
EFFECT OF DIGITAL GAME-BASED LEARNING ON STUDENTS' ENGAGEMENT & MOTIVATION AT THE PRIMARY LEVEL

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ABSTRACT

Games have been a part of human societies throughout recorded history. They can be card games, board games, dice games, different sports, etc. With this in mind, 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 findings of the study. This study aimed to measure the effect of digital games on students' motivation and engagement. A quantitative approach and Time series 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 instrument was adapted for developing a questionnaire for measuring the engagement and motivation of the students (Liem & Martin, 2012). The validity of the tool was determined through the experts' opinion. The study was conducted for four weeks. The procedure involved conducting, daily digital game

treatments and collecting daily observations to monitor changes in engagement and motivation levels over time. Quantitative data were analyzed using mean. Data analysis involved obtaining daily observation sheet scores. The results indicated that Digital game-based learning significantly enhances engagement and motivation among primary-level students, as evidenced by consistent increases in engagement and motivation scores over the experimental period.

KEYWORDS

Digital game-based learning, Engagement, Motivation, Grade-5

INTRODUCTION

Technology integration has guided us in a new era of pedagogical innovation in modern education. Among the technological advancements, digital game-based learning (DGBL) has emerged as a captivating approach to engage and motivate students, particularly at the primary level. DGBL leverages digital games' interactive and immersive nature to create educational and entertaining learning experiences. The intersection of education and digital gaming has given rise to a transformative educational approach called DGBL. Unlike traditional passive learning methods, DGBL harnesses the inherent attributes of games to provide interactive and experiential learning environments (Zhang et al., 2021). As a result, students are not mere recipients of information but active participants in their learning journeys.

Some of the most persistent problems in education today are low achievement and learning, behavioral, and emotional problems that cause many students to drop out of school. School dropout was thought to be a slow process, losing interest and feeling isolated. This was shown by the fact that they were always late, missed school, failed classes, got suspended, and switched schools (Finn, 1989). Even among students who finish the required number of years of school, some studies have found high rates of boredom, isolation, and disconnection with school. Studies have shown that high school students are often bored, staring out the window and counting down the seconds until the bell rings, and not interested in learning. However, Students do not always feel alone and disconnected when learning at school. Some situations can make learning more exciting, stimulating, and engaging, leading to more meaningful learning. People think that using games in education is a great way to combine knowledge with fun (Huizenga et al., 2009).

Engaging and motivating primary-level students presents a unique set of challenges owing to their developmental characteristics. Young learners exhibit varying attention spans, learning preferences, and energy levels. Although traditional forms of instruction are often used, it is common to find that students' interest levels are not sustained in this population. It identifies that although current research has made it

possible to use children’s natural inclinations to play in solving these challenges, the recent study shows that DGBL can address these matters (Cheong et al., 2022).

By adopting elements of gameplay including rewards, challenges, and progression of levels, DGBL encourages learning among the students in which they are motivated not only by reward but also by the mere fact that learning is a fun activity. Interest, with aspects like peoples’ attention being directed towards a given context, mental processing being exerted, and interaction taking place, was a strong motivation to learn. In this context, DGBL’s settings promote engagement because when the students are for instance asked to solve real problems the settings take them through the probable solutions to achieve the objectives (Connolly et al., 2020). They are incorporated into a context where situations are modeled reflecting real-life problems that students have to be able to solve through the application of knowledge gained. Thus, the DGBL brings a socio-constructivist perspective, which provides meaning and value to enhance learners’ motivation in knowledge acquisition and use of the knowledge.

The current rote memorization-based learning approach in Pakistan causes students to lose interest in learning, which ultimately results in school dropout. As technology develops, digital game technology in Pakistan is expanding. It is an innovative educational tool to enhance students' learning experiences. There is a growing body of researches on the use of DGBL and its impact on students’ engagement and motivation, but some research gaps still need to be addressed. These include the age of the students, the type of games used in DGBL, the subject used to be taught through DGBL, and the long-term effect of DGBL on students’ engagement and motivation. It is necessary to investigate the DGBL effect on the engagement and motivation of primary school students. Therefore, this study aimed at students’ engagement and motivation 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.

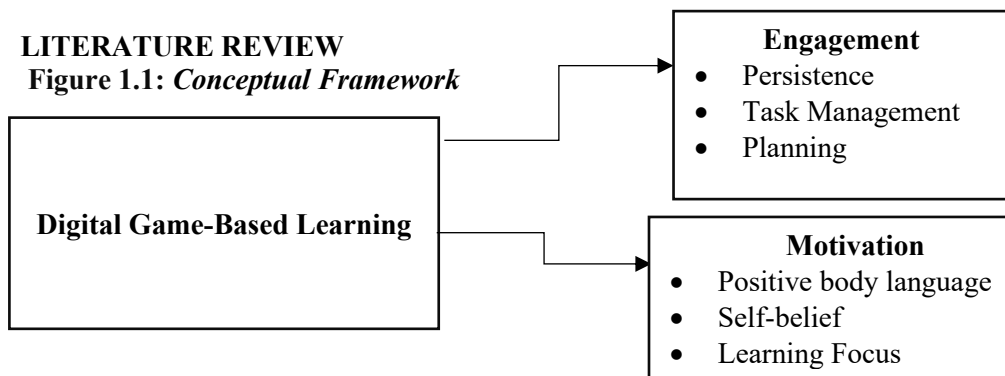


Figure 1.1 Conceptual framework developed by the researcher indicators of students' engagement and motivation taken from (Liem & Martin, 2012) and digital game-based learning.

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 can contain commercial off-the-shelf games that are used after being purchased and changed for educational purposes, in addition to games that are developed entirely with educational aim and intention. Here there is a significant shift in the dimension of education through the gamification concept making use of the inherent attraction of games in DGBL. It engages students in decision-making processes, problem-solving strategies and critical thinking processes, teamwork and good communication as well as innovation. DGBL is learning process where several factors such as challenge, reward, and feedback system as well as performance analysis are included with the aim of promoting learner interest (Huizenga et al., 2017).

Engagement

The effect of digital game-based learning (DGBL) on primary school student engagement has contributed significantly to our understanding of this subject. These studies have examined the relationship between DGBL and student involvement using a variety of study techniques and approaches, shedding light on the possible benefits and challenges associated with integrating digital games into elementary education. The results of this research show a positive correlation between DGBL and student engagement, with increased levels of active engagement, focus, and involvement in learning activities among students (Liu et al., 2020).

Connolly et al. (2020) carried out a meta-analysis of research on the impact of educational games on student success and engagement, including elementary school studies. According to the meta-analysis, educational games have a favorable impact on students' involvement and academic performance in a variety of topics. It was discovered that the games improved student engagement, motivation, and problem-solving abilities.

Motivation

In a study that involved Kiili et al. (2018), the researchers sought to determine the effects of game-based learning on mathematical literacy skills in a primary school. As a result of the research conducted into the study, it has been revealed that children who engaged in game-based learning were much happier, motivated, and well-rounded in

terms of mathematical fluency than their counterparts receiving regular class instructions. Those games also helped in problem solving, teamwork, and also facilitated active learning games among children.

Ouahbi et al. (2014) investigated if the integration of games will increase the impact of an introductory programming course. Following the research procedure, forty high school students from Morocco took part in the study. While the other half of the students practiced the Pascal programming school methods, the other half initiated English animations with the Scratch gaming context. When exposed to the Scratch gaming environment, the students theorized and reworded more independently and with less incentive than when exposed to normal paradigms involving Pascal programming. Self-generated motivational surveys that were administered at the initial and the end of the research yielded evidence of this.

Critical Summary

The literature review demonstrates that digital game-based learning has the potential to impact primary school students' engagement and motivation positively. The engaging and interactive nature of digital games can capture students' attention, leading to increased learning motivation. Additionally, individualized learning experiences, collaborative opportunities, and the incorporation of real-world connections can further enhance the effectiveness of digital game-based learning. However, it is essential to consider the pedagogical design, game content, and the alignment of learning objectives with digital game-based learning to ensure meaningful and applicable learning outcomes. Further research and empirical studies are needed to explore the long-term effects and effectiveness of digital game-based learning in the primary education context.

RESEARCH OBJECTIVES

1. To find out the effect of digital game-based learning on students' engagement.
2. To investigate the effect of digital game-based learning on students' motivation.

RESEARCH QUESTIONS

1. What is the effect of digital game-based learning on students' engagement at the primary level?
2. What is the effect of digital game-based learning on students' motivation at the primary level?

RESEARCH METHODOLOGY

Research Design

This study was experimental, and a Time Series design was used. The study was quantitative. Quantitative data was used to determine the DGBL effect on students'

engagement and motivation.

Experimental Procedure

Experimental design refers to the overall 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 selected a whole class of 20 students of grade 5 to participate in the experiment. The sample size was selected according to the study's 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. Parents' unfamiliarity with the results of digital games and their hesitancy to grant permission for their children to be taught through digital games in the 5th-grade class than researcher informed Parents 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 learning tools throughout the experiment. Students and researcher attended the orientation week to ensure that they understood the logistics and objectives of the study. This week, the researcher set up math games in the computer lab to facilitate digital game-based learning. Part of the installation process included setting up the required software and making sure the games functioned properly. The researcher could also talk to students and find out how comfortable they were with playing video games on the internet during orientation week. The researcher evaluated the pupils' comfort and passion levels by watching how they interacted with the games. With this knowledge, it would be easier to comprehend the attitudes and reasons of students regarding the use of digital games as a teaching tool in the future.

The researcher briefed the students during orientation week on the goals and requirements of the study as well as how math games will be used to enhance their

learning process. In the coming weeks, students will study a variety of arithmetic concepts and progressively introduce new obstacles. The pupils were informed and psychologically ready for the digital game-based learning. The purpose of orientation week was to lay the groundwork for the researcher and the students to come to a mutual understanding. Without preparing everyone for the ensuing digital game-based learning sessions, the experiment could not have been implemented successfully.

Intervention

During the experimental phase, to enhance pivot knowledge amongst Grade 5 children and to make learning fun, entertaining and interactive, a digital game-based learning intervention was introduced to use in the computer lab. During the intervention process the progressive approach was used, which means that several levels and subjects were introduced one after the other. In the first two days of the intervention, the researcher focused on the addition level, which is the level of the sums. The Researcher also filled an observation sheet in order to assess the motivational and engagement levels of the students in the learning process. During this time, the children were able to engage in addition math games throughout the class. It is flexible and many more ideas are practiced and reinforced in a friendly, fun, and engaging manner in the form of games.

The intervention continued for two days following the addition level throughout the subtraction level. The students were able to practice and enhance their comprehension of subtraction by engaging in math activities that corresponded to subtraction skills. The effectiveness of the treatment provided through digital games was successfully measured by the researcher using an observation sheet to assess the participants' motivation and level of participation.

The next phase of intervention, multiplication, continued for three days. Through interactive gameplay, math games help students improve their multiplication skills by emphasizing multiplication topics. After multiplying, division came; it took three days. Their understanding of division was made stronger through games on mathematics that focused on the concept. Two weeks into the program, a third chapter which involves employing fraction challenge games was introduced by the researcher. Through these games students were taught addition, subtraction, multiplication and division using fractions. The purpose of this chapter was to make students have a better grip on fractions

The fourth chapter was about decimal games and it started during the last week of the intervention. 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.

Population

The study was accomplished to find out the effect of Digital game-based learning on students’ engagement and motivation at primary level. Therefore, 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. So, the researcher selected one school. The school was selected through a lottery method. The sample selection of this school was taken through the 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 20 students in 5th grade studying the subject of Mathematics.

DATA ANALYSIS

The data collected from the daily observation sheet were analyzed using descriptive statistics.

Table 1: Engagement of students’ during digital games session

Ite ms	Persistence	Alwa ys	Ofte n	Some times	Rarely	Never	Mean
1	Pays attention in class	6	14	0	0	0	4.3
2	Students collaborate and work well with their class fellows.	4	16	0	0	0	4.2
3	Complete assigned work	5	14	1	0	0	4.2
4	Persistent when confronted with complex problems	5	12	3	0	0	4.1

5	Work on new assignments with sincere effort	4	15	0	1	0	4.1
6	Tries to finish assignments even when they are difficult	5	10	4	1	0	3.95
7	Gets not discouraged and continuously trying when encountering an obstacle in schoolwork.	7	10	2	1	0	4.15

Ite ms	Task Management	Alwa ys	Ofte n	Somet imes	Rarely	Never	Mean
1	Participates actively in discussions.	4	16	0	0	0	4.2
2	Asks Questions to get more information.	10	7	3	0	0	4.35
3	Raises his/her hand to answer a question or volunteer information.	6	13	1	0	0	4.25
4	Attempts to do his/her work timely and well.	8	11	1	0	0	4.35

Ite ms	Planning	Alwa ys	Ofte n	Somet imes	Rarely	Never	Mean
1	The students effectively prioritizes tasks	0	16	4	0	0	3.8
2	Organize their materials and workspace	4	13	2	0	1	3.95

3	The students arrive on time and are ready for class	3	15	2	0	0	4.05
4	The students have all the necessary materials (books, notebooks, stationery, etc.)	7	11	2	0	0	4.25

Table 2: Motivation of students' during digital games session

Items	Positive Body Language	Always	Often	Some times	Rarely	Never	Mean
1	Eye contact with the Teacher	6	12	2	0	0	4.2
2	Appropriate posture	8	10	2	0	0	4.3
3	Nonverbal response	3	15	2	0	0	4.05
4	Body Language Consistency	5	13	2	0	0	4.15

Items	Learning Focus	Always	Often	Somet imes	Rarely	Never	Mean
1	Active Participation	4	16	0	0	0	4.2
2	Attentive listening	8	10	2	0	0	4.3
3	Following directions	2	17	1	0	0	4.05
4	Asking Questions	10	7	2	1	0	4.3

Items	Self- Belief	Always	Often	Somet imes	Rarely	Never	Mean
1	Working independently	5	14	1	0	0	4.2

2 Problem-solving to get needed help	1	15	4	0	0	3.85
3 Confident to share ideas	4	12	4	0	0	4

Table 3: Weekly comparison of students' engagement

Engagement	Week 1	Week 2	Week 3	Week 4	Mean
Persistence	3.826	4.168	4.224	4.338	4.139
Task Management	4.05	4.3	4.35	4.45	4.2875
Planning	3.55	4	4.1	4.4	4.0125

Figure 1: Students' Persistence Weekly Comparison

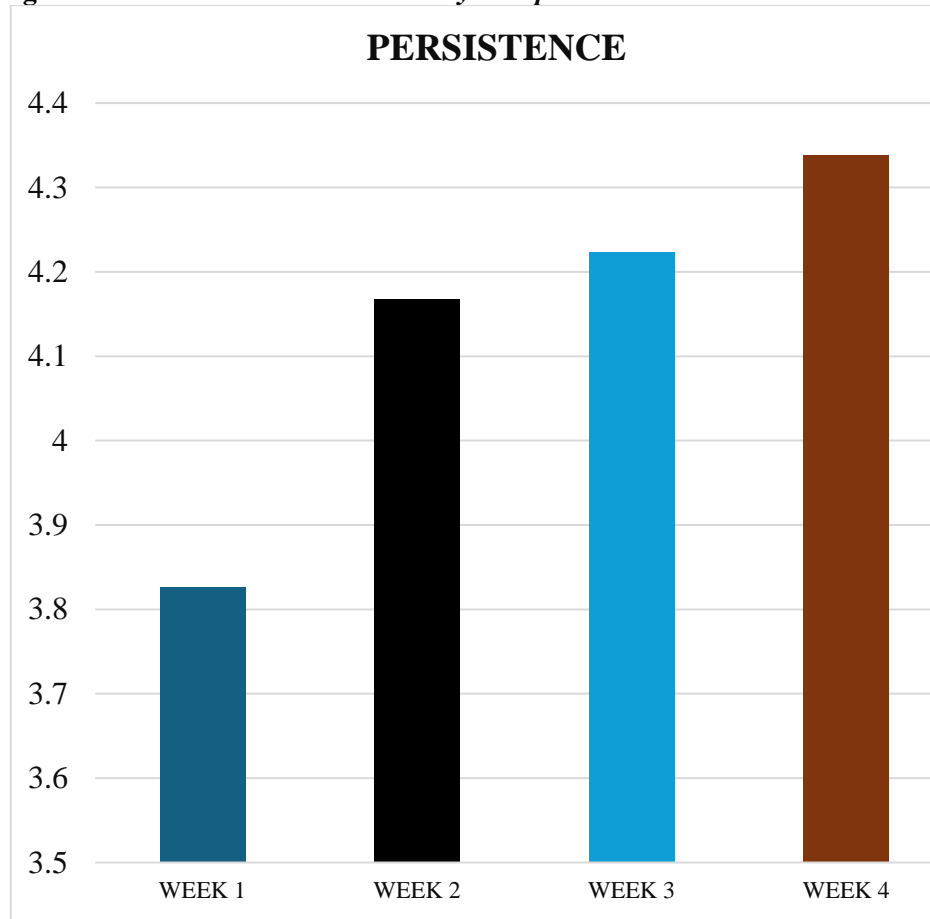


Figure 2: Students' Task Management Weekly Comparison

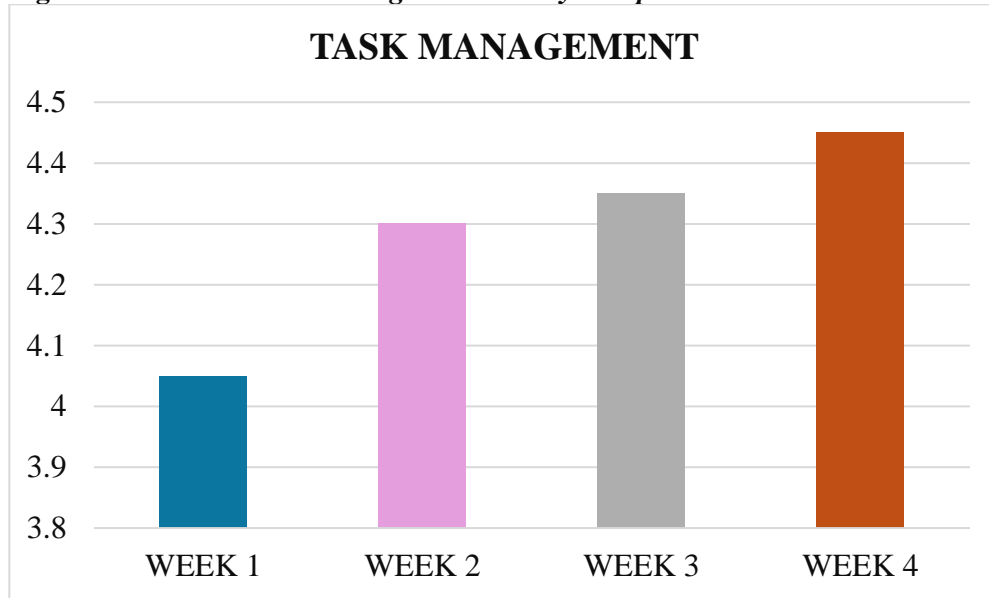


Figure 3: Students' Planning Weekly Comparison

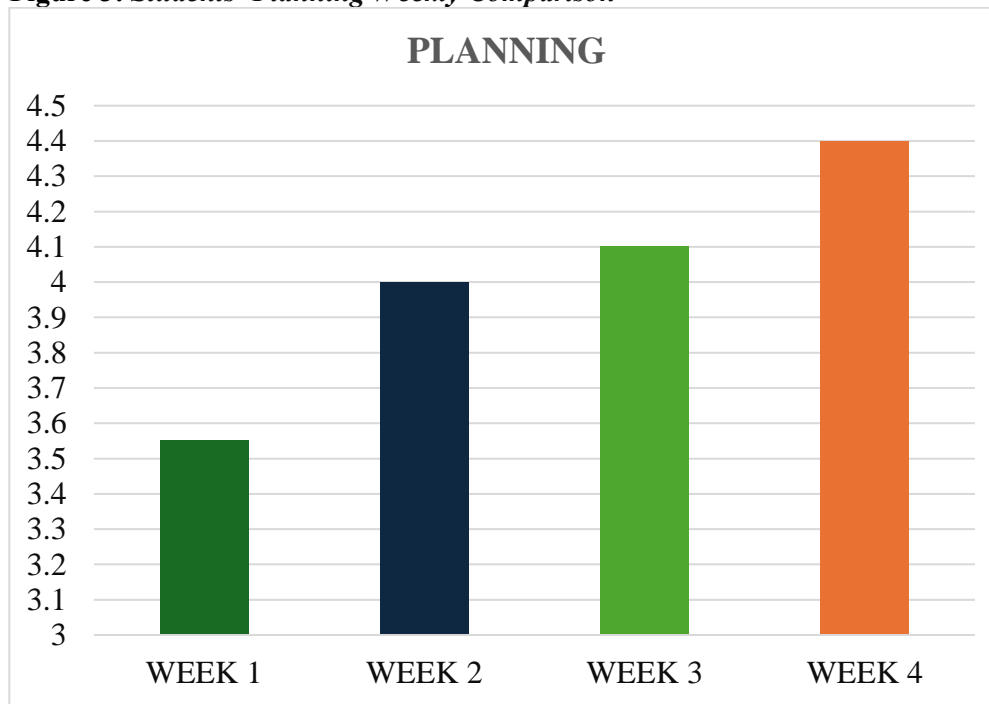


Table 4: Weekly Comparison of Students' Motivation

Motivation	Week 1	Week 2	Week 3	Week 4	Mean
Positive Body Language	3.95	4.2	4.2	4.35	4.175
Learning Focus	3.9	4.15	4.4	4.45	4.225
Self-Belief	3.864	3.93	4.064	4.198	4.014

Figure 4: Students' Positive Body Language Weekly Comparison

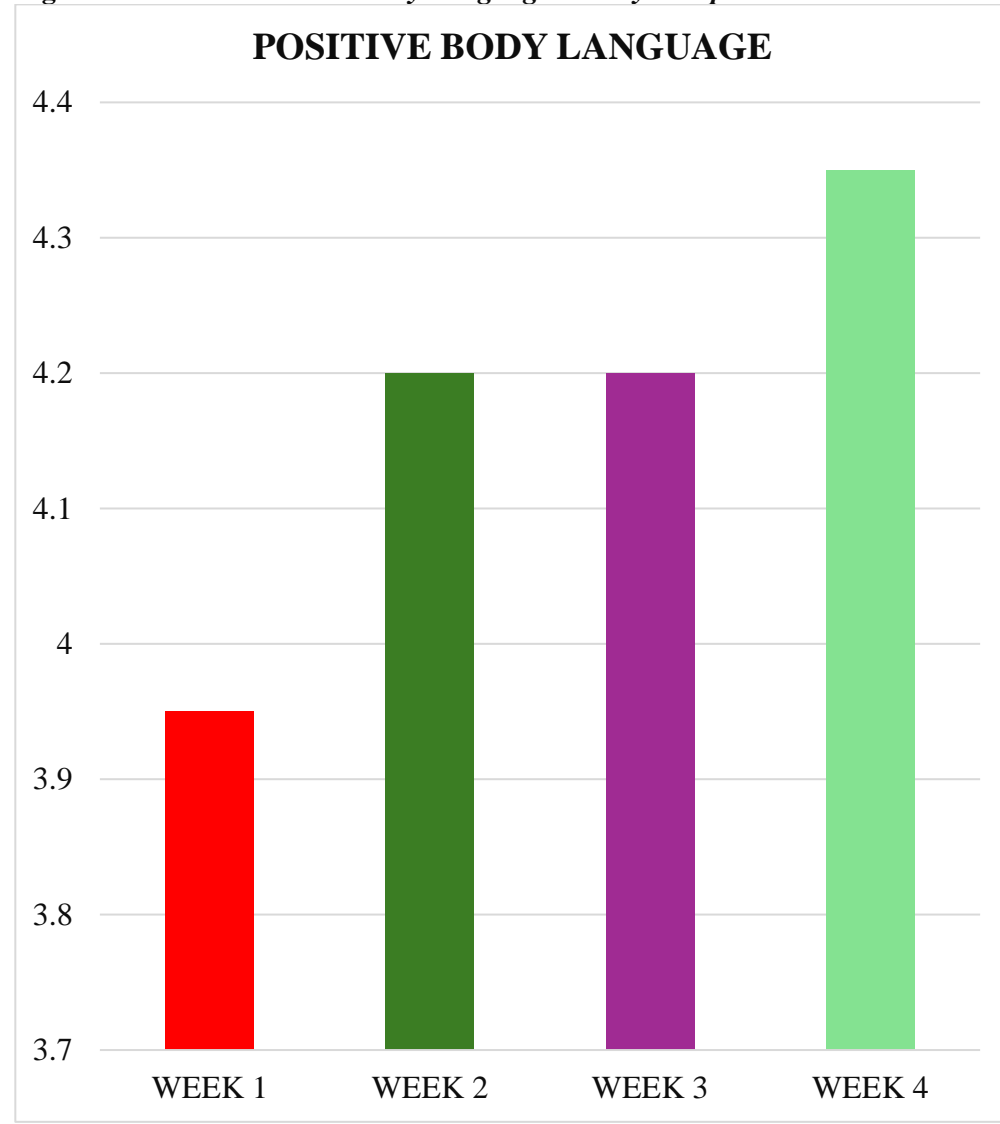


Figure 5: Students' Learning Focus Weekly Comparison

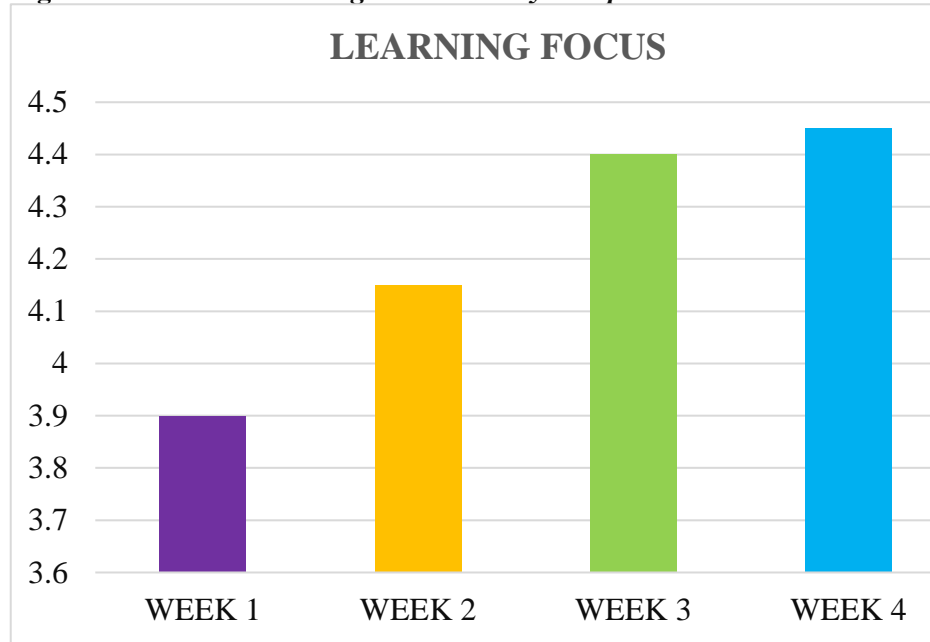
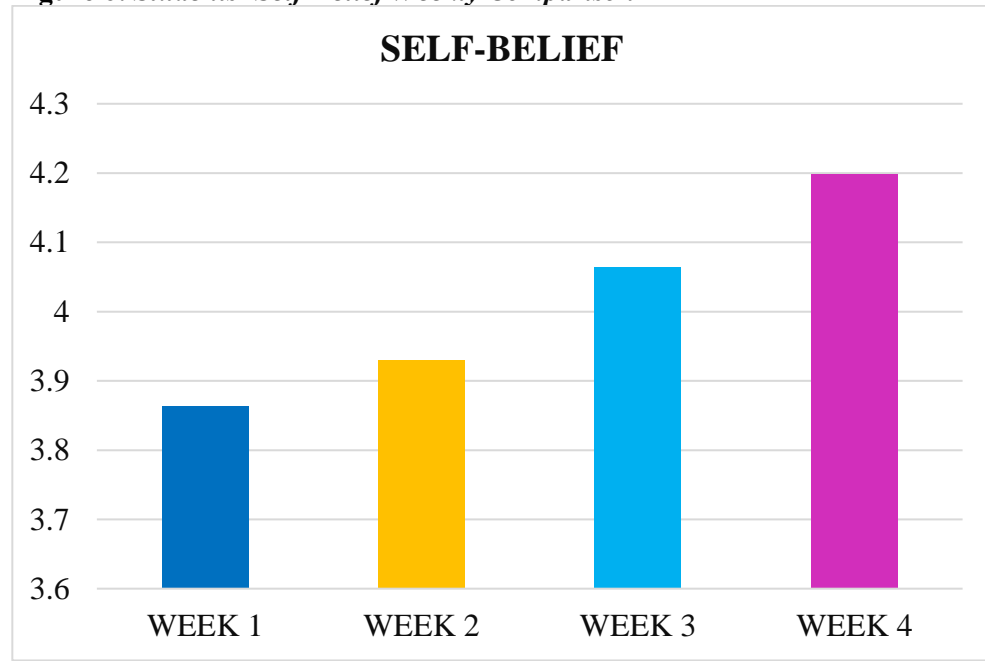


Figure 6: Students' Self-Belief Weekly Comparison



DISCUSSION

The study's statistical analysis and findings indicate that students consistently exhibited high levels of persistence, task management skills, and planning abilities in digital game-based learning. In the digital classroom, they had active discussions, showed good prioritization of tasks and maintained a positive body language that showcased their motivation. Importance should be given to increasing students' persistence over four weeks trial thus showing increased willingness by them to persevere in learning. Task management, planning, positive body language, learning focus and self-belief were enhanced as a result of digital game-based learning thus indicating its significance in improving student's motivation and overall engagement in education.

Recent studies emphasize that DGBL frequently integrates elements such as challenge, feedback mechanisms, and collaborative opportunities, thereby fostering autonomy and competence among learners (Chen & Tu, 2021; Wang et al., 2022). This integration leads to increased intrinsic motivation among students, enhancing their active participation and engagement in the learning process (Eyupoglu & Nietfeld, 2019).

The findings also demonstrate that the implementation of digital game-based learning (DGBL) significantly elevated levels of engagement and motivation among students. This corroborates the notion that digital games serve as potent tools for revitalizing learning experiences, especially when thoughtfully integrated into educational curricula (Sun et al., 2020). Recent studies emphasize that strategically incorporating digital games into learning environments enhances student engagement and motivation (Cadiz et al., 2023; Baek et al., 2015). During the intervention phase, students interacted with educational content embedded within digital games, revitalizing their interest and motivation toward the subject matter (Hung et al., 2020).

This indicates clearly that primary education level has been positively impacted on DGBL (digital game-based learning). These results are aligned with other recent research and provide significant evidence of the potential benefits of video games for educational purposes (Luo et al., n.d.; Gui et al., 2023). They recognize the value of digital games being used as valuable tools for enhancing learning including mathematics which often seems difficult to understand for some learners (Hwang et al., 2013; Tokac et al., 2019).

RECOMMENDATIONS

Students' persistence in digital game-based learning classrooms increases their engagement in learning. So, Educational institutions may embrace digital game-based learning as a tool for learning and particularly in subjects like mathematics that

students often perceive as challenging. This approach can foster an environment where students are more engaged to persist in their studies.

Students display strong task management abilities when engaged in digital game-based learning. Educators can capitalize on this by incorporating more digital games as learning tools that require active participation, diligence, and punctuality to further enhance these skills. Additionally, instructional designers may develop a variety of digital learning games that align with the curriculum.

Students demonstrated notable planning skills while using digital games, Instructional designers and educators may focus on designing and selecting games that provide personalized challenges and immediate feedback emphasize task prioritization and organization of materials. This can contribute positively to students' planning abilities in the broader context of their education.

Students demonstrated strong positive body language and learning focus abilities in digital game-based learning classrooms. These aspects of motivation can be cultivated further through the use of digital games. 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 students' learning focus.

Students demonstrated positive self-belief while learning through digital games So, Game designers can design digital games that promote independent work and cooperative game elements that can foster student collaboration and confidence. This approach enhances communication skills and self-belief.

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