, we considered the students' existing mathematical skill levels before the intervention. According to the findings, the children who participated in the math intervention game had greater competency than those who worked using paper and pencil.

Another study by Warren et al. (2014) indicated that as culturally appropriate mathematical learning activities were introduced into a learning environment, teachers became more aware of children's understanding of mathematics and how they could engage in teaching mathematics while maintaining their philosophy of play. This was indicated by the fact that teachers became more aware of how they could teach mathematics while maintaining their philosophy of play as culturally appropriate mathematical learning activities were introduced. As a result, they could modify their pedagogies to meet the numerous requirements of their pupils.

Digital games often present content in a contextualized and interactive format, which can aid in the comprehension of complex subjects. A study by Qian and Clark (2022) found that game-based learning tools significantly improved students' ability to understand and apply challenging academic concepts. The study highlighted that game-based learning environments facilitated deeper cognitive processing, leading to better academic performance in subjects such as mathematics and science.

Empirical Research of DGBL

According to research by Ashraf et al. (2014), the software used in computer games is developed to leave a long-lasting mark on the human brain. Researchers set out to determine whether playing these games has a significant enough impact on players to motivate them to learn a language other than their native tongue. Two different groups of Iranian students were assembled to do the same test. In the experiment, participants in the control group were instructed to learn English vocabulary by more conventional means. In contrast, those in the experimental group were tasked with playing computer games. Therefore, researchers successfully discovered that learning through computer games is the most effective method to teach pupils anything, even foreign languages, in an easy-to-understand manner.

Video games' influence on the learning process is the primary topic of investigation for Simkova's (2014) study. The applied methodology attempted to investigate productive ways of using computer games. According to the findings, playing computer games is favorably connected with the education process, particularly when game software is built specifically for the goal of education. In the end, only a few games were examined for this research, and the results showed that this learning method was beneficial for children.

A significant body of research has explored how DGBL affects students' performance in STEM (Science, Technology, Engineering, and Mathematics) subjects. Liu et al. (2023) conducted a study examining the effects of AI-enhanced game-based learning on academic achievement in STEM education. The research revealed that students who used AI-powered educational games demonstrated marked improvements in their understanding and application of STEM concepts. The adaptive nature of these games allowed for personalized learning experiences, which helped students grasp complex topics more effectively.

Yuksel and Yuksel (2015) conducted a study to understand better the correlation between the use of computers in the classroom and students' levels of academic success. The experimental group and the control group were created so that the impact could be measured. The control group traditionally received their education, whereas the experimental group was taught using instructional software that was based on computers. The test, which served as a pre-test, a post-test, and a maintenance test for students in the second class of the Vocational Foreign Language lesson, had the primary objective of determining the level of achievement achieved by those students. Consequently, using PC-assisted instructional tactics in teaching foreign languages is more successful than using conventional instructional strategies for the academic accomplishment and upkeep of the students.

Research Methodology

Research Design

This study was experimental, and one group pretest-posttest design was used. The proposed study was quantitative. Quantitative data was used to determine the DGBL effect on students' engagement and motivation.

Experimental Research Procedure

Experimental design refers to the plan and structure of an experiment. It involves defining the participants, variables, procedures, and methods for collecting and analyzing data. In the

context of the experimental research methodology described earlier, the design can be explained as follows:

Participants

In the experimental research, the participants were Grade 5 students from Dr. AQ Khan's school system. The researcher recruited students to participate in the experiment. The sample size was selected according to the study's specific requirements and resources.

Grade 5 students were selected as participants because they had acquired foundational math skills, making them suitable for evaluating digital game-based learning. To ensure ethical considerations were met, informed consent was obtained from the parents or guardians of the participating students. Participants were informed about the study's nature, potential benefits, risks, and precautions as part of the consent process.

A controlled and representative sample was selected to arrive at valid conclusions regarding the effect of digital game-based learning on student engagement and motivation at the primary level.

Orientation Week

An orientation week was conducted before the intervention began during the experimental research. This week, students were introduced to the digital games used as teaching tools throughout the experiment. Students and researchers attended the orientation week to ensure that they understood the logistics and objectives of the study.

The researcher installed math games in the computer lab this week, creating an environment conducive to digital game-based learning—the setup of necessary software and ensuring that the games appropriately worked were part of the installation process.

Further, the researcher validated the questionnaires provided by the math teachers before and after the test. This validation process ensured that the assessment tools were valid and accurately measured the target math concepts.

During orientation week, the researcher could also interact with students and gauge their familiarity with digital games. The researcher observed the students' engagement with the games and assessed their level of comfort and enthusiasm. As a result of this information, it would be possible to understand better students' attitudes and motivations towards using digital games as a learning tool in the future.

Throughout orientation week, the researcher explained to the students the purpose and expectations of the experiment and how math games would be incorporated into their learning process. Students will learn about different math topics in the upcoming weeks and gradually introduce new challenges.

The orientation week was a foundational stage for the students and the researcher to establish a common understanding. A successful experiment implementation would have been impossible without preparing everyone for the subsequent digital game-based learning sessions.

Pre-Test

In the experimental research, a pre-test was conducted before the intervention began. The purpose of the pre-test was to assess the baseline knowledge, skills, and motivation levels of the Grade 5 students regarding the math concepts that would be covered during the experiment. It served as a measurement tool to establish a starting point for the student's performance and engagement before any intervention occurred.

The pre-test was administered by the math teachers who were familiar with the curriculum and content being taught. It consisted of questions, problems, or tasks related to the specific math topics that would be addressed during the experiment. The pre-test evaluated the student's understanding and competence in addition, subtraction, multiplication, division, fractions, and decimals.

The data collected from the pre-test were used for several purposes:

Establishing Baseline: The pre-test allowed researchers to establish the students' initial knowledge, skills, and motivation. This baseline was crucial for comparing the post-test results and determining the effectiveness of the digital game-based learning intervention.

Individual Differences

The pre-test data provided insights into the individual differences among the participants. It helped identify students who may have required additional support or exhibited unique characteristics that could influence their engagement and motivation during the experiment.

The pre-test was carefully designed to align with the learning objectives and the specific math concepts that would be addressed in the experiment. The questions or tasks were straightforward, appropriate for Grade 5 students, and designed to assess the targeted knowledge and skills accurately. In a pre-test, researchers established a starting point for the

student's performance and motivation, allowing for a comparison of their progress and engagement during and after the intervention. It provided a more comprehensive understanding of the effect of digital game-based learning on students' engagement and motivation at the primary level.

Intervention

During the experimental phase, a digital game-based learning intervention was implemented in the computer lab to teach Grade 5 students various math concepts using interactive and engaging math games. A progressive approach was used throughout the intervention, gradually introducing different levels and topics.

A researcher began the intervention by focusing on the addition level for the first two days and used an observation sheet daily to measure students' engagement and motivation. During this time, the students played math games to develop their addition skills. In the games, additional concepts are practiced and reinforced in a fun and interactive way.

During the subtraction level, the intervention lasted for two days after the addition level. By playing math games related to subtraction skills, the students were able to practice and improve their understanding of subtraction.

The next phase of the intervention involved multiplication, which lasted three days. Math games focus on multiplication concepts, allowing students to develop their multiplication skills through interactive gameplay.

Multiplication was followed by division, which also lasted three days. They practiced and strengthened their understanding of division operations through math games targeted at division skills. Two weeks after the intervention began, the researcher introduced the third chapter, which involved using fraction challenge games. These games used a fraction to help students learn addition, subtraction, multiplication, and division. This chapter aimed to develop students' fractional skills and comprehension further.

A fourth chapter was introduced in the final week of the intervention, which focuses on decimal games. The students played math games with decimals involving addition, subtraction, multiplication, and division. The purpose of this chapter was to improve students' understanding of decimal numbers as well as their ability to work with them.

The students displayed high interest and enthusiasm throughout the intervention for the math games. They lined up outside the computer lab a few minutes before the math period, indicating their excitement for interactive learning.

Through the intervention phase, students engaged with digital game-based learning in a fun and interactive manner, practicing and applying math concepts in fun and engaging ways.

Post-Test

After four weeks of the experiment, a post-test was conducted to assess the participants' performance and measure any changes or improvements resulting from the intervention. This allowed a direct comparison between the participants' pre-test and post-test scores.

The post-test aimed to evaluate the participants' knowledge, skills, engagement, and motivation in the math concepts taught using digital game-based learning. By comparing the post-test scores with the pre-test scores, researchers could determine the intervention's effectiveness and whether it positively impacted the participants' learning outcomes.

Retention Test

A retention test was administered one week after the post-test to assess the participants' long-term retention of the knowledge and skills acquired during the intervention. The retention test used the same measures or instruments as the post-test to ensure consistency.

The retention test aimed to evaluate whether the participants could retain and recall the math concepts learned through digital game-based learning. By administering the same measures again, researchers could determine the stability of the intervention's effects over time.

The retention test provided insights into the persistence of the participants' learning outcomes and whether they could transfer and apply the acquired knowledge and skills beyond the immediate post-test period. It helped assess the long-term impact of the intervention and provided valuable information about the durability of the intervention's effects.

Researchers could assess the short-term and long-term effects of the digital game-based learning intervention on the participants' math performance, engagement, and motivation by conducting the post-test and retention test. These assessments provided a comprehensive understanding of the intervention's effectiveness and the sustainability of the learning outcomes.

Digital Games

Figure.1

Decimal Game

The game is a set of fun games that help kids learn about math. It is made to work ONLINE and OFFLINE on even the most basic smartphones and PCs.

- Works with Android 4.4 and up
- Tests, rewards, and feedback built right in.
- It is easy tilt say.
- Graphics that are bright and based on everyday themes and situations to help with learning.

This game covered the following learning objectives:

1. Add and subtract decimals
2. Comparing Decimal numbers.

Figure 2

Fraction Challenge: Math Game

The recommended age for this game is 9 to 12 years old.

- Works offline.
- Works with Android 4.4 and up.
- Game outcomes are in line with the Curriculum of Mathematics
- Step-by-step instructions in English and Urdu to help students understand the ideas better.

The following are the learning objectives this game covered:

1. Add and subtract two or more fractions with different denominators.
2. Multiply a fraction by a number
3. Multiply a fraction by another fraction
4. Divide a fraction by a number
5. Divide a fraction by another fraction

Figure 3

Math Games: Math for Kids

Math games for kids are super fun! Using basic arithmetic, students can use this game to solve math puzzles, brain teasers, and brain math puzzles.

1. Addition games – up to 6-digit addition, sequential addition, plus more additional games.
2. Subtraction games – up to 6-digit subtraction games and learn how to subtract.
3. Multiplication games - best practice game to learn multiplication tables and multiplying methods.

4. Division games - Learn to divide by playing multiple fun division games.

The following are the learning objectives this game was covered:

1) Add numbers of complexity and arbitrary size.
2) Subtract numbers of complexity and of arbitrary size.
3) Multiply up to 6 digits by a 2-digit and 3- digit number
4) Divide up to 6 digits by a 2-digit and 3- digit number.

Model Lesson Plan

Class: grade 5th Topic: Addition

Time: 35 minutes Av aids: Digital games, whiteboard and marker.

Method: Computer Assisted Instruction method

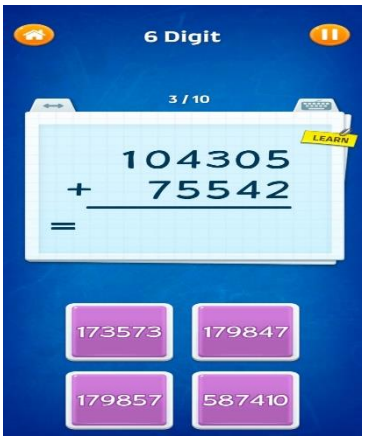
Table 1

Learning outcomes

By the end of lesson plan, students' will be able to:

- Add numbers of complexity.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all? I hope you are doing great. In the previous class you have already learnt about simple addition. Now please let me know 10+5=? 6+7=? 12+3=? Correct, good.	 15 13 15
Announcement of the Topic	So today the topic which we are going to study is. Addition	
Presentation	Teacher will start the game on all computers Which is Math Game	

	 The teacher will instruct before playing that how to play. After that student started playing. After completing 10 levels. Each student will get a score. The teacher will repeat the game until each student gets a 10/10 score.	Students will see the game. Students will open the game and open the category of addition for 5th grade.   
Application	After the ending of session of playing game teacher will give them	Student will give answers to those questions.

	2,3 questions from their addition exercise.	
Recapitulation	So, today we have studied addition. Addition means adding something.	Students will summarize the concept together with teacher
Assessment	Teacher will understand the students' performance by their score in games. These scores helps' them to motivate to gain more score in second level as compared to their class fellows	

Population of study

The population of the study consisted of all 5th grade students of Dr. AQ khan School System studying in seven schools in Islamabad district. The population of this study consisted of 177 students of 5th class studying in 7 schools in All campuses of Dr. AQ khan School System during the session 2023 – 24.

Research Sample

The research study was experimental in nature. So, the researcher selected one school. The school was selected through lottery method. The sample selection of this school was taken through Simple Random Sampling Technique. The selected school was Dr. AQ khan school system from H-13 area. The sample for this research study consisted of all 20 students of 5th-grade, age 11-13 years studying the subject of Mathematics.

Procedure (Validity)

The researcher created a pretest consisting of 22 test items and a post-test consisting of 16 test items taken from three specific chapters of the "Mathematics" textbook. These tests assessed the student's prior knowledge and understanding after the intervention. A table of specifications was utilized to guide the selection of test items. This test was validated by

engaging in discussions with Subject Specialists who teach the Subject of "mathematics" at Dr. AQ Khan School System in Islamabad to assess its construct validity. The experts above' remarks regarding the quality of test items, and the researcher integrated their ideas and got approval from the supervisor for implementation.

Ethical Consideration

1. Ethics was considered during research
2. The researcher-built trust between the researcher and the participant and behaved trustily.
3. Participants consent was taken before the research process
4. Confidentiality of data was assured.
5. Personal information was not being asked for by students.
6. The research and data collection purpose were explained honestly and transparently to the participants.
7. The chosen games have free access.
8. Researchers deeply evaluate and use games to check their usability in our culture. All games were culturally fit in our society.
9. To ensure ethical considerations were met, informed consent was obtained from the parents or guardians of the participating students.
10. Participants were informed about the study's nature, potential benefits, risks, and precautions as part of the consent process.

Data Analysis and Interpretation

Hypothesis

There is no significant difference in the academic achievement of students learning through digital games.

Table 2

Significance of Difference between the Mean Pretest and Post-Test Score of Students' Academic Achievement.

		N	Mean	t-test	Cohen's d value
Pair 1	Pre-test	20	12.2000	-6.710	1.50
	Post test	20	15.0500		

The t-value of -6.710 measures the difference between the two means, expressed in the number of standard deviations the means are apart. In this context, the negative t-value

indicates that the post-test mean score (15.0500) is significantly higher than the pre-test means score (12.2000).

Since the p-value is smaller than the typical significance level of 0.05 (5%), the null hypothesis that "There is no significant difference in engagement & motivation of students who are learning through digital games." was rejected, which states that there is no difference between students' academic achievement that are learning through digital games.

Figure 4

Pre-test and post-test Mean

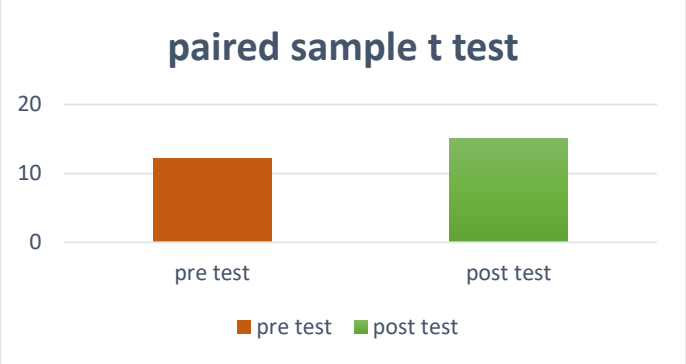


Table 3

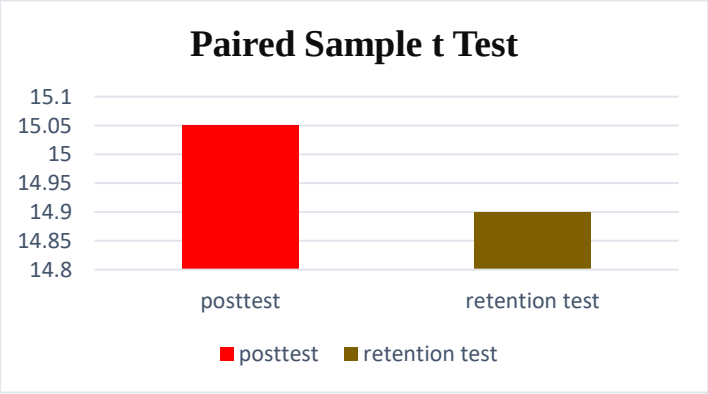
Significance of Difference between the Mean Post-Test and Retention test Score of Students' Academic Achievement.

		N	Mean	t-test	Cohen's d value
Pair 2	Post-test	20	15.0500	1.143	0.255
	Retention test	20	14.9000		

The post-test mean score is 15.0500, and the retention test mean score is 14.900. A p-value of 0.267 indicates no statistically significant difference between the two means at the conventional significance level of 0.05 (5%).

Figure 5

Post-test and Retention test Mean



Result

Keeping in view of the statistical analysis of data and findings of the study, the following conclusions were drawn.

1. The digital game-based learning strategy increased students' academic achievement.
2. The digital game-based learning strategy was more helpful in enhancing students' learning after intervention than before intervention.

Recommendations

1. The current study's positive outcomes showcase the potential of digital game-based learning; educators may explore a variety of game types, mechanics, and genres to cater to diverse learning preferences and styles. Incorporating a mix of educational games, simulations, and interactive storytelling can sustain interest and engagement over time.
2. Developers and educators may focus on designing games that provide personalized challenges and immediate feedback. Adaptive game mechanics that adjust difficulty levels based on individual progress can maintain a flow state and optimal engagement for students of varying skill levels.
3. Teachers may receive ongoing training and professional development in effectively integrating digital game-based learning into their curriculum. This includes understanding game mechanics, identifying learning objectives within games, and employing strategies to maximize engagement and motivation.

References

Alif Ailaan and SDPI. (2016). Alif Ailaan Pakistan District education rankings 2016 (pp. vi–109). Islamabad https://sdpi.org/alif-ailaan-district-education-ranking/project_detail

Anastasiadis, T., Lampropoulos, G. K., & Siakas, K. V. (2018). Digital Game-based Learning and Serious Games in Education. *International Journal of Advances in Scientific Research and Engineering, 4*(12), 139–144. https://doi.org/10.31695/ijasre.2018.33016

Annetta, L. A., Minogue, J., Holmes, S. Y., & Cheng, M. T. (2022). Investigating the impact of digital game-based learning on students' motivation and engagement. *Journal of Science Education and Technology*, 31(2), 202-215. https://doi.org/10.1007/s10956-021-09921-8

Ashraf, H., Motlagh, F. G., & Salami, M. (2014). The Impact of Online Games on Learning English Vocabulary by Iranian (Low-Intermediate) EFL Learners. *Procedia—Social and Behavioral Sciences, 98*, 286-291. https://doi.org/10.1016/j.sbspro.2014.03.418

Chang, M., Evans, M. A., Kim, S., Norton, A., & Samur, Y. (2015). Differential effects of learning games on mathematics proficiency. *Educational Media International*, *52*(1), 47–57. https://doi.org/10.1080/09523987.2015.1005427

Cheong, C., Filippou, J., & Cheong, F. (2022). Investigating the impact of game-based learning on primary school students' engagement and motivation. *Computers & Education*, 181, 104752. https://doi.org/10.1016/j.compedu.2021.104752

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2020). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, *94*, 1-23. https://doi.org/10.1016/j.compedu.2015.11.004

De Freitas, S., & Maharg, P. (2022). Digital games and collaborative learning: A systematic review. *Educational Technology Research and Development*, 70(4), 1089-1104. https://doi.org/10.1007/s11423-021-10057-2

Finn, J. D. (1989). Withdrawing From School. *Review of Educational Research*, *59(*2), 117–142. https://doi.org/10.3102/00346543059002117

Huizenga, J., Dam, G. T., Voogt, J., & Admiraal, W. (2017). Teacher perceptions of the value of game-based learning in secondary education. *Computers & Education, 110*, 105–115. https://doi.org/10.1016/j.compedu.2017.03.008

Liu, Z., Wang, H., & Li, X. (2023). AI-enhanced game-based learning: Effects on students' academic achievement in STEM education. *Computers & Education*, 173, 104271. https://doi.org/10.1016/j.compedu.2022.104271

Qian, M., & Clark, K. R. (2022). Game-based learning and 21st-century skills: A review of recent research. *Computers in Human Behavior*, 112, 106482. https://doi.org/10.1016/j.chb.2020.106482

Simkova, M. (2014). Using of Computer Games in Supporting Education. *Procedia - Social and Behavioral Sciences, 141*, 1224–1227. https://doi.org/10.1016/j.sbspro.2014.05.210

Ulmanen, S., Soini, T., Pyhältö, K., & Pietarinen, J. (2014). Strategies for academic engagement perceived by Finnish sixth and eighth graders. *Cambridge Journal of Education*, *44*(3), 425–443. doi:10.1080/0305764 x.2014.921281.

Warren, E., Thomas, L., & DeVries, E. (2014). Engaging Indigenous children in mathematical learning in an early childhood setting. *International Journal of Pedagogies and Learning, 6*(2), 97–107. https://doi.org/10.5172/ijpl.2011.97

Yüksel, H., & Yüksel, A. (2015). The Effect of Computer Assisted Instruction on the Academic Achievement and Retention of Technical Programme Students in Vocational Foreign Language. *Procedia - Social and Behavioral Sciences, 174*, 2513–2518. https://doi.org/10.1016/j.sbspro.2015.01.924

Teaching and learning: achieving quality for all. (2023). *Global Education Monitoring Report.* https://www.unesco.org/gem-report/en/teaching-and-learning-achieving-quality-all