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

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

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AUTHOR'S DECLARATION

This thesis, entitled "Effect of Digital Game-Based Learning on Students' Engagement and Motivation at Primary Level," has been written solely by myself, without any external assistance or unauthorized collaboration.

I also affirm that this thesis has not been previously submitted for any other academic qualification or degree. Any similarities between this work and the works of others have been appropriately referenced and attributed.

I understand the academic and ethical responsibilities of completing this thesis and take full responsibility for its content and authenticity.

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The thesis entitled "Effect of Digital Game Based Learning on Students' Engagement & Motivation at Primary Level" submitted by Farah Abdul Qadir Reg. 420-FSS/MSEDU/F21 in partial fulfillment of MS Education has been completed under my guidance and supervision. I am satisfied with the quality of student's research work and allow her to submit this thesis for further process as per IIUI rules and regulations.

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DEDICATION

I dedicate this thesis to the boundless grace and guidance of Allah, the Most Compassionate and Most Merciful. With heartfelt gratitude, I acknowledge His divine wisdom which illuminates my path throughout this academic journey.

I dedicate this thesis to my beloved parents, Siddiqa Bibi and Muhammad Abdul Qadir, whose unwavering love, support, and sacrifices drive my success.

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Farah Abdul Qadir

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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 5^{th} 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 collect 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 score. 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*

CHAPTER 1

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, fail classes, get suspended, and switch 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 was a great way to combined 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. 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.

Engagement, involving mental effort and active information processing, was a critical motive for learning. DGBL's immersive environments promote engagement 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.

Digital game-based learning (DGBL) has been said to help people learn and be more motivated. Mishra and Foster (2007), list over 250 examples of how game-based learning affects the mind or body. A literature review of research on learning through games could show how claims about games are based on real-world evidence. Researchers point out several problems with the investigation. For example, when it comes to game-based learning, most of the studies done so far show that it was an excellent way to learn, but many of them have destructive methods, are rarely

experimental, and come up with results that do not match up. Some reviews also include non-empirical research (like anecdotal or opinion-based articles) and low-quality research, or they leave out qualitative analysis. Also, the review methods are not explained in detail. This study focuses on the effects of digital game-based learning (DGBL) on students' engagement and motivation at the primary level. Engagement and Motivation are crucial factors in the learning process, significantly impacting performance. DGBL was an effective method of teaching that can improve students' engagement and motivation in the classroom. However, there is still a need for empirical evidence to support this claim.

1.1 Background of the study

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 engagement and motivation at the primary level. DGBL refers to seeking significant impact digital games as educational tools, leveraging the interactive and immersive aspects of gaming to create dynamic learning experiences.

Recent research has shed light on the impact of DGBL on primary-level students' engagement and motivation. With the rise of digital natives – students who have grown up in a technology-rich environment – educators seek methods that resonate with their digital fluency and preferences (Prensky, 2001). DGBL aligns with this trend, providing an avenue to harness students' familiarity with technology and their inherent enjoyment of digital interactions.

Engagement and motivation are critical factors in successful learning outcomes. However, maintaining students' interest and enthusiasm, especially in the primary years, can be challenging due to their varied learning styles and limited attention spans. DGBL offers a promising solution by capitalizing on the inherent motivation that arises from well-designed game mechanics, such as challenges, rewards, and progress tracking (Dickey, 2015). These mechanisms tap into students' natural curiosity and desire for mastery, contributing to sustained engagement.

When technology was 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 was 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 was 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 (“Teaching and Learning: Achieving Quality for All,” 2023).

Therefore, this study looked into the effects of digital game-based learning (DGBL) using instructional educational games, which could help change the current education system and give everyone a chance to learn something useful.

1.2 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. Digital game technology in Pakistan is growing as technology advances. 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 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 on 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.

1.3 Objectives of the study

This study has the following 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.

1.4 Research Questions

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

RQ1 What is the effect of digital game-based learning on students' engagement at the primary level?

RQ2 What is the effect of digital game-based learning on students' motivation at the primary level?

1.5 Significance of the Study

This study aims to contribute to research that applies to the field of primary education and to concentrate on DGBL in the context of formal educational environments.

Students, video game designers, curriculum developers, and educators can benefit from findings of the study. Video game designers and curriculum developers benefited from better planning and decision-making about successfully implementing digital game-based learning in schools. The Educators can arrange their instructional methods and make use of video games to increase the student's level of engagement, as well as their motivation.

This study also contributed to Students exploring digital game-based learning effectiveness on their learning. Overall, this study has significant implications for the contributing education field and can potentially improve the quality of education for primary-level students.

1.6 Delimitations of the Study

1. The study was delimited to all Campuses of Dr. AQ Khan School System in Islamabad.
2. The research study was experimental in nature. So, it was delimited to one school which was selected randomly.

3. The research study was delimited to grade 5 students of all Campuses of Dr. AQ Khan School System Islamabad.

4. This study was delimited to digital games (Math games: math for kids, Fraction challenge: math game, Decimal game).

5. Only Three chapters were included from the textbook of “Mathematics” recommended by Oxford University Press. These were “Number and Arithematic Operations ” (Chapter 1), "Fractions" (Chapter 3), "Decimals and Percentages" (Chapter 4).

1.7 Operational Definitions

1.7.1 Digital Game-Based Learning

Digital game-based learning is an approach to teaching and learning that involves using digital games to promote students’ engagement and motivation. DGBL combines game design principles with educational content to create a fun and interactive learning experience for students.

1.7.2 Engagement

A student's level of interaction with others, as well as the quantity of involvement and quality of effort directed toward activities that contribute to persistence and completion, are all factors that calculate a student's level of engagement (Hughes, 2021).

1.7.3 Motivation

The term "academic motivation" refers to the factors that influence a student's conduct in academic matters (Schunk et al., 2010). These factors include:

- The student's interest in academic activities;
- The student's capability on academic functioning;

- The amount of effort put into achieving academic accomplishment;
- The amount of persistence shown in one's work.

1.8 Conceptual Framework

Figure 1.1

Conceptual Framework

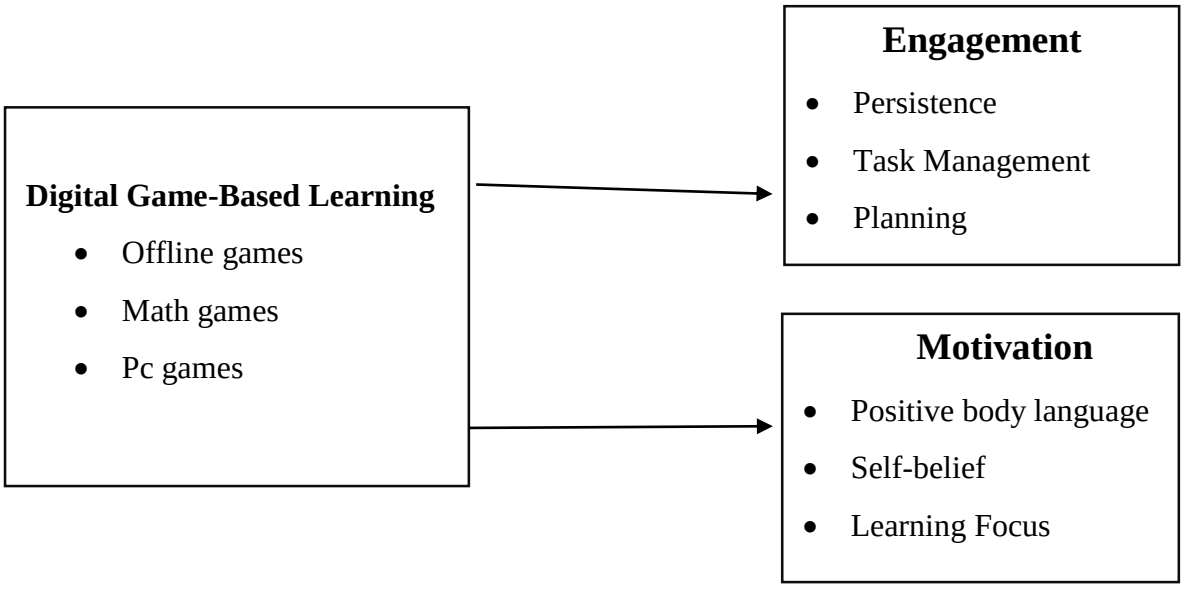


Figure 1.1 Conceptual framework developed by the researcher indicators of students' engagement and motivation taken from (Liem &Martin, 2012) and digital game-based learning.

CHAPTER 2

LITERATURE REVIEW

This section gives an overview of the relevant research on how digital game-based learning can change education to be better, fairer, and more efficient. It was start by giving a bigger picture of DGBL and then look at how DGBL affects engagement and motivation. It was looked at the research on how well and relatively digital games help people learn.

2.1 Digital Game-Based Learning

DGBL was broader term for learning in which players use computers, tablets, smartphones, netbooks, etc., to engage in an activity that helps them learn (Kiili, 2005). Learners are put in a virtual "gameplay" setting where topics and ideas are presented as rules, choices, and results instead of content to be taught or learned (Perrotta et al., 2013).

In a curriculum context, this means turning curriculum context laws of motion into game mechanics, which work by the rules set by game logic (Ulicsak & Wright, 2010). There may not be a single way to teach with serious games that teach. Older games were primarily based on the behaviorist theory of learning. However, newer games use theories like experiential, situated, and socio-constructivist learning (Kim et al., 2009). But getting the learning results you want depends on how the game was made, how the content was built into the game to make learning a natural part of playing, and how the game mechanics and logic work. The idea behind game-based learning was that it made people interested by making learning fun and getting them to interact with the subject. However, it was important to select games that were easy to use, keep people challenged and motivated, and help them reach their learning goals

(Chiu et al., 2012). 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.

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. By utilizing the inherent allure of games to produce immersive and interactive learning experiences, DGBL offers a novel approach to education. It encourages cooperation, communication, and creativity while actively engaging students in problem-solving, decision-making, and critical thinking. Challenges, rewards, feedback mechanisms, and progress monitoring are some of the components that DGBL hopes to include to produce an exciting and inspiring learning environment (Huizenga et al., 2017).

Digital games in DGBL can cover various topics and subjects, from science and mathematics to history and language instruction. They might be created for many age groups and educational levels, including primary education. Digital platforms, including computers, tablets, smartphones, and interactive whiteboards, can perform DGBL activities, providing flexibility in access and utilization (Eseryel et al., 2014).

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).

Effective primary education must include both engagement and motivation. Engaged students actively participate in the learning process, which improves their comprehension and memory of the material. Students more engaged in class are more likely to contribute to group projects, work cooperatively with their classmates, and take responsibility for their education. Additionally, motivation was critical to fencing students' motivation to learn and succeed. Students were more likely to be curious, create objectives, and persevere in the face of difficulties when they are genuinely driven (Papastergiou, 2009).

Werbach and Hunter (2012), developed a helpful model for visualizing game components and how they work together. The pyramidal structure comprises dynamics, mechanics, and components (aesthetic elements such as images and sound are omitted because they are more essential to the player's experience with the game than the game itself). The elements found on lower levels are either representations or implementations of the components that can be found on higher levels that are more abstract. Therefore, the broad conceptual components of the game are referred to as its dynamics. These components include limits, relationships, story, and progression. The components of uncertainty and challenges, competition and collaboration, feedback and incentives, and so on are all examples of mechanics.

These factors are what drive the activity forward. Lastly, components are particular manifestations of dynamics and mechanics with which the players engage directly and immediately. For instance, to give the impression that the player is progressing during the game, the game's mechanics could include challenges and feedback. These game mechanics can be implemented by deploying within the game

components like points, levels, content unlocking, achievements and badges (rewards awarded for accomplishing a specified set of activities), and so on. In other words, the game can be built around these components. It was essential to keep in mind that each component has the potential to stand in for more than one game mechanic or dynamic at any given time. For instance, points linked with a scoreboard can reflect feedback, growth, connections, and competitiveness (Hussein et al., 2019).

Motivated students exhibit more significant effort, focus, and perseverance, leading to improved academic performance. Moreover, engagement and motivation contribute to developing essential skills such as critical thinking, problem-solving, and collaboration. Engagement and motivation lay the foundation for lifelong learning and personal growth by fostering a positive and supportive learning environment.

The goal of the literature review in this situation was to searched for and evaluate current studies that look into how digital game-based learning (DGBL) affects motivation and engagement among primary school pupils. 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 was added to our understanding of how DGBL affects students' motivation and engagement by educating researchers, educators, and policymakers about the advantages and disadvantages of implementing DGBL in primary school. The literature review aims to offer insightful knowledge to help direct future studies, instructional strategies, and decision-making on DGBL in primary educational settings (Ronimus et al., 2019).

2.1.1 Benefits of Digital Game-Based Learning

Digital game-based learning (DGBL) has various cognitive, social, and emotional advantages for pupils in the primary grades. Regarding cognitive advantages, DGBL encourages better problem-solving abilities by giving pupils challenging assignments that demand critical thinking and decision-making. As a result of DGBL's interactive features, students can apply their knowledge in simulated settings, which improves their comprehension and memory of concepts. Additionally, DGBL encourages the growth of spatial thinking abilities by incorporating virtual navigation and object manipulation into its exercises (Zou et al., 2021).

Students can participate in multiplayer games or team projects thanks to the social and collaborative elements of DGBL, which encourage peer engagement and communication. This encourages the growth of interpersonal abilities, teamwork, and cooperation. Students are encouraged to cooperate, discuss ideas, and negotiate solutions through collaborative gameplay in DGBL, which promotes teamwork and problem-solving abilities. Additionally, the social component of DGBL increases student motivation and engagement since it fosters a sense of camaraderie and community among players (Papastergiou, 2009).

From an emotional standpoint, DGBL offers a pleasurable and satisfying learning experience, eliciting pleasant feelings and boosting students' passion for learning. Gamers may experiment, make mistakes, and learn from failure in a safe environment because of games' immersive and interactive aspects, which lower anxiety and fear of failure. Students gain a sense of satisfaction by overcoming obstacles and succeeding in the game, which raises their self-efficacy and confidence. This encouraging reinforcement extends to other academic assignments and enhances general drive and self-worth. (Huizenga et al., 2017).

DGBL has enormous potential to improve primary school children's motivation, engagement, and learning results. Educators can use the cognitive, social, and emotional advantages of DGBL to design engaging learning environments that are responsive to students' many needs and interests. Teachers can take advantage of these advantages and give pupils a more effective and engaging learning experience by successfully incorporating DGBL into elementary school.

2.1.2 Game Design Elements in DGBL

By affecting student engagement and motivation and altering the learning experience, game design components are essential to digital game-based learning (DGBL). The following are some essential game design principles frequently used in DGBL:

Students attempt to accomplish the aims and objectives of the games in DGBL. These aims may be in line with the curriculum's objectives or learning outcomes, giving a sense of using a graded difficulty level, DGBL pushes pupils as they advance. This component maintains students' interest and motivation by giving them a sense of achievement and advancement as they complete progressively challenging activities or levels.

In DGBL, feedback mechanisms are crucial for directing student learning and fostering motivation. Students may better understand their performance, make necessary changes, and develop their skills with immediate and constructive feedback. Rewards can also be utilized to recognize students' achievements and offer extrinsic motivation, such as points, badges, or virtual goods (Hsu et al., 2012).

Students are actively learning through engaging and immersive experiences provided by DGBL. Students can interact with characters or other game elements, manage things, and explore virtual worlds, which helps them feel present and involved.

Giving players options and freedom within the game encourages a sense of control and ownership over their learning process. Students can customize their gaming and the way they learn by incorporating decision-making chances, branching paths, or other adjustable aspects into DGBL(Eseryel et al., 2014)

The tales of storylines used in DGBL games frequently pique the student's emotional and intellectual interests. A gripping story may establish a context for learning, pique interest, and offer pupils a meaningful foundation for connecting with the subject.

DGBL might incorporate elements of cooperation and competitiveness to encourage interpersonal communication and motivation. Students are encouraged to collaborate, share ideas, and assist one another's learning through multiplayer modes or cooperative exercises. Leaderboards and timed challenges are two competitive components that might motivate students to work hard and get better grades.

Gamification-based learning (DGBL) can be used to gauge student learning. These tests can be easily incorporated into the gameplay to give pupils immediate feedback on their skills and knowledge. Game-based exams provide a more exciting and authentic way to evaluate student achievement than standard assessment methods.

Effectively utilizing these game design components, DGBL gives students an engaging and inspiring learning experience. These components encourage social contact, active learning, meaningful feedback, a sense of progress, and active lead

student learning. Computer educators can use these components in DGBL experiences to improve student motivation, engagement, and learning outcomes(Liu et al., 2020).

2.1.3 The Role of Teachers and Facilitators in DGBL

According to Eseryel et al. (2014) Teachers and facilitators are crucial in effectively implementing digital game-based learning (DGBL). Their involvement and guidance are essential for creating a supportive and enriching learning environment. Here are some key roles and responsibilities of teachers and facilitators in DGBL:

Instructional Design and Integration: Teachers are responsible for selecting appropriate games or educational software aligned with the learning objectives and curriculum. They must integrate DGBL effectively into their instructional practices, complementing and enhancing the learning experience. This includes identifying relevant game-based activities, creating connections between the game and curriculum content, and designing meaningful learning tasks.

Pre-Game Preparation: Before students engage with the game, teachers can provide pre-game instruction to set expectations, establish learning goals, and introduce key concepts or skills. They can clarify the relevance and connections between the game and the broader curriculum. This preparation helps students approach the game with a purpose and understanding of how it relates to their learning (Eseryel et al., 2014).

Game Selection and Evaluation: Teachers are responsible for selecting appropriate games that align with the learning objectives, student needs, and curriculum standards. They should consider factors such as educational value, engagement features, usability, and accessibility when evaluating and choosing games for DGBL.

Regularly assessing and evaluating the effectiveness of the games in achieving learning outcomes was also essential.

Monitoring and Facilitation: During gameplay, teachers monitor students' progress, engagement, and interactions within the DGBL environment. They provide guidance and support as needed, facilitating discussions, addressing challenges, and clarifying concepts. Teachers can foster a collaborative and supportive atmosphere by encouraging students to share strategies, collaborate, and reflect on their experiences.

Formative Assessment and Feedback: Teachers utilize formative assessment strategies to gauge students' understanding, performance, and progress within the DGBL environment. They provide timely and constructive feedback to students, highlighting strengths and areas for improvement. Feedback can be given within the game environment and during post-game reflections to guide students' learning and growth (Anastasiadis et al., 2018).

Reflection and Debriefing: Teachers facilitate reflection and debriefing sessions after gameplay to help students make connections between their experiences in the game and real-world contexts. These discussions encourage students to reflect on their decision-making, problem-solving strategies, and learning outcomes. Teachers can also guide students in relating their experiences to the broader curriculum and promote metacognitive awareness (Eseryel et al., 2014).

Differentiation and Individualized Support: Teachers recognize students' diverse needs and learning styles and provide differentiated support within the DGBL environment. They can offer additional resources, scaffolding, or modifications to ensure all students can access and benefit from the game-based learning experience.

Individualized support may also include addressing specific learning challenges or providing extension opportunities for advanced learners.

Ethical and Responsible Gameplay: Teachers promote responsible and ethical gameplay by guiding students on appropriate behavior, online safety, and digital citizenship. They foster discussions around the ethical implications and consequences of actions within the game. Teachers help students develop critical thinking skills and ethical decision-making abilities within the context of DGBL (Anastasiadis et al., 2018).

By fulfilling these roles and responsibilities, teachers and facilitators maximize the potential of DGBL to enhance student engagement, motivation, and learning outcomes. Their guidance, support, and expertise create a meaningful and impactful DGBL experience that aligns with educational goals and fosters students' cognitive, social, and emotional development (Hsu et al., 2012).

2.2 Engagement

Engagement is critical and helps learning, but it was hard to defined. It can be considered a student's willingness to do regular school things like follow the teacher's directions or turn in work when asked. The two might have some things in common with student motivation, but they differ.

Even though what it means has not changed much, there has been much growth in interest in student engagement. Engagement was primarily defined by things that could be seen, like students participating in class. Later, emotional or "affective" components, such as feelings of attachment, belonging, and enjoyment, were added to the idea (Connell & Wellborn, 1991).

The newest idea was cognitive engagement, which was based on how much effort a student puts into learning and what strategies they use (Fredrick et al., 2004).

Engaging students were very important for learning. Teachers today must do everything they can to keep their students' attention. Disengagement could cause students to not only do worse in school but also misbehave and have a terrible attitude.

2.2.1 Cognitive Engagement

Cognitive engagement was when a student had to work hard to understand complex ideas and, as a result, learns the most challenging skills (Fredrick et al., 2004). Students pay attention and keep working toward their goals, even when things are unplanned. Cognitive engagement is the work a child does in his or her mind to learn. It was not the same as a student doing well, who might do well but not be motivated to work harder than required. This kind of engagement includes things like wanting to work hard and being willing to be flexible when solving problems.

There are not many ways to tell if someone's mind is active. Most of them are self-reporting surveys that ask about work styles, how hard people liked to work, and how to deal with failure (Connell & Wellborn, 1991). Many questions also ask about the student's motivation and plan to study, like how they pay attention or used any new information they learn.

Observation was another way to determine whether the mind was active. This means you should watch how students check their work, explain their answers, and work hard to finish tasks (Helme & Clarke, 2007).

2.2.2 Behavioral Engagement

Behavioral engagement was shown when a student participates in social, extracurricular, or academic activities. The most intricate part of this kind of

engagement was the behavior change that leads to good performance, like talking to peers and working together. Behavior engagement also helps with cognitive engagement by making sure that students' actions show that they are interested. This can be shown in many ways, like asking questions, studying, participating in activities and conversations, doing homework, etc (Connell & Wellborn, 1991; Finn,1989). This kind of involvement is easy to measure because it is easy to see how students act. Most evaluations compare destructive behaviors to good ones.

Most of the time, behavior engagement is measured by self-report surveys, teacher ratings, or observations (Finn & Rock, 1997). Different signs of good behavior, such as following the rules or doing classwork or homework, are used in these methods. Being absent often, getting in the way of other students' work, or talking to other students are all signs of bad behavior. Work is a way to measure things like attention, persistence, and effort. There are other ways to measure how much students do outside school (Finn & Rock, 1997).

Observations are another way to measure how someone is engaging in their behavior (Stipek, 2002). Students' attention, how well they do their work, their enthusiasm can be measured on a scale from "off-task" to "deeply involved." The last way to measure behavioral engagement is through focus group discussions and case studies, which help collect detailed accounts of how students interact with their peers.

2.2.3 Affective Engagement

Affective engagement is a way to measure how people feel about learning and what they think about it (Skinner & Belmont, 1993). Students' feelings about their work, how much they appreciate it, and how they feel about it show how emotionally involved they are in their schoolwork. So, when students feel close to their classmates, teachers,

and school, they are emotionally engaged. The most common way to measure affective engagement is with self-report surveys that ask about teacher-student relationships or any feelings and values related to school or academic work (Stipek, 2002). Most questions ask students to rate their interest in learning tasks and write down how excited they are to try new projects (Chapman, 2003).

2.3 Motivation

Most instructional designers agree that the motivation variable is essential, but it is hard to define because it is a hypothetical concept that is hard to measure scientifically. Educational psychologists define motivation as the mental processes that give people the energy, direction, or purpose they need to change their actions (Kleinginna & Kleinginna, 1981). Motivation can change based on many factors and is made up of many different interests, values, perceptions, and actions that are closely related. There are many ways to explain what motivates someone. Most can be put into two main groups: physiological and psychological. Most physiological definitions of motivation use the word "energized" to describe how a person feels when motivated. In psychological definitions of motivation, the mental aspects of motivation are considered. Motivation is the thing that makes people do or not do something. Things like pleasure or interest drive intrinsic motivation, while extrinsic motivation is usually driven by wanting something from the outside (Broussard, 2004).

2.3.1 Importance of Motivation

Almost everyone agrees that learning and being motivated are two good things. Dewey said in 1986 that the most critical attitude is the desire to learn. If a person is more interested in a particular subject, they have more chances to learn about it. He says that intrinsic motivation makes people feel better about learning and helps them

spend more time and effort learning, and helps them spend more time learning (Schunk & Zimmerman, 2007). That a student's motivation is the most essential thing to consider when making a virtual university. It is essential to understand what motivates people so that you can use it correctly when making instructional activities. Knowing what conditions give people energy is essential to understand what makes people act as they do. Last but not least, instructional designers should be given much attention when making educational games (Duncan, 2020).

2.3.2 Measurement of Motivation

Parents or teachers often complete self-report questionnaires or rating scales to determine a person's motivation level. These instruments comprise different subscales, such as attributions, self-efficacy, interest, self-perception, curiosity, persistence, and enjoyment of learning. A few examples of well-known instruments are the Children's Academic Intrinsic Motivation Inventory (Gottfried et al., 2001), the Scale of Intrinsic Versus Extrinsic Motivational Orientation in the Classroom (Harter, 1981), and the Instrumental Competence Scale for Children. Made these instruments (Gottfried et al., 2001). However, when these tools are used with elementary school kids, they need to be changed so that the language does not cause too much stress. These changes include reading things out loud and making the rating scales easier to understand. (Lange & Adler, 1997).

Behavior indicators can also be used to figure out how motivated someone is. Some studies use "free choice persistence," which looks at how long people do something after the rewards are removed (Deci et al., 1999). The use of effective reading strategies, which can include things like organization, rehearsal, or understanding, is another thing that can be judged. Another sign that someone is persistent is if they talk to themselves while doing a task or asking for help. When

working on complex tasks, learners with high levels of motivation can maintain a high level of persistence, but learners with low motivation tend to give up or work less hard in these situations.

2.3.3 Extrinsic and Intrinsic Motivation

The challenge of gaining an understanding of people's motivations, or the psychological factors that drive their actions, is not only challenging but also extremely important. To accomplish this goal, psychologists have produced an understanding of different theories of motivation; nevertheless, this examination was focused on a single strategy in particular. This model of motivation is founded on cognitivism and differentiates between two significant forms of motivation: intrinsic and extrinsic. (Deci et al., 1999).

The individual is the source of their intrinsic motivation, which is neither affected by nor dependent on any rewards or influences from the outside world. It refers to the pleasure or interest of participating in the activity and can potentially be more influential in education than its equivalents based on extrinsic factors. Studies have shown that naturally motivated students have a greater thirst for knowledge and are more ready to enhance their abilities. (Wigfield et al., 2004)

On the other hand, extrinsic motivation is derived from sources that are external to the person. It is a term that refers to acts carried out to attain an outcome or reward unrelated to the work at hand, the most common example of which is financial gain.

According to O'Donohoe and Vedrashko (2011) the SAPS framework classifies extrinsic rewards into the following four categories: status, access, power, and stuff. This classification is used in the context of gamification. Rewards consist of acknowledgment, respect, and adoration for one's accomplishments, while status is how

others view an individual. The term "access" refers to prizes that include an element of exclusivity, such as objects or content that cannot be opened in any other way than by completing the job. Within the context of the gamified setting, "power" refers to the rewards and capabilities of the player. The term "stuff" refers to various tangible and intangible objects, including products, currencies, and other forms of value.

When building these kinds of systems, one must be aware of the limitations of using extrinsic motivators. Research conducted by Gneezy and Rustichini (2000) has demonstrated that their influence on performance is not monotonic and that improper use of extrinsic rewards can be demotivating. In their experiment, subjects were divided into four treatment groups, and each group received a set payment for correctly answering 50 questions taken from an intelligence test. In addition, subjects in the second, third, and fourth groups earned 0.1 New Israeli Shekel (NIS), 1 NIS, and 3 NIS each correctly answered question, respectively. The average number of correct answers in the first group was 28, but in the second group, it dropped to 23, while in the third and fourth groups, it remained consistent at 34. According to these findings, the value of monetary awards that are not exceptionally high can hurt performance. The authors explained this behavior as a result of the fact that the subject can interpret an insufficient reward as being insulting. In addition, there is evidence of an over-justification effect, in which the pursuit of extrinsic benefits crowds out the pursuit of intrinsic pleasures.

According to Lepper et al. (1973) theory of intrinsic motivation. The researchers discovered that children who demonstrated an inherent interest in an activity (such as drawing) had a decreased level of intrinsic motivation after obtaining expected benefits, i.e., when they had previous knowledge of the reward. This was the case even if the children had shown an inherent interest in the activity. On the other hand, intangible (such as verbal praise) and unexpected incentives do not appear to cause this effect.

Both of these fundamentally different kinds of motivators can be seen thriving in an academic setting. The pleasure of learning and the desire to improve oneself are examples of intrinsic motivation, while things like grade reports and the possibility of punishment are external motivators. The hope of a better career and higher social position gained through education is an example of an external motivator. At least up to a certain age, it is not easy to think that many children place great significance on long-term goals such as a profession. Furthermore, recurrent failure can diminish an individual's intrinsic motivation, meaning pupils who underperform are even less driven to improve their performance. Ultimately, the reality that studying is "not fun" tends to triumph over the various motivators made available to students inside the educational system.

Even though almost everyone is familiar with and can comprehend the concept of fun, it is not easy to explain. When conducting a scientific and systematic analysis, the fact that most dictionaries include references to enjoyment or amusement in their definitions is insufficient. As is the case with games, this is due to the expansive nature of the idea and the challenge of encapsulating all of the pursuits that might be seen as enjoyable under a single all-encompassing term. The situation is further complicated because having fun is often a very individual and subjective experience. Indeed, various people find pleasure in a variety of activities, including the following:

Some people love the thrill of a challenge or the opportunity to solve a problem, while others are more inclined towards leisure and favorable odds. As an illustration, some people find collecting stamps or other memorabilia enjoyable, while others find that activity dull.

Putting the idea of fun into many categories is one technique to gain a deeper understanding of the concept. The Four Keys to Fun technique was developed by XEO

Design, a consultancy and game design firm (Lazzaro, 2004). This approach is one example of an attempt to classify fun in this manner. This way of looking at things recognizes four distinct types of enjoyment related to various feelings. The participants' imaginations are sparked and inspired to explore and be creative due to easy fun related to a laid-back environment, curiosity, and a pleasant surprise. On the other hand, having hard fun involves overcoming challenges, gaining new knowledge, accomplishing goals, and finding solutions to problems; it is associated with feelings of satisfaction, pride, and irritation. Pleasure with other people necessitates engaging in various forms of social contact, including collaboration, communication, and competitiveness. The third category is the seemingly severe paradoxical fun: the fun in doing things that have purpose and significance outside of the context of the game, for oneself or others (for example, environmental action, aiding one's community, etc.). This category describes the fun of doing things with purpose and meaning outside the game's framework. Other scholars have also developed taxonomies of fun that are conceptually similar to the one described above. For example, Hunicke et al. (2004) developed a fun taxonomy subdivided into eight categories: sensation, fantasy, narrative, challenge, fellowship, discovery, expression, and submission. It is essential to acknowledge that there are numerous forms of enjoyment, some of which may be better suited for and more productive in an educational setting than others.

It is essential to remember that these categories do not exclude one another and that a single activity or game may varying degrees, incorporate elements from multiple categories. Placing excessive emphasis on a single facet of enjoyment is terrible because it may lead to lost possibilities for participation in activities. There are moments when joy materializes out of nowhere; yet, to reliably deliver fun as a product, games should be made in a way that taps into a diverse range of feelings, which allowed

them to elicit various types of motivation in players. This is the best method for games to serve as a motivator.

2.4 Factors Influencing Engagement and Motivation in DGBL

According to Hwa (2018) several factors influence student engagement and motivation in digital game-based learning (DGBL) environments. Understanding these factors is crucial for designing compelling DGBL experiences. Here are key factors that influence engagement and motivation in DGBL:

Game Design Features: The game's design features significantly influence student engagement and motivation. Elements such as clear goals, challenging tasks, interactive gameplay, feedback mechanisms, rewards, and progression systems contribute to a compelling and immersive learning experience.

Autonomy and Choice: Providing students autonomy and choices within the game fosters a sense of ownership and control over their learning. Allowing students to make decisions, customize avatars or gameplay elements, and select pathways or challenges promotes intrinsic motivation and engagement.

Social Interactions: Incorporating social interactions within DGBL can enhance engagement and motivation. Collaborative gameplay, multiplayer modes, or online communities provide opportunities for students to interact with peers, share ideas, collaborate on tasks, and engage in healthy competition, fostering a sense of belonging and motivation.

Feedback and Progress Monitoring: Timely and informative feedback is crucial for maintaining student engagement and motivation in DGBL. Providing feedback on students' progress, performance, and achievements helps them understand their strengths and areas for improvement and guides them toward mastery.

Personalization and Relevance: DGBL experiences that are personalized and relevant to students' interests, preferences, and prior knowledge tend to be more engaging and motivating. Tailoring the game content and challenges to students' individual needs and incorporating real-life contexts or scenarios increases the perceived value and meaningfulness of the learning experience (Hwa, 2018).

Competence and Success Experiences: Students' sense of competence and belief in their ability to succeed in the game influence their engagement and motivation. DGBL experiences that scaffold learning, provide appropriate challenge levels, and offer opportunities for incremental success can boost students' confidence, self-efficacy, and motivation.

Teacher Support and Guidance: The role of the teacher in facilitating DGBL experiences is essential. Teachers who provide instructional support, guidance, and encouragement can positively influence student engagement and motivation. Teacher involvement in monitoring progress, providing feedback, and facilitating discussions or reflections related to the game can enhance students' learning experience.

Individual Differences: Recognizing and addressing differences in learning preferences, cognitive abilities, and motivational profiles is essential in DGBL. Students may respond differently to specific game design elements or instructional approaches, and considering these individual differences can optimize engagement and motivation.

By considering these factors, educators can design DGBL experiences that effectively engage and motivate students. The thoughtful integration of game design features, social interactions, autonomy, feedback, personalization, teacher support, and consideration of individual differences can create a rich and immersive learning

environment that promotes student engagement, motivation, and learning outcomes (Hwa, 2018)

2.5 Relationship between student engagement and motivation:

Nayir (2017) states that engagement and motivation in class are essential for active learning. They must be extremely driven for this purpose. In other words, highly motivated students attempt to engage in class. Consequently, knowing students' motivation levels is essential for class participation.

Pellikaan (2021) states that engagement is a sense of purpose, belonging, and dedication to an organization, whereas motivation is the willpower and desire to act upon these emotions. Students' engagement serves as the basis to perform their best work, whereas motivation is the fuel or energy required to perform that task. Engagement and motivation are distinct concepts.

Students in school may be highly driven but not actively engaged. Motivated, disengaged students were likely leave school for greater chances or simply another school with more effective engagement techniques.

It is also possible for a student who is engaged but unmotivated. They have created ties to study and believe in the broader objective. However, there is no direct incentive for them to participate individually because they already gain satisfaction from group efforts. (Pellikaan, 2021).

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

According to Ray and Smith (2010), a child's foundation for future learning is always based on their education when they are younger. In recent years, there has been a need to improve children's reading skills; yet, in a world where everything is

connected through information and communications technology (ICT), proficiency in mathematics has become just as vital as literacy (Frye et al., 2013). Children unable to acquire the necessary understanding of informal mathematics throughout their formative years sometimes struggle with formal mathematics when they start school and eventually fall behind their peers. According to Bodovski and Farkas (2007) children with poor mathematics achievement at early grade levels demonstrate slower progress as they age. According to Appleton and Lawrenz (2011) a student's early knowledge is an excellent predictor of their later success in a subject, and persistent problems in a subject are typically the only reason a student fails high school and does not continue their education at a postsecondary institution.

Recent studies have shown that playing age-appropriate, well-designed digital games can provide an individualized, student-centered learning experience that improves mathematical abilities and fosters inclusive learning. According to Outhwaite et al. (2017) there is an inverse relationship between the repetitive and interactive features of digital games and the amount of cognitive task demand. This means the more competitive and interactive a game is less cognitive task load it places on students. This is especially helpful for students who struggle academically and have poor memory skills. It would appear that interactive treatments based on tablets containing these elements have a good chance of narrowing the achievement gap in mathematics over time.

According to Coştu et al. (2011) educational games may also favor students' attitudes toward the subjects they are learning, particularly among upper-elementary and lower-secondary school pupils. Students participated in a study led by Coştu and colleagues (2011). In this study, the students recognized the benefits of learning through games and exhibited good attitudes toward using game-based learning in mathematics

classrooms. A research titled "Ke (2008)" investigated the possibility of using computer mathematics games as an anchor for math instruction. According to the findings, game-based tutoring is dynamic in terms of its timing, initiation, substance, style, and the reaction it creates in the tutee, and it also improves students' performance on state tests (Ke, 2008). This study has the potential to operate as a springboard for additional investigation into the use of educational gaming as an instructional artifact to supplement various other teaching strategies.

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 through the use of [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 more extraordinary patience 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.

Because a strong foundation in mathematics is essential to academic achievement across the curriculum, children must begin their school careers with a strong foundation in mathematics. Due to this, it is necessary to have an early

intervention that is also effective to fill up any gaps that may exist in their formal knowledge. The early encouragement of students' mathematical education can have a significant and long-lasting positive impact on their lives and assist in developing foundational skills essential for their future. Beginning in preschool, educators and parents need to adopt a mentality that places equal importance on reading and mathematical reasoning to pave the way for children's learning in the early grades. This allowed for a more seamless transition into the elementary years. The majority of the previous study has concentrated on a curriculum that is based on a level that is higher than middle school. This is because collecting results via student-answered surveys and questionnaires is more straightforward when the curriculum level is higher. Because there are many constraints, research conducted in primary schools is more challenging to carry out, and as a result, it has been shunned to a large extent. Also, researchers never used their application, developed with the same goals in mind as classroom instruction, to carry out the research. In the classroom, there is less evidence of developed programs being evaluated on handheld mobile devices like tablets; these tests were carried out on desktop or laptop computers. It is of the utmost importance to examine the impact of these more recently developing technologies on educational practices because the boom in the usage of personal computers is progressively waning in favor of the rising use of smartphones and tablets (Clements & Sarama, 2020).

2.7 Theoretical Review of Digital Game-Based Learning

The theoretical framework section of the literature review provides a conceptual foundation for understanding the role of engagement and motivation in learning. It explores the theoretical models and frameworks that support using digital game-based learning (DGBL) to enhance students' engagement and motivation at the primary level.

Theoretical Models Supporting DGBL and Engagement: This subsection presents various theoretical models and frameworks that provide insights into the relationship between DGBL and student engagement. Examples of such models include Self-Determination Theory (SDT), which emphasizes intrinsic motivation, autonomy, and competence; Flow Theory, which focuses on the optimal experience of being fully immersed and engaged in an activity; and Social Cognitive Theory, which highlights the role of observational learning and social influences in fostering engagement.

Theoretical Models Supporting DGBL and Motivation: This subsection explores theoretical models and frameworks that support using DGBL to enhance student motivation. It may include models like Achievement Goal Theory, which examines how students' goal orientations (e.g., mastery goals, performance goals) impact their motivation and learning outcomes; Expectancy-Value Theory, which explores the beliefs and values students associate with their learning tasks; and the ARCS Model of Motivation, which focuses on attention, relevance, confidence, and satisfaction as critical criticals influencing motivation.

Since gamification as a field of study is still very new, there are not many well-established theories about the topic. There are also some apparent differences in how gamification should be defined. Constructivism is the idea of "learning by doing," which can be implemented in the digital age through game-based learning. Students can learn how to solve problems and make decisions independently through games (*Constructivism*, n.d.). You can also change how the interactive tasks work. This is a Chinese saying. "Tell me, and I will forget." If you show me, I might remember. Involve me in, and I will learn." With game-based learning tools, students and workers interested in learning can embrace it instead of seeing it as a burden.

2.8 Empirical Researches

2.8.1 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 or not 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.

Turkay and Adinolf (2012) researched how digital games and collectible card games influence the players' ability to learn new things. These games may contribute to a learning ecosystem by analyzing how collectible card games (CCGs) stimulate innovativeness, understanding, and logical thinking and how these components could assist players in integrating information and developing abilities that may be difficult to train in a classroom context.

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 particular learning method was beneficial for children.

Al-Mansour and Al-Shorman (2012) built software for the students of King Saud University to use to evaluate the effectiveness of computer-assisted language learning as part of their contribution to the research that Al-Mansour and Al-Shorman were conducting to support the research. To instruct students in the English language, they built the software. A control group and an experimental group were developed so that the impact could be measured. They are students from the university who were taught English using both the computer-assisted language learning (CALL) approach and the more traditional way. Nevertheless, the findings of study showed that the experimental group's achievement demonstrates the good impact of this teaching technique. Students can learn a foreign language in less time by keeping them engaged in the learning process. This keeps the students motivated, which accelerates the learning process.

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, it would appear that 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.

2.8.2 Empirical Research of DGBL Impact on Engagement

Insights into this topic have been greatly aided by earlier research on the impact of digital game-based learning (DGBL) on student engagement at the elementary level. These studies have investigated the connection between DGBL and student engagement using various research methods and methodologies, illuminating the potential advantages and difficulties of incorporating digital games into primary education. According to the findings of these studies, DGBL and student engagement are positively correlated, with students exhibiting higher levels of active engagement, focus, and involvement in learning activities (Liu et al., 2020).

Several aspects of game design, instructional techniques, learner characteristics, and instructor facilitation might affect student engagement in DGBL settings. However, studies have also drawn attention to issues that need to be addressed, such as technological constraints, restricted access to technology, and unwanted distractions. This collection of research provides a basis for understanding the influence of DGBL on student involvement by synthesizing the data from several studies. It also offers insights into effective practices and topics for further research. Future studies in this area can expand on these findings to further our knowledge of how DGBL can improve student engagement at the elementary level.

Several studies have been conducted to investigate the effects of digital game-based learning on students' engagement and motivation at the primary level. One such study by Hwang et al. (2013) explored the impact of digital game-based learning on student engagement and motivation in a primary school setting. The findings revealed that students who engaged in digital game-based learning demonstrated higher engagement and motivation than those who used traditional instructional methods. The

use of games enhanced students' enjoyment, concentration, and willingness to participate in learning activities

Ke (2008) used various methods to study how educational computer games affect math skills, self-awareness about how you learn, and a positive attitude toward learning math. Fifteen kids in grades 4 and 5 took part in the study. During their math program over the summer, they played a series of games on the web called ASTRA EAGLE. Tools such as attitude surveys, questionnaires, an in-field observation protocol, and a 30-question math test for game abilities were utilized to compile and analyze the study results. The results showed that: 1) the gaming sessions made the students feel better about learning math, but it did not change how well they did on tests; and 2) not all math games are as interesting for kids as others; it depends on what they do in the game story.

Schaaf (2012) compared DGBL activities with practical, research-based learning strategies to see if there were any differences in how students behaved and how interested they were in the task over time. Students in Grades 3 through 5 were chosen at random, and their data were collected through surveys about their attitudes and observations of how long they spent on tasks during eight lesson cycles. The Candy Factory and Pearl Diver games from DGBL were used to teach half of the students, while the other half were taught differently. In the tests, more students in the DGBL groups were interested and spent more time on tasks than in the groups that used other methods (Schaaf, 2012). However, sometimes, it was the other way around. (Schaaf, 2012) concluded that DGBL can get students as interested as other research-backed learning strategies. However, it cannot always be considered the best teaching method and should only be used when students need fun and exciting experiences.

In Annetta et al. (2009) did a quasi-experimental study to determine what students thought and felt when playing the genetics video game MEGA. The experimental group had 66 students, and the control group had 63 students from four classes. Both groups had gone to the same high school. The result was based on how well the students did on a genetics unit test and how well they did on tests using The Protocol for Classroom Observations. (Annetta et al., 2009). They did not find any difference in how much students learned when they played games on desktop computers for 90 minutes, but they did find a big difference in how interested the students were in the game.

Another study by Connolly et al. (2020) involved a meta-analysis of studies examining the effects of educational games on student engagement and achievement, including studies conducted at the primary level. The meta-analysis showed that educational games positively affected student engagement and achievement across various subjects. The games were found to increase student motivation, active participation, and the development of problem-solving skills.

Huizenga et al. (2009) researched how playing a mobile city game affected the participants' level of interest, motivation, and overall learning. The Wagg Society made frequency 1550. It was a board game played by people who knew about the history of Amsterdam. The authors used a "quasi-experimental" method to study a group of 485 students from 20 different classes at five different institutions. Half of the students played the mobile history game, while the other half participated in traditional, project-based classroom learning. Students' levels of engagement were seen and written down on observation sheets. Their motivation levels were measured using a modified questionnaire version used in previous research. The student's understanding of the topic was judged by how well they did on a thirty-question test that was made just for

them. The researchers (Huizenga et al., 2009) found that the experimental group that played the game was more interested and learned more than the control group. However, there was no apparent difference between the experimental and control groups in their interest subjects.

Facer et al. (2004) made the mobile game Savannah to help kids learn more about how animals act. People play the game on their phones. They did a study to find out how kids used the game and what they learned from it. Ten kids between 11 and 12 looked at the game and gave their opinions. During the testing, the kids played two games where they were lions and used GPS-enabled personal digital assistants as mobile clients to a game server on a personal computer. The analysis was based on what the students said in interviews and what they saw with their own eyes. Students were very interested in and enjoyed playing the game. As a result, the prototype gave an exciting look at how mobile gaming could help people learn and pointed out some problems with this way of learning and the way resources are made.

Samur (2012) looked into the effects of educational games and virtual manipulatives by finding ways to measure how interested students are in the content. The research was based on a design that was called "quasi-experimental." It had three experimental groups and one control group, and each of the experimental groups was made up of kids from fifth-grade classrooms. People in the experimental groups were able to play Candy Factory and Pearl Driver, and they also did exercises with virtual manipulatives. People in the control group worked on exercises simultaneously with paper and pencil. Questionnaires that measured how much people took part showed that people in the groups who played educational games were likelier to take part than those in the other groups.

2.8.3 Empirical Research of Digital Game-Based Learning on Motivation

Ouahbi et al. (2014) used games to teach an introductory programming course and evaluated how well it worked. Forty Moroccan high school students took part in their research. Half of these students made animated English stories in the Scratch game environment, while the other half used the usual Pascal programming classroom methods. Students who used standard Pascal programming methods were less motivated and learned less independently than those who used the Scratch gaming environment. This was shown by motivational surveys at the beginning and end of the research.

Trevino-Guzmán and Pomales-Garcá (2014) gave a group of 44 first-year college students and students in pre-college programs a computer game based on core industrial ideas. The data was collected through interviews and online pre-test and post-test questionnaires using a local questionnaire distribution system. According to the research (Trevino-Guzmán & Pomales-Garcá, 2014), the results showed that the students who participated in the gaming activity learned more about the subject and were more motivated to go to college. The authors concluded that games could be a good way to be excellent and keep the best talent.

After playing the game, Su and Cheng (2013) made a 3D simulation to teach students about software engineering and see how motivated, happy, and good at learning the students were. Sixty-three people in tertiary education took part in the study, and the research was done in a way that was almost like an experiment. The educational program for software engineering has a section on the waterfall development process, and this game was made to teach it. The control group used traditional one-on-one instruction, while the experimental group used an innovative game-based learning method- and pre-and post-tests were given to see how much the

students learned. Motivational surveys were given to see how well the teaching method worked. The results showed that students in the experimental group who used the 3D game-based approach did better in school and were more motivated to learn than students in the control group. The results also showed that game-based learning was more popular with students because the challenges sparked their interest and got them involved in the learning activities (Su & Cheng, 2013).

Yang researched in (2012) to determine if DGBL helped students improve their problem-solving ability, desire to learn, and academic performance. The research was done in a way that could be called "quasi-experimental," and 44 high school students were tested on what they knew about civics and society. Half of the students were taught using traditional methods, and the other half were taught using digital games. During a semester, students took tests before and after class to see how well they solved problems and how motivated they were to study. Students in the experimental group were more motivated and got better at solving problems than students in the control group. However, the two groups had no significant difference in performance (Yang,2012).

Additionally, Kiili et al. (2018) examined the effects of game-based learning on mathematical literacy skills in a primary school context. The study found that students who engaged in game-based learning showed higher motivation, enjoyment, and mathematical literacy levels than those who received traditional instruction. Games promoted active learning, problem-solving, and collaboration among students.

The previously mentioned studies, another study by Salvat (2007) examined the effects of a digital game-based approach on primary school students' engagement and motivation in science education. The researchers found that incorporating digital game-based learning significantly increased students' engagement and motivation. The game-based approach fostered curiosity, encouraged active exploration and experimentation,

and heightened students' interest in science topics. Students reported higher enjoyment and perceived relevance of the learning experience when using digital games in their science education. This study further supports the notion that digital game-based learning can positively impact students' engagement and motivation, particularly in science education at the primary level.

Previous research on the impact of digital game-based learning (DGBL) on primary school students' motivation has provided important insights in this area. These studies have used various approaches and designs to investigate the connection between DGBL and student motivation and identify the potential advantages and difficulties of incorporating digital games into primary education (Erhel & Jamet, 2013). According to the results of these studies, DGBL and student motivation are positively correlated, with students exhibiting higher levels of intrinsic drive, self-efficacy, and enthusiasm in academic pursuits. Inspiring game design elements, efficient feedback mechanisms, opportunities for autonomy and choice, meaningful social connections, and the support of peers and teachers as motivators are just a few of the elements that impact student motivation in DGBL contexts. The need to balance intrinsic and extrinsic motivation, maintain motivation over time, and take individual differences in motivational profiles into account are among the obstacles and limitations that have been identified. This corpus of research establishes a basis for comprehending how DGBL can successfully increase student motivation at the primary level by synthesizing the results from several investigations. These studies can serve as a foundation for future study in the field, filling in gaps and improving teaching strategies to maximize the motivational advantages of DGBL(Hung et al., 2020).

Charsky and Ressler (2011) used a commercially available computer game called Civilization III to determine how motivated students are to learn about historical

ideas. Students in the ninth grade, ages 14 to 15, were split into three groups: one group was the control, and the other two were the experimental groups. The game was used to teach history to the first experimental group, while the second experimental group also drew concept maps while playing the game. The standard teaching method in a classroom was used to teach the control group. Motivational surveys were given to students before and during the intervention to determine their motivation. The results showed that the students who played the game were the most motivated (Charsky & Ressler, 2011).

Kebritchi et al. (2010) examined how playing a math game affected students' achievement and motivation. They also examined how prior knowledge, English language, and computer skills affected the results. One hundred ninety-three students and ten teachers from a high school all took part in their study. The students got to play a series of games called Dimension that were meant to teach them things over 18 weeks. The data were gathered using surveys to measure motivation and tests to measure how well students did in school. The authors found no significant differences in how motivated the control and experimental groups were. However, they did find that the experimental group did better than the control group.

Papastergiou (2009) did research in which he compared two different versions of the Learner app. One version, LearnMem1, had parts like games, while the other, LearnMem2, did not. Both programs were based on a Greek high school computer science curriculum with the same learning goals. At the beginning and end of the intervention, the participants took a test to see how much they knew about computer memory and filled out an observation form. Compared to students who did not use the game-based program, those who did show much higher engagement, efficacy, and activity levels. (Papastergiou, 2009), on the other hand, found that while playing games

helped get people more interested in learning, there was a chance that they could also get in the way of learning. Even though boys played computer games more than girls, the study showed that gender differences did not affect how much kids learned. From the research, this was the conclusion that could be made.

Whitton's (2007) research questioned the idea that games are an excellent way to teach because they interest kids. The author got information about how motivated and interested students are by interviewing 12 students in-depth and then surveying 200 students on a large scale. The study's results showed that most of the students who took part in the study did not find games to be in any way inspiring. As a result, there did not seem to be any link between how motivated students are to play games for fun and how motivated they are to use games to learn. However, the research showed that students might be more likely to play games to learn if the games are based on sound teaching ideas.

2.9 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.

CHAPTER 3

RESEARCH METHODOLOGY

After a review of the relevant literature, the next stage was to create a research instrument and collect data to answer the study's questions. This chapter covers the research paradigm, research design, study population, sample selection technique, instrument creation, and data collection procedures.

3.1 Research Paradigm

The paradigm of this research is positivism because positivist paradigm asserts that true knowledge is derived from sensory experience and can be obtained through observation and experimentation.

3.2 Research Design

This study was experimental, and Time Series design was used. The study was quantitative and single group design was employed. Quantitative data was used to determine the DGBL effect on students' engagement and motivation.

3.3 Experimental Research Procedure

3.3.1 Development of Lesson Plan

The researcher prepared a comprehensive lesson plan. The lesson plan employed a computer-assisted educational technique. Twenty lesson plans were created utilizing a computer-assisted instructional technique, as outlined in Appendix I. These lesson plans were specifically designed to align with the content covered in three chapters that were presented during the duration of the experiment. The educational objectives of the book served as the basis for the content of each lesson plan inside the computer-assisted instructional technique utilizing digital games. Using the designated

instructional technique, the researcher employed the lesson plans to augment student engagement and motivation. The engagement and motivation qualities associated with various lesson plans were as follows:

1. **Planning Skills:** Digital games often require students to strategize and plan their moves to achieve objectives. Students improve their problem-solving and critical-thinking abilities by thinking ahead and developing plans.

2. **Task Management:** In digital games, students often face multiple tasks and challenges that must be completed within a limited timeframe. This fosters time management skills as they learn to prioritize and allocate their time efficiently.

3. **Self-Belief and Confidence:** As students' progress through levels and succeed in solving problems, they build a sense of self-belief and confidence in their abilities. Overcoming challenges in the game instills a positive growth mindset, encouraging them to take on more challenging tasks.

4. **Learning Focus:** Digital games require students' full attention and focus to succeed. Playing these games helps them develop better concentration and stay engaged and immersed in the learning process.

5. **Persistence:** Digital games often involve repeated attempts and potential failures before achieving success. This teaches students the importance of perseverance and resilience in overcoming challenges.

6. **Positive Body Language:** The teacher provides verbal remarks and motivates students in class while also employing nonverbal gestures to encourage and support them.

The researcher developed all lesson plans according to the curriculum of Grade 5^{th}. The format of the lesson plan was adapted from the herbetarian method.

3.3.2 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:

I. Participants

In the experimental research, the participants were Grade 5 students from Dr. AQ Khan's school system. The researcher selected 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.

II. Role of Teacher and Researcher in DGBL Classroom

The researcher instructed and trained the teacher for the study.

In a digital game-based learning (DGBL) classroom, the role of the researcher involves systematic observation and data collection, monitoring student interactions, engagement levels, and behaviors while they engage with the digital games. Additionally, the researcher evaluates how well students meet learning objectives through their gameplay, assessing improvements in knowledge, skills, and persistence. Behavioral analysis is also conducted to observe how students solve problems, collaborate with peers, and handle challenges within the game.

The teacher in a DGBL classroom facilitates and guides students, providing instructional support to help them navigate and utilize the digital games effectively, and offering real-time assistance when they encounter difficulties. The teacher motivates and encourages students with positive reinforcement, using phrases like "Excellent!" and "Well done!" to acknowledge achievements and efforts. By being actively present, the teacher supports and motivates students, boosting their confidence and persistence. Furthermore, encourage students' engagement by allowing them to play the games independently, which naturally increases their involvement in the learning process.

III. 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, Teacher and researcher 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.

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 were learned about different math topics in the upcoming weeks and gradually introduce new challenges. This proactive approach ensured that the students were well-informed and mentally prepared for the digital game based learning.

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.

IV. 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 also 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. To gauge their engagement and motivation, the researcher employed an observation sheet, effectively measuring the impact of the treatment delivered through digital games.

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.

3.3.3 Digital Games

Decimal Game

Figure 3.1

Decimal Game

There are 1000 cubes in one whole. There are tenths, hundredths, and thousandths of this. Children play with this part to learn how numbers like 2,.02, and 002 relate. Over time, children learn to picture the whole, even when only given a part. They learn to compare, subtract, and add decimal numbers. 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 to play.
- Graphics that are bright and based on everyday themes and situations to help with learning.

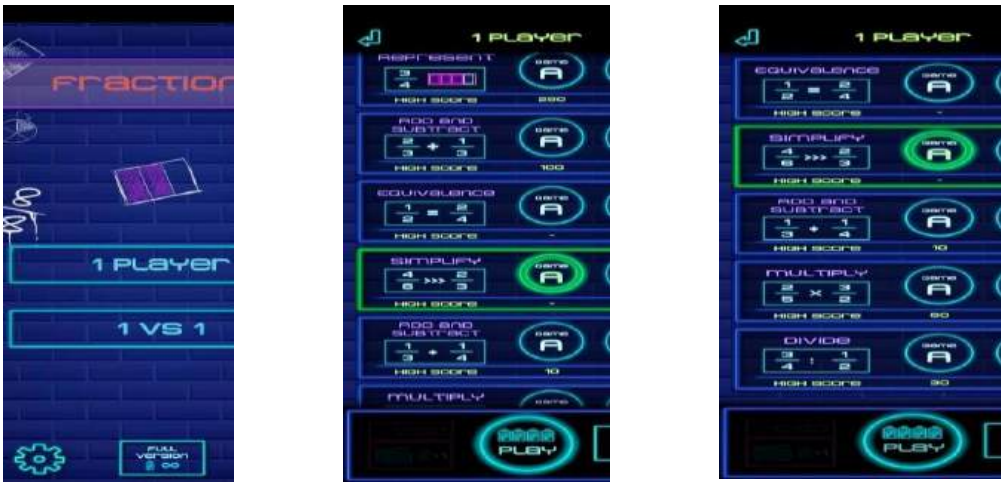
  This game covered the following learning objectives:

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

Fraction Challenge: Math Game

Figure 3.2

Fraction Challenge: Math Game



Students can use this game to learn about fractions, adding and subtracting with the same and different denominators, multiplying and dividing fractions, finding equivalent fractions, and reducing fractional numbers. Students can use this

game to learn about fractions, adding and subtracting with the same and different denominators, multiplying and dividing fractions, finding equivalent fractions, and reducing fractional numbers.

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 to help students understand the ideas better.

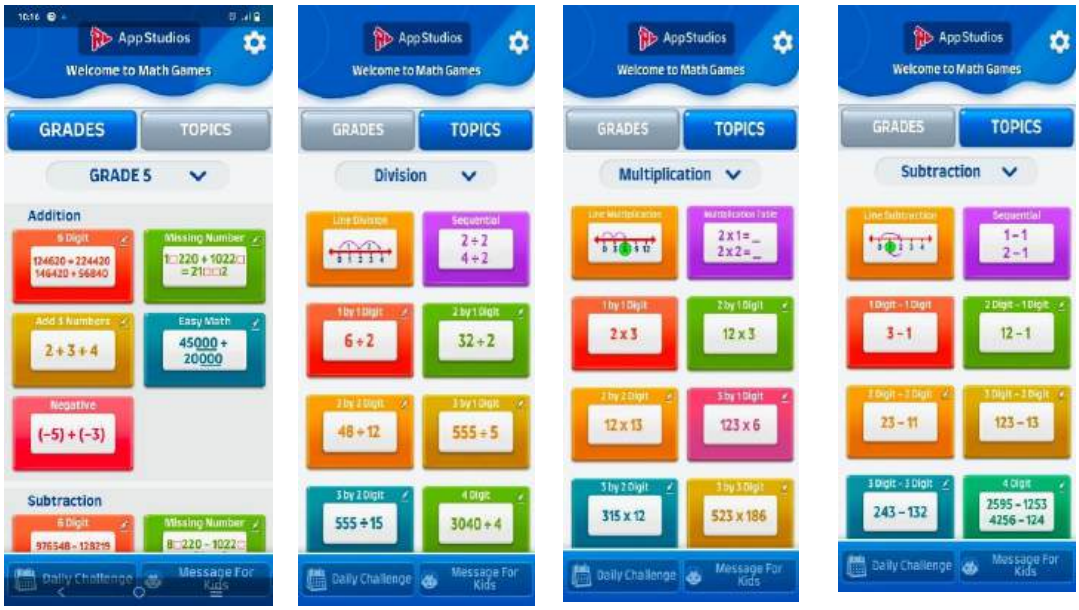
The following are the learning objectives this game covered:

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.

Math Games: Math for Kids

Figure 3.3

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. Pick up new skills in addition, subtraction −, multiplication ×, and division, ÷ or get more advanced mixed operations.

1. Addition games – up to 6-digit addition, sequential addition, plus more addition 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.

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.

UNIT PLAN

UNIT LESSON PLAN NO. 1

SUBJECT: Mathematics **GRADE: 5TH**

UNIT NUMBER: 1 **Title of Unit:** Numbers and arithmetic operation

NUMBER OF LESSON PLANS (PERIOD): 10

MAJOR OBJECTIVES OF UNIT:

1. Add numbers of complexity and arbitrary size.
2. Subtract numbers of complexity and 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.

Experimental group:

Lesson Plan No	Topic/Major Concept	Minor Concepts	No Of Lessons	Time Period	Teaching Method	Instruction Material To Be Used
1	Add the number of complexity	Add numbers of complexity.	1	2	Computer-assisted instruction method	Whiteboard Board marker

		Add numbers of arbitrary size.				Computer game “Math Game: Math for Kids”
2	Subtract numbers of complexity	Subtract numbers of complexity. Subtract numbers of arbitrary size.	1	2	Computer-assisted instruction method	Board marker Whiteboard Computer game “Math Game: Math for Kids”
3	Multiply up to 6 digit	Multiply up to 6 digits by a 2-digit number Multiply up to 6 digits by a 3-digit number	1	3	Computer-assisted instruction method	Board marker Whiteboard Computer game “Math Game: Math for Kids”
4	Divide up to 6 digit	Divide up to 6 digits by 2-digit number	1	3	Computer-assisted instruction method	Board marker Whiteboard

	Divide up to 6 digits by three-digit number.	Computer game “Math Game: Math for Kids”

Unit Lesson Plan No 2

SUBJECT: Mathematics **GRADE: 5TH**

UNIT NUMBER: 3 **TITLE OF UNIT:** Fraction

NUMBER OF LESSON PLANS (PERIOD): 5

MAJOR OBJECTIVES OF UNIT:

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

Experimental group

Lesson Plan No	Topic/Major Concept	Minor Concepts	No Of Lessons	Period	Teaching Method	Instruction Material To Be Used
1	Addition and subtraction of fraction	Addition of fraction Subtraction of fraction	1	2	Computer Assisted Instruction Method	Whiteboard Board marker

						Computer game “Fraction Challenge”
2	Multiply fraction	Multiply the fraction by a number. Multiply the fraction by another fraction.	1	2	Computer Assisted Instruction Method	Board marker Whiteboard Computer game” Fraction Challenge”
3	Divide fraction	Divide a fraction by a number. Divide a fraction by another fraction.	1	2	Computer Assisted Instruction Method	Chart Whiteboard Computer game” Fraction Challenge”

Unit Lesson Plan No 3

SUBJECT: Mathematics **GRADE: 5TH**

UNIT NUMBER: 4 **TITLE OF UNIT:** Decimals and percentages

NUMBER OF LESSON PLANS (PERIOD): 5

MAJOR OBJECTIVES OF UNIT:

1. Add and subtract decimals.
2. Recognize like and unlike decimals.
3. Convert decimals to fractions and vice versa.
4. Comparing Decimal numbers.

Experimental group:

Lesson Plan No	**Topic/Major Concept**	**Minor Concepts**	**No Of Lessons**	**Period**	**Teaching Method**	**Instruction Material To Be Used**
1	Recognize like and unlike decimals.	I am making decimal numbers. Comparing decimal number	1	1	Computer Assisted Instruction Method	Board marker Whiteboard Computer game" decimal game"
2	Add and subtract decimals.	Add decimals Subtract decimals	2	4	Computer-Assisted Instruction Method	Whiteboard Board marker Computer game" decimal gam

3.3.4 Experimental Research Threats

Threats to Internal Validity

1. **Maturity:** This threat may also be eliminated with time bound. Students were not grown cognitively because this experimental study was finished in four weeks.
2. **Instrumentation:** To counter this hazard, validated instrument was used.
3. **History:** The experimental study was shorter period so there was no external event occurred that affect the experiment.
4. **Attrition:** This threat was controlled by Implementing strategies to retain participants, such as. Playing digital games, good remarks and acknowledging students and the experiment was only one month so there was no dropout of students.

Threats to External validity

1. **Reactive arrangements:** The act of observing students' engagement and motivation could lead to changes in their behavior. To remediate this problem, the Researcher incorporated experiment in regular class and students did not know they were observed.
2. **Generalizability Threat** The specific digital games and classroom context may not be representative of other settings or populations. The research study was experimental in nature. So, it was delimited to one school. To remediate this problem, Researcher deeply evaluate and use games to check their usability in our culture. All games were culturally fit in our society.

3.4 Population of study

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.

Source

https://draqkhanschoolsystem.edu.pk

3.5 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.

3.6 Research Instruments

To measure the effect of digital game-based learning on the primary level. An adapted observation checklist (Liem &Martin, 2012) was used by the researcher.

An observation checklist was used to observe students' engagement and motivation of primary level students. The observation checklist was based on these indicators, i.e., Engagement (persistence, task management, and planning) for Motivation (self-belief, learning focus, Body language). There were total 26 statements and 5 point scale was used ranging from Always, Often, sometimes, Rarely and Never.

The choice to utilize the adapted instrument from Liem and Martin (2012) Motivation and Engagement Wheel in research is driven by a strategic consideration of both practicality and cost-effectiveness. This instrument offers a valuable framework

that encompasses essential sub-variables related to motivation and engagement. Significantly, the decision to forego individual statements for each variable is influenced by financial considerations, as accessing specific statements incurs costs. In opting for the adapted version that focuses on sub-variables, the research aims to strike a balance between capturing meaningful insights into motivation and engagement and managing limited resources judiciously.

3.7 Procedure (Validity)

The Observation sheet for Engagement and motivation was validated by specialists from the Faculty of Education at the International Islamic University Islamabad (IIUI). There were some grammatical mistakes and some statements were excluded as they seemed irrelevant. Changes were made according to their suggestions. The observations given by the experts were assimilated and afterward endorsed by the supervisor for administrative purposes.

3.8 Data Collection

Data were collected through quantitative tool. Formal consent was obtained from respondents Parents. An observation checklist was used to observe students' engagement and motivation levels. Class observations were conducted at regular intervals, ensuring comprehensive coverage of the learning process over time. The researcher conducted 20 observations of whole class enabling the researcher to capture a comprehensive picture of the evolution and effect of digital game-based learning on the students' engagement and motivation over an extended period.

3.9 Data Analysis

Descriptive statistics (Mean) were applied manually by the researcher to measure the results.

3.10 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 were assured.
5. Personal information was not being asked from students.
6. The research and data collection purpose was explained honestly and transparent 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.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

The first three chapters introduced the research problem, reviewed the relevant literature, and outlined the research methodology. This chapter focuses on the presentation and analysis of data on various study aspects. The data collected from the daily observation sheet were analyzed using descriptive statistics.

4.1 Descriptive Statistics

4.1.1 Engagement

Table 1

Persistence of students during digital games session

Items	Persistence	Always	Often	Sometimes	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

Table 1 showing frequency and mean values of Persistence a sub-indicator of engagement, particularly in the context of learning through digital games. the students demonstrate a high level of persistence, attentiveness in class, collaboration skills, and effort in completing assignments. They also exhibit resilience and a strong willingness to tackle difficult tasks. The first statement, "Pays attention in class," received the highest mean score of 4.3, signifying that, on average, majority of students consistently maintains a high level of attentiveness during digital learning sessions. This demonstrates strong engagement in the learning process.

Following closely, the second and third statements, "Students collaborate and work well with their classmates" and "Completes assigned work," both received mean scores of 4.2. These scores indicate that respondents generally perceive the individual as someone who effectively collaborates with peers and reliably completes their

assigned tasks during digital learning activities. Slightly trailing behind, the fourth and fifth statements, "Persistent when confronted with complex problems" and "Works on new assignments with sincere effort," both garnered a mean score of 4.1. These scores suggest that, on average, majority students display persistence in the face of complex challenges and puts sincere effort into new assignments during digital learning.

The sixth statement, "Tries to finish assignments even when they are difficult," received a mean score of 3.95, indicating that the individual generally attempts to complete challenging assignments.

Lastly, the seventh statement, "Get not discouraged and continuously trying when encountering an obstacle in schoolwork," received a mean score of 4.15, demonstrating that respondents perceive the individual as resilient and persistent when facing obstacles in their academic work. This reflects a positive attitude and determination in overcoming difficulties.

Table 2

Task Management of students during digital games session

Items	Task Management	Always	Often	Sometimes	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

Table 2 showing frequency and mean values of task management. Serve as a sub-indicator of engagement in a digital learning environment, where students are learning through digital games. Results showing that the students appear to be actively engaged in discussions, proactive in seeking information, participates willingly in discussions, and consistently strives to complete their work effectively and on time. Firstly, with a mean score of 4.2, it's evident that the students actively participate in discussions within the digital game-based learning environment.

Moving to the second item, "Asks Questions to get more information," the mean score of 4.35 is notably high. It signifies that, on average, the students are proactive in seeking clarification and additional information through questions during their digital game-based learning experiences.

In the third item, "Raises his/her hand to answer a question or volunteer information," the mean score of 4.25 indicates that the individual consistently volunteers to answer questions or share information within the digital learning environment.

Lastly, in the fourth item, "Attempts to do his/her work timely and well," the mean score of 4.35 demonstrates that, on average, students' are diligent and punctual in completing their assignments effectively.

Overall, the mean score indicates majority students have high level of task management.

Table 3

Planning of students during digital games session

Items	Planning	Always	Often	Sometimes	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 3 showing frequency and mean values of planning which serve as a sub-indicator of engagement, particularly in the context of learning through digital games The data provided pertains to students planning skills, specifically focusing on their

ability to prioritize tasks, organize their materials and workspace, arrive on time for class, and ensure they have all the necessary materials. Starting with the first item, "The students effectively prioritize tasks," it's notable that the mean score is 3.8. This suggests that, on average, majority students often prioritize tasks effectively during their digital learning sessions.

Moving on to the second item, "Organize their materials and workspace," the mean score of 3.95 indicates that, on average, students are reasonably good at organizing their materials and workspace. In the third item, "The students arrive on time and are ready for class," the mean score of 4.05 reflects a positive perception of the individual's punctuality and prepared for their digital learning sessions.

Finally, in the fourth item, "The students have all the necessary materials," the mean score of 4.25 is relatively high, indicating that respondents perceive the individual as consistently having all the required materials for their digital learning activities.

4.1.2 Motivation

Table 4

Positive Body Language of students during digital games session

Items	Positive Body Language	Always	Often	Sometimes	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

Table 4 data presented here focuses on the assessment of an individual's positive body language, which is often considered a sub-indicator of motivation particularly in the context of learning through digital games. In the first item, "Eye contact with the Teacher," the mean score of 4.2 indicates that, on average, majority students' maintains eye contact with the teacher during digital learning sessions. The second item, "Appropriate posture," received a slightly higher mean score of 4.3. This suggests that, on average, majority students consistently maintain an appropriate posture, during digital learning sessions which is an indication of attentiveness.

Moving to the third item, "Nonverbal response," the mean score of 4.05 indicates that, on average, majority students provides nonverbal responses such as nodding or facial expressions, during digital learning sessions. Finally, in the fourth item, "Body Language Consistency," the mean score of 4.15 suggests that, on average, majority students consistently display consistent body language throughout digital learning sessions.

Table 5

Learning Focus of students during digital games session

Items	Learning Focus	Always	Often	Sometimes	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

The data provided in Table 5 focuses on the assessment of students Learning Focus, which is considered as sub-indicator of motivation, particularly in the context of learning through digital games. In the first item, "Active Participation," the mean score of 4.2 indicates that, on average, majority of students are consistently engage in active participation in digital learning activities. The second item, "Attentive listening," received an even higher mean score of 4.3. This suggests that, on average, majority students are highly attentive and focused when listening during digital learning session in the classroom.

In the third item, "Following directions," the mean score of 4.05 indicates that, on average, majority students often adhere to instructions and guidelines provided in the digital learning environment.

Finally, in the fourth item, "Asking Questions," the mean score of 4.3 suggests that, on average, majority students are proactive in asking questions.

Table 6

Self-Belief of students during digital games session

Items	Self- Belief	Always	Often	Sometimes	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 6 provides insights into an individual's self-belief, which is a sub-indicator of motivation, particularly in the context of learning through digital games. In the first item, "Working independently," the mean score of 4.2 suggests that, on average, the students frequently display self-belief when learning through digital games.

The second item, "Problem-solving to get needed help," received a mean score of 3.85. This score indicates that, on average, the students utilizes problem-solving skills to seek assistance during digital learning sessions.

In the third item, "Confident to share ideas," the mean score of 4 highlights that, on average, majority of the students demonstrate confidence in sharing their ideas while learning through digital games.

Table 7

Persistence Weekly Comparison

Engagement (Persistence)	Week 1	Week 2	Week 3	Week 4	Mean
	3.826	4.168	4.224	4.338	4.139

These findings suggest that students demonstrated a remarkable increase in their persistence as they engaged with digital games for learning purposes over the course of this experiment. The consistent week-to-week improvement indicates that students not only initially embraced the concept of learning through digital games but also displayed an enhanced willingness to persist and persevere in their efforts. The persistence score of students engaged in learning through digital games was measured over a four-week period, with weekly cumulative mean scores calculated for each week.

The data revealed a consistent upward trend in students' persistence levels. In Week 1, the mean persistence score was 3.826, which increased to 4.168 in Week 2, further to 4.224 in Week 3, and reached its highest point at 4.338 in Week 4. The overall mean persistence score across the four weeks was 4.13.

Figure 4.1

Persistence Weekly Mean

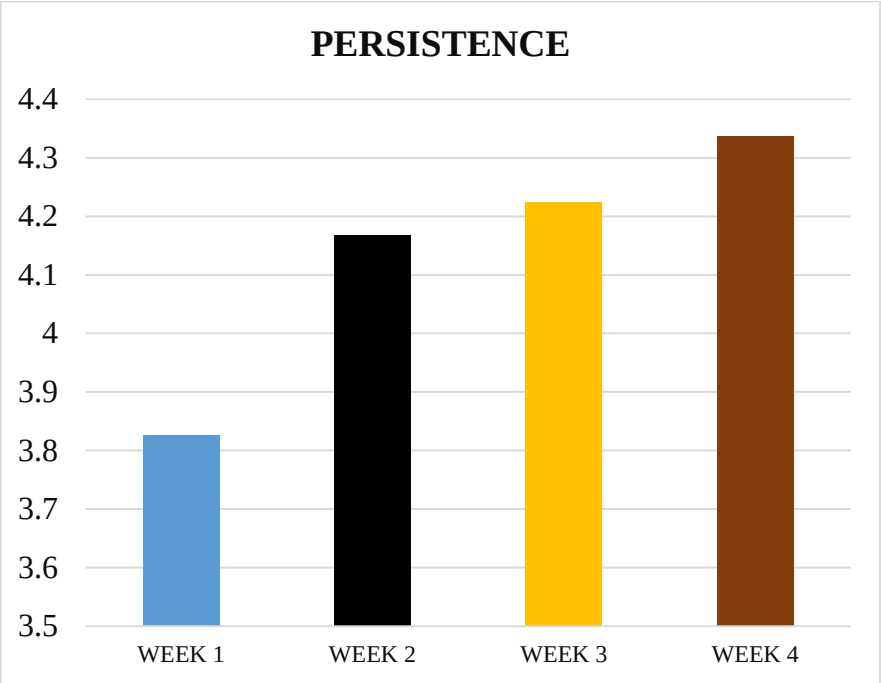


Table 8

Task Management Weekly Comparison

Engagement (Task Management)	Week 1	Week 2	Week 3	Week 4	Mean
	4.05	4.3	4.35	4.45	4.2875

The task management scores of students engaged in learning through digital games were measured over a four-week period, with weekly cumulative mean scores calculated for each week.

The data illustrates a consistent and positive trend in students' task management abilities. In Week 1, the mean task management score was 4.05, which increased to 4.3

in Week 2, further to 4.35 in Week 3, and reached its highest point at 4.45 in Week 4. The overall mean task management score across the four weeks was 4.2875.

These findings suggest that students displayed a noticeable improvement in their task management skills as they engaged with digital games.

Figure 4.2

Task Management Weekly Mean

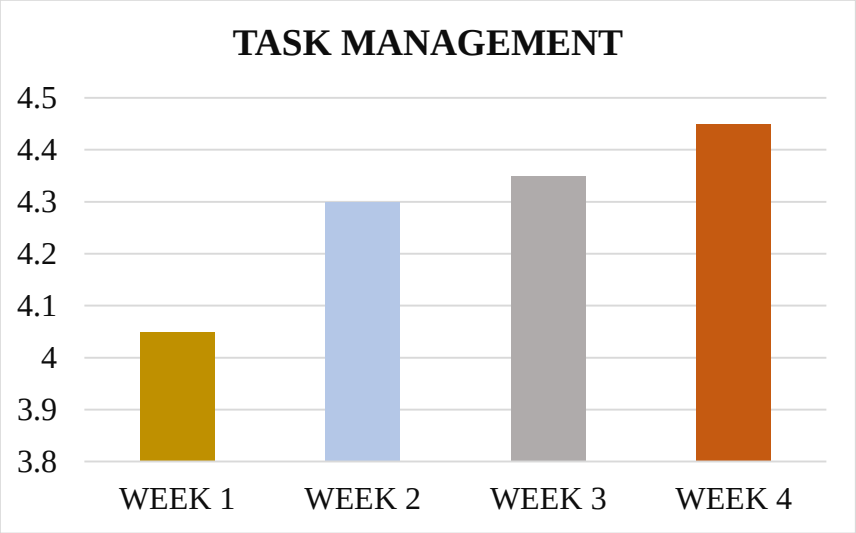


Table 9

Planning Weekly Comparison

Engagement (Planning)	Week 1	Week 2	Week 3	Week 4	Mean
	3.55	4	4.1	4.4	4.0125

The planning scores of students engaged in learning through digital games were measured over a four-week period, with weekly cumulative mean scores calculated for each week. The data reveals a consistent and positive trend in students' planning abilities. In Week 1, the mean planning score was 3.55, which increased to 4.0 in Week

2, further to 4.1 in Week 3, and reached its highest point at 4.4 in Week 4. The overall mean planning score across the four weeks was 4.0125.

These findings suggest that students demonstrated substantial improvement in their planning skills as they engaged with digital games for learning purposes throughout the study.

Figure 4.3

Planning Weekly Mean

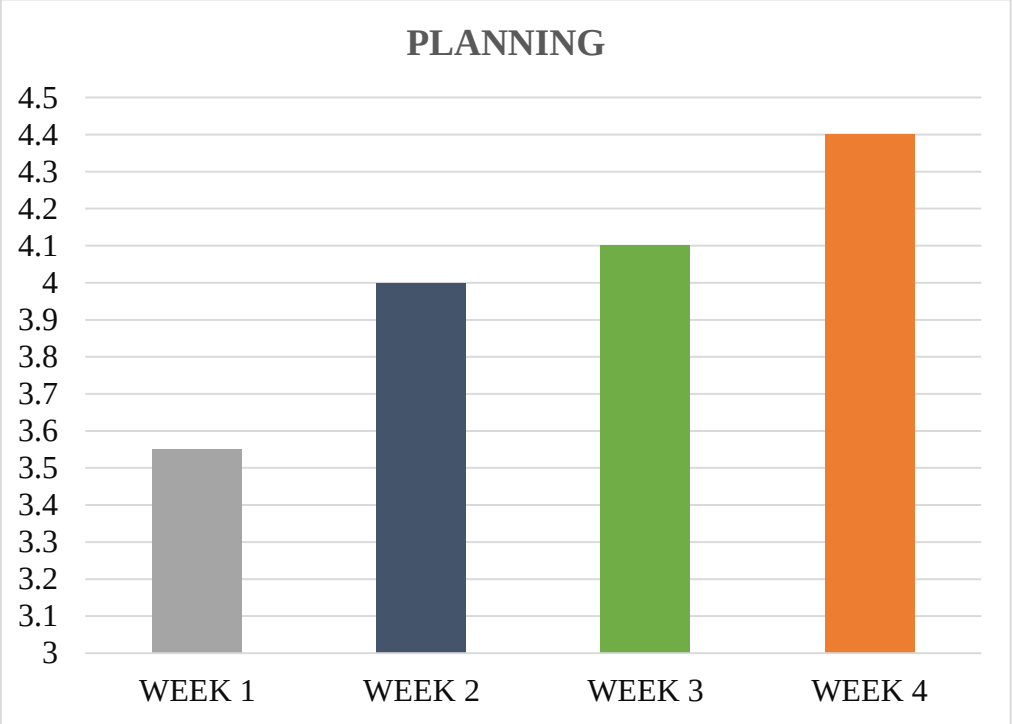


Table 10

Positive Body Language Weekly Comparison

Motivation (positive Body Language)	Week 1	Week 2	Week 3	Week 4	Mean
	3.95	4.2	4.2	4.35	4.175

Table 10 shows that the positive body language scores of students engaged in learning through digital games were measured over a span of four weeks, with weekly cumulative mean scores calculated for each week. The data presents an encouraging and sustained trend in students' positive body language. In Week 1, the mean score was 3.95, which steadily increased to 4.2 in both Week 2 and Week 3, and reached its zenith at 4.35 in Week 4. The overall mean positive body language score across the four weeks was 4.175. These findings underscore a significant improvement in students' display of positive body language as they engaged with digital games for learning purposes during the study.

Figure 4.4

Positive Body Language Weekly Mean

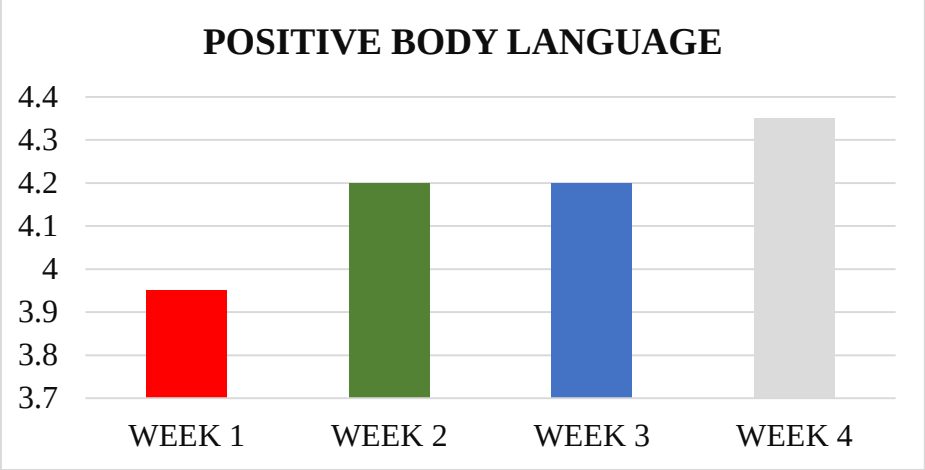


Table 11

Learning Focus Weekly Comparison

Motivation (Learning Focus)	Week 1	Week 2	Week 3	Week 4	Mean
	3.9	4.15	4.4	4.45	4.225

The learning focus scores of students engaged in learning through digital games were meticulously measured over a four-week period, with weekly cumulative mean scores calculated for each week. The data demonstrates an encouraging and consistent trend in students' learning focus. In Week 1, the mean score was 3.9, which steadily increased to 4.15 in Week 2, further to 4.4 in Week 3, and reached at 4.45 in Week 4. The overall mean learning focus score across the four weeks was 4.225. These findings highlight a substantial improvement in students' ability to maintain their focus and concentration as they engaged with digital games for learning purposes.

Figure 4.5

Learning Focus Weekly Mean

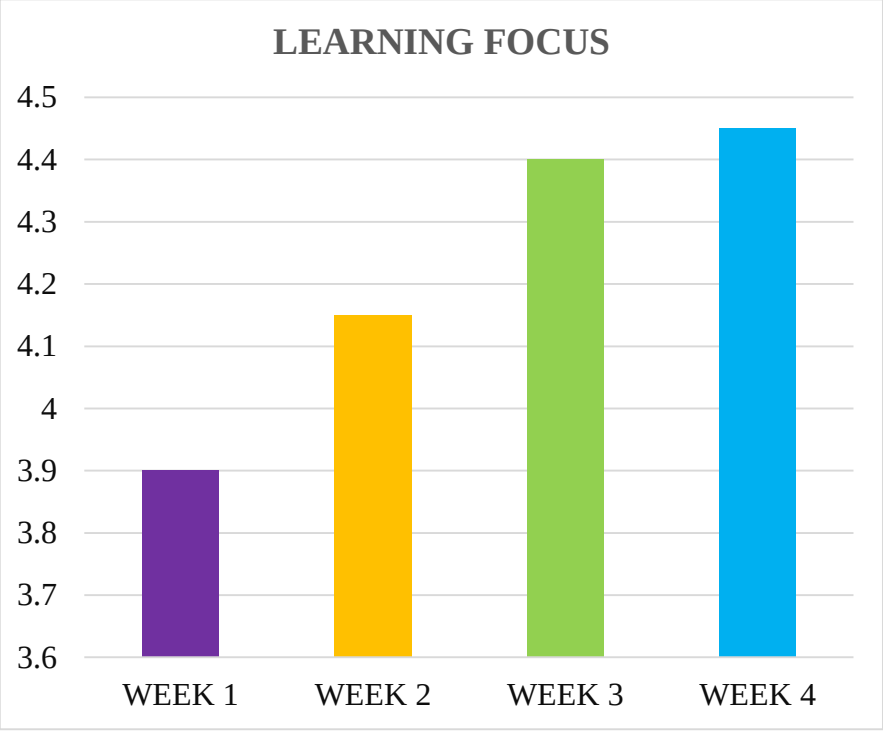


Table 12

Self-Belief Weekly Comparison

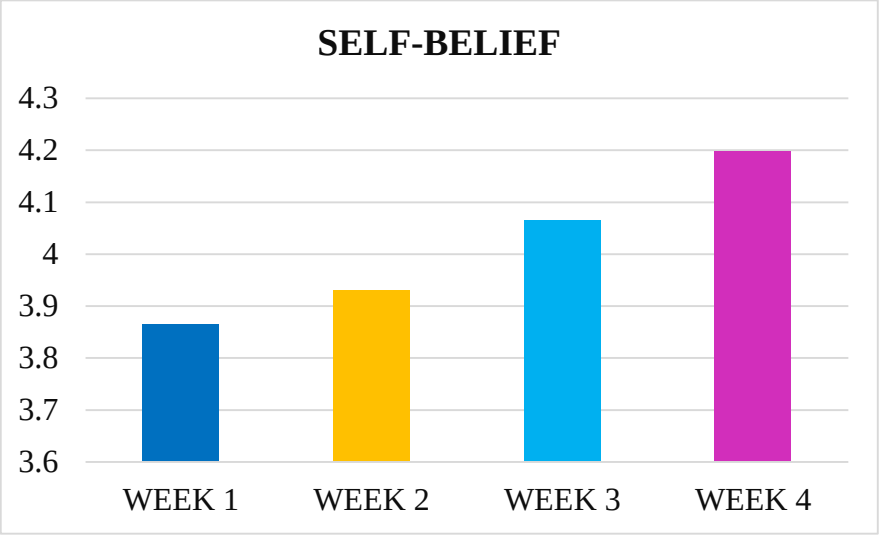
Motivation (Self-Belief)	Week 1	Week 2	Week 3	Week 4	Mean
	3.864	3.93	4.064	4.198	4.014

Table 12 shows self-belief scores of students learning through digital games were measured over a four-week period, with weekly cumulative mean scores calculated for each week. The data reveals a notable and consistent improvement in students' self-belief. In Week 1, the mean self-belief score was 3.864, which gradually increased to 3.93 in Week 2, further to 4.064 in Week 3, and reached its highest point at 4.198 in Week 4. The overall mean self-belief score across the four weeks was 4.014.

These findings underscore a significant enhancement in students' self-belief as they engaged with digital games for learning purposes during the study.

Figure 4.6

Self-Belief Weekly Mean



CHAPTER 5

SUMMARY, FINDINGS, DISCUSSION, CONCLUSION & RECOMMENDATIONS

5.1 Summary

This study aimed to explore the effect of digital game-based learning on the engagement and motivation of primary school students in Mathematics. The primary objectives of the study were to: (a) find out the effect of digital game-based learning on students' engagement, (b) investigate the influence of digital game-based learning on students' motivation. The population of this study consisted of 177 students of 5^{th} 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 a sample of 20 enrolled Grade 5^{th} students of Dr. AQ khan school system H-13 was selected. The entire Grade 5^{th} class were included in the sample. The research design adopted for this study was experimental, employing a Time series design. Quantitative methodology was utilized to evaluate the effect of digital game-based learning on students' engagement and motivation. The study spanned four weeks, encompassing the instruction of three chapters. The procedure involved conducting, daily digital game treatments and collect daily observations to monitor changes in engagement and motivation levels over time. Quantitative data collection method was employed in this study. Formal consent was obtained from the participants, and an observation checklist was utilized to evaluate students' engagement and motivation levels. Notably, the study reported no dropout rates, with consistent attendance of the participating students. Data were ultimately collected from a total of 20 students. Data analysis involved obtaining scores from observation checklist. These scores were then used to calculate means.

5.2 Findings

Through the analysis of data, the following findings emerged. The details are as follows:

1. Students consistently demonstrate a high level of persistence. They maintain a strong level of attentiveness in class (mean score of 4.3), effectively collaborate with peers and reliably complete assigned tasks (mean scores of 4.2), display persistence in solving complex problems and investing sincere effort in new assignments (mean scores of 4.1), completing challenging assignments, as evidenced by a mean score of 3.95 and exhibit resilience by continuously trying to overcome games challenges (mean score of 4.15) (Based on table 1).

2. Students exhibit a strong level of engagement in task management. They actively participate in discussions (mean score of 4.2), proactively seek information through questions (mean score of 4.35), readily volunteer to answer questions or share information (mean score of 4.25), and consistently demonstrate diligence and punctuality in completing assignments effectively (mean score of 4.35). These findings collectively indicate that the majority of students possess a high level of proficiency in task management skills, contributing to their active engagement in the learning process (Based on table 2).

3. Students exhibit notable planning skills. within the context of learning through digital games, on average, they demonstrate effective task prioritization (mean score of 3.8), reasonable organization of materials and workspace (mean score of 3.95), punctuality and readiness for class (mean score of 4.05), and a consistent presence of all necessary materials (mean score of 4.25). These findings indicate that the majority of students possess sound planning abilities, which contribute positively to their engagement in the digital learning classroom (Based on table 3).

4. Students display positive body language in the context of learning through digital games, which serves as a sub-indicator of motivation. On average, they maintain eye contact with the teacher (mean score of 4.2), consistently exhibit appropriate posture (mean score of 4.3), provide nonverbal responses (mean score of 4.05), and consistently display consistent body language (mean score of 4.15) throughout their digital learning sessions (Based on table 4).

5. Students consistently demonstrate a high level of learning focus, within the context of learning through digital games, which serves as a sub-indicator of motivation. On average, they actively participate in digital learning activities (mean score of 4.2), exhibit strong attentiveness during listening (mean score of 4.3), frequently follow directions (mean score of 4.05), and are proactive in asking questions (mean score of 4.3). These findings indicate that the majority of students maintain a high level of motivation in their digital games based learning session (Based on table 5).

6. Students exhibit positive self-belief in the context of learning through digital games, which serves as a sub-indicator of motivation. On average, they demonstrate a strong ability to work independently (mean score of 4.2) and confidently share their ideas (mean score of 4). While the mean score for "Problem-solving to get needed help" is also above average level at 3.85, it still indicates that, on average, students effectively utilize problem-solving skills to seek assistance during their digital learning sessions. These findings collectively illustrate that the majority of students possess a positive self-belief that enhances their motivation in the digital learning environment (Based on table 6).

7. The finding of this study indicate a notable and consistent increase in students' persistence when engaged in learning through digital games over the course of a four-

week experiment. The data reveals a clear week-to-week improvement, suggesting that students not only initially embraced the concept of using digital games for learning but also displayed an enhanced willingness to persist and persevere in their learning efforts. The mean persistence score started at 3.826 in Week 1, increased to 4.168 in Week 2, continued to rise to 4.224 in Week 3, and reached at 4.338 in Week 4. The overall mean persistence score across the four weeks was 4.139, underscoring the positive impact of digital game-based learning on students' persistence in the learning process (Based on table 7).

8. The data analysis reveals a consistent and positive trend in the task management abilities of students engaged in learning through digital games over a four-week period. The mean task management score exhibited significant growth, starting at 4.05 in Week 1 and steadily increasing to 4.3 in Week 2, 4.35 in Week 3, and at 4.45 in Week 4. The overall mean task management score across the four weeks was calculated as 4.2875. These findings indicate a clear and noticeable improvement in students' task management skills as they actively participated in digital game-based learning, reflecting the positive impact of this learning approach on their organizational and time management abilities (Based on table 8).

9. The data analysis highlights a consistent and positive trend in the planning abilities of students who participated in learning through digital games over a four-week period. The mean planning score started at 3.55 in Week 1 and demonstrated steady improvement, reaching 4.0 in Week 2, 4.1 in Week 3, and at 4.4 in Week 4. The overall mean planning score across the four weeks was calculated as 4.0125. These findings indicate substantial and noteworthy enhancement in students' planning skills as they actively engaged with digital games for learning purposes throughout the study,

underscoring the positive impact of this learning approach on their planning abilities (Based on table 9).

10. The data from Table 10 reveals a consistent and positive trend in the positive body language of students who engaged in learning through digital games over a span of four weeks. The mean score, which began at 3.95 in Week 1, steadily increased to 4.2 in both Week 2 and Week 3, culminating at its highest point of 4.35 in Week 4. The overall mean positive body language score across the four weeks was calculated as 4.175. These findings highlight a significant and notable improvement in students' ability to exhibit positive body language throughout the study, underscoring the positive impact of digital game-based learning on their motivation in a learning context (Based on table 10).

11. The data analysis spanning four weeks reveals an encouraging and consistent trend in the learning focus of students engaged in learning through digital games. Commencing with a mean score of 3.9 in Week 1, the learning focus steadily increased to 4.15 in Week 2, further advanced to 4.4 in Week 3, and reached at 4.45 in Week 4. The overall mean learning focus score across the four weeks was calculated as 4.225. These findings signify a substantial and notable improvement in students' capacity to sustain focus and concentration during digital game-based learning experiences, emphasizing the positive impact of this learning approach on their ability to motivate effectively in the study context (Based on table 11).

12. The data from Table 12, collected over a four-week period, reveals a consistent and notable improvement in students' self-belief as they engaged in learning through digital games. Commencing with a mean self-belief score of 3.864 in Week 1, this score gradually increased to 3.93 in Week 2, further advanced to 4.064 in Week 3, and at its highest point of 4.198 in Week 4. The overall mean self-belief score across the four

weeks was calculated as 4.014. These findings underscore a significant and positive enhancement in students' self-belief throughout the study, emphasizing the substantial effect of digital game-based learning on their motivation within the digital games context (Based on table 12).

5.3 Discussion

In recent years, digital game-based learning (DGBL) has gained significant attention as an innovative approach to enhance student engagement and motivation in primary education. The study aimed to explore the effect of DGBL on student engagement and motivation at the primary level. 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., signifying a positive effect of DGBL on learning outcomes. The findings provide valuable insights into this pedagogical approach's effectiveness in enhancing engagement and motivation among primary school students and align with the growing body of research that highlights the benefits of incorporating digital games into educational settings (Deterding et al., 2011).

Additionally, their motivation levels appeared to improve as they interacted with the digital games, showing sustained interest and participation.

The consistently high levels of persistence demonstrated by students in this study are noteworthy. Students maintained a strong level of attentiveness in class, effectively collaborated with peers, and reliably completed assigned tasks. Students demonstrating persistence, attentiveness, and collaboration align with studies in digital game-based learning showing that engagement and active involvement are positively associated with prolonged attention span and task persistence (Zhai et al., 2018).

The proficiency in task management skills exhibited by the majority of students is a significant contributor to their active engagement in the learning process. Actively participating in discussions, seeking information proactively, volunteering to answer questions, and consistently completing assignments with diligence and punctuality all reflect students' ability to manage their tasks effectively (Hwang & Wu, 2014). The substantial improvement in planning skills over the study period highlights the positive impact of digital game-based learning on students' planning abilities, which in turn enhance their engagement (Wolters & Hussain, 2015).

Students maintaining positive body language during digital game based learning sessions aligns with research demonstrating that non-verbal cues significantly influence student engagement and interaction in online environments (Tawil, 2019). Maintaining eye contact and appropriate posture reflect engagement and a positive learning attitude often nurtured by gamified learning settings (Nadeem et al., n.d.)

Moreover, high levels of learning focus correspond with recent research highlighting that digital game-based learning environments promote sustained attention and active participation among students (Bakhsh et al., 2022). Actively participating in activities and being attentive during listening sessions correlate with the immersive and engaging nature of gamified learning experiences (Sun et al., 2020).

The positive self-belief skills displayed by students align with studies indicating that gamified learning environments enhance students' self-efficacy and confidence in tackling challenges (Hernández et al., 2021). The ability to work independently and seek help when needed reflects the fostering of self-directed learning abilities within digital game-based contexts (Toh & Kirschner, 2020).

These findings corroborate prior research in the field Ray and Smith (2010) conducted a similar study and found that students who engaged in DGBL significantly improved learning outcomes more than those in traditional classrooms. The interactive and immersive nature of digital games captures students' attention and encourages active participation which could increase the post-intervention scores.

Moreover, in concurrence with earlier studies Su and Cheng (2013) the current research establishes that digital game-based learning significantly enhances students' motivation levels. Incorporating game elements, such as rewards, competition, and a sense of achievement, fosters a motivational context that stimulates students' desire to learn. This aligns with the qualitative feedback from students during the study, where they expressed increased enthusiasm for learning and a heightened willingness to tackle challenges presented by digital games.

The study's daily observations of the entire class revealed higher engagement and motivation among students exposed to DGBL. This aligns with the self-determination theory proposed by Deci and Ryan (1999), which posits that activities promoting autonomy, competence, and relatedness enhance intrinsic motivation. 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).

Moreover, Gillet et al. (2010) concept of "flow" provides additional insight into the observed high engagement levels. Flow occurs when individuals are fully immersed in an activity, experiencing a state of heightened focus and enjoyment. DGBL's ability

to offer tailored challenges and immediate feedback can facilitate this flow state, thus promoting sustained engagement.

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).

In conclusion, the outcomes of this study underscore the substantial and favorable impact of digital game-based learning (DGBL) on enhancing students' engagement and motivation at the primary education level. These findings are consistent with recent research and highlight the significant potential of digital games as valuable educational tools (Luo et al., n.d.; Gui et al., 2023). They emphasize the importance of recognizing digital games as valuable resources for augmenting students' learning experiences, particularly in subjects such as Mathematics, which may pose perceived challenges to learners (Hwang et al., 2013; Tokac et al., 2019).

5.4 Conclusions

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

1. The findings of the study revealed that students consistently demonstrated a high level of persistence in their learning through digital games. They maintained

attentiveness in class, effectively collaborated with peers, completed assignments with dedication, and displayed resilience in overcoming academic challenges. This highlights the enduring nature of their engagement. (Based on finding 1).

2. Students exhibited strong task management skills, actively participating in discussions, seeking information proactively, and consistently completing assignments with diligence. This proficiency in task management contributes significantly to their active engagement in the learning process. (Based on finding 2).

3. Students displayed notable planning skills, including effective task prioritization, organization of materials, punctuality, and preparedness for class. These planning abilities positively influenced their engagement in the digital learning classroom. (Based on finding 3).

4. Students consistently exhibited positive body language during digital game-based learning. They maintained eye contact, displayed appropriate posture, provided nonverbal responses, and consistently displayed Positive body language. This indicates their motivation in the digital game based classroom. (Based on finding 4).

5. The study found that students consistently maintained a high level of learning focus. They actively participated in digital learning activities, displayed strong attentiveness during listening, followed directions, and were proactive in asking questions. This high level of learning focus reflects their motivation in digital learning sessions (Based on finding 5).

6. Students exhibited positive self-belief in the digital learning environment. They displayed confidence in working independently, sharing ideas, and effectively utilized problem-solving skills to seek assistance when needed. This self-belief contributed significantly to their motivation in the digital game based learning classroom (Based on finding 6).

7. The study observed a consistent and notable increase in students' persistence over the four-week experiment. This indicates that students not only embraced digital game-based learning but also exhibited an enhanced willingness to persist and persevere in their learning efforts (Based on finding 7).

8. Students displayed significant improvements in their task management and planning abilities over the four-week experiment. This suggests that engagement in digital game-based learning positively influenced their planning and time management skills. (Based on finding 8 & 9).

9. There was a notable improvement in students' ability to exhibit positive body language as they engaged with digital games for learning purposes over the four-week experiment. This underscores the positive effect of digital game-based learning on their motivation (Based on finding 10).

10. The findings revealed a substantial improvement in students' ability to learning focus and concentration during digital game-based learning experiences over the four-week experiment. This indicates the effectiveness of this digital game based learning approach in enhancing their motivation (Based on finding 11).

11. Students demonstrated consistent and significant growth in their self-belief over the four-week experiment, emphasizing the substantial effect of digital game-based learning on their motivation (Based on finding 12).

5.5 Recommendations

Based on the findings that digital game-based learning has led to increased classroom engagement and motivation levels, several recommendations can be made to optimize its implementation at the primary level:

1. Students' persistence in digital game based learning classroom increase 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.

2. Students' display strong task management abilities when engaged in digital game-based learning. Educators can capitalize on this by incorporating more digital games as a learning tool 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.

3. 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.

4. 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.

5. 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.

6. Digital game-based learning has positive effect on student engagement and motivation and it is effective method for students learning. So, it is strongly recommended that the Ministry of Education provide essential technological support in schools. This support may include the provision of free access to high-speed internet and the establishment of IT support departments within schools. These measures will not only facilitate the optimal utilization of digital resources but also ensure data security and restrict access to inappropriate websites for minors, thereby enhancing the overall educational experience.

5.6 Recommendations for Future Researches

1. It is recommended for future researchers to assess the long-term effect of digital game-based learning on students' motivation and engagement.

2. This research study was delimited to the primary level. Future researchers may research the effect of digital game-based learning at any other level like middle, Secondary and higher school.

3. This research study was experimental and delimited to Dr. AQ. Khan School System Islamabad; future researchers may conduct research on other public and private schools in Pakistan.

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Appendix 1

LESSON PLAN 1

Class: grade 5th **Topic**: Addition

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

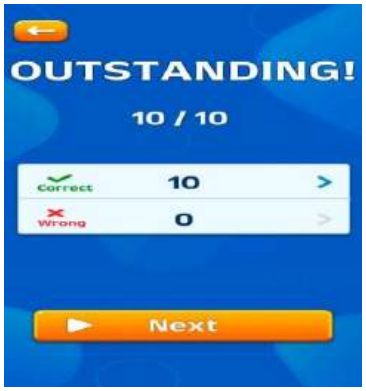
Method: Computer Assisted Instruction method

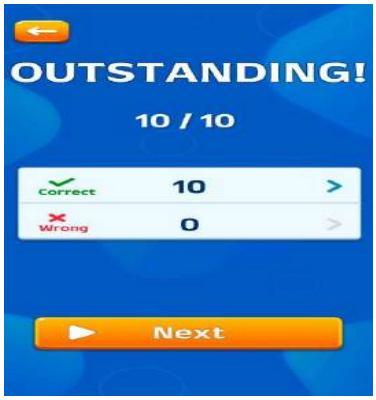
Learning outcomes:

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 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	

	 Teacher will instruct before playing that how to play. After that students started playing.	Students' will see the game. Students will open the game and open the category of addition for 5th grade.   

	After completing 10 levels. Each student will get score. Teacher will repeat the game until each student got 10/10 score.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their addition exercise.	Student will give answers of those questions.
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	

LESSON PLAN 2

Class: grade 5th **Topic**: Addition

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

Method: Computer Assisted Instruction method

Learning outcomes:

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

- Add numbers of complexity and of arbitrary size.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about addition basics level. 108+326= 225+321= 321+123= Correct, good	434 546 444
Announcement of the Topic	So today the topic which we are going to study is addition complexity	Student's will listen.
Presentation	Teacher will start the game on all computers Which is Math Game	

	 Teacher will instruct before playing that how to play. After that students started playing. After completing 10 levels. Each student will get score.	Students' will see the game. Students will open the game and open the category of addition for 5th grade.  

	Teacher will repeat the game until each student got 10/10 score.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their addition exercise.	Student will give answers of those questions.
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.	

LESSON PLAN 3

Class: grade 5th **Topic**: Addition

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

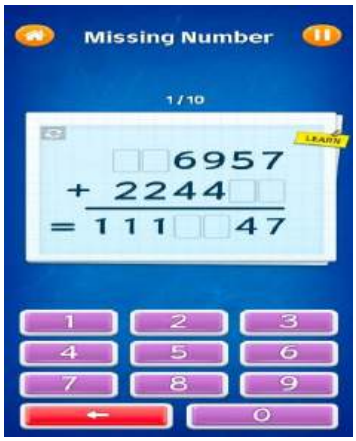
Method: Computer Assisted Instruction method

Learning outcomes:

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

- Identify missing number in addition

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about addition complexity. Today we will studied addition missing number complexity. First tell me 3+ ? = 8 10+ ? = 17 ? + 9 = 18 Correct, good	Students' will tell the answers 5 7 9
Announcement of the Topic	So today the topic which we are going to study is. ADDITION	Student's will listen.
Presentation	Teacher will start the game on all computers Which is Math Game	

	 Teacher will instruct before playing that how to play. After that students started playing. After completing 10 levels. Each student will get score.	Students will see the game. Students will open the game and open the category of addition for 5th grade.  

	Teacher will repeat the game until each student got 10/10 score.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their addition exercise	Student will give answers of those questions
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.	

Lesson Plan 4

Class: grade 5th **Topic**: Subtraction

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

Method: Computer Assisted Instruction method

Learning outcomes:

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

- Subtract numbers of complexity and of arbitrary size.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about simple level of subtraction. Now please let me know 10-5=? 9-3=? 15-7=? Correct, Good.	5 6 8
Announcement of the Topic	So today the topic which we are going to study is "Subtraction"	Students' will listen.

Presentation	Teacher will start the game on all computers Which is Math Game.  Teacher will instruct before playing that how to play. After that students started playing.	Students' will see the game. Students will open the game and open the category of subtraction for 5th grade. 

	Students' have to choose one correct answer out of 4 options After completing 10 levels. Each student will get score. Teacher will repeat the game until each student got 10/10 score.	 
Application	After the ending of session of playing game teacher will give them 2,3 questions from their subtraction exercise	Student will give answers of those questions

Recapitulation	So, Today we have studied subtraction. subtraction means the process or skill of taking one number or amount away from another.	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.	

Lesson Plan 5

Class: grade 5th **Topic**: Subtraction

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

Method: Computer Assisted Instruction method

Learning outcomes:

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

- Subtract numbers of complexity and up-to 6-digit.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum.	

	How are you all hope you are doing great. In previous class you have already learnt about simple level of subtraction. Now please let me know 10-5=? 9-3=? 15-7=? Correct, Good.	5 6 8
Announcement of the Topic	So today the topic which we are going to study is "Subtraction"	Students' will listen.
Presentation	Teacher will start the game on all computers Which is Math Game.	Students' will see the game. Students will open the game and open the category of subtraction for 5th grade. 

	Students' get 1 score for each level. And total levels for section were 10. Students will subtract upto 6 digit number. After completing 10 levels. Each student will get score. Teacher will repeat the game until each student got 10/10 score.	 
Application	After the ending of session of playing game teacher will give them 2,3 questions from their subtraction exercise.	Student will give answers of those questions
Recapitulation	So, Today we have studied subtraction. subtraction means the process or skill of taking one	Students will summarize the concept together with teacher.

	number or amount away from another.	
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.	

Lesson Plan 6

Class: grade 5th **Topic**: Multiplication

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

Method: Computer Assisted Instruction method

Learning outcomes:

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

- To understand multiplication up-to 3 digit number

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about simple level of Multiplication	W.Salam Fine. Good

	Now please let me know 10× 95= 8× 73 = 7× 93= Correct, Good.	 950 584 651
Announcement of the Topic	So today the topic which we are going to study is Multiplication.	Students' will listen.
Presentation	Teacher will start the game on all computers Which is Math Game.  Students' have to solve the multiplication and got 1 score for each level.	Students' will see the game.

	After completing 10 levels. Each student will get score. Teacher will repeat the game until each student got 10/10 score.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their multiplication exercise.	Student will give answers of those questions
Recapitulation	So, today we have studied multiplication. multiplication means the repeated addition of groups of equal sizes.	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.	

Lesson plan 7

Class: grade 5th **Topic**: Multiplication

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

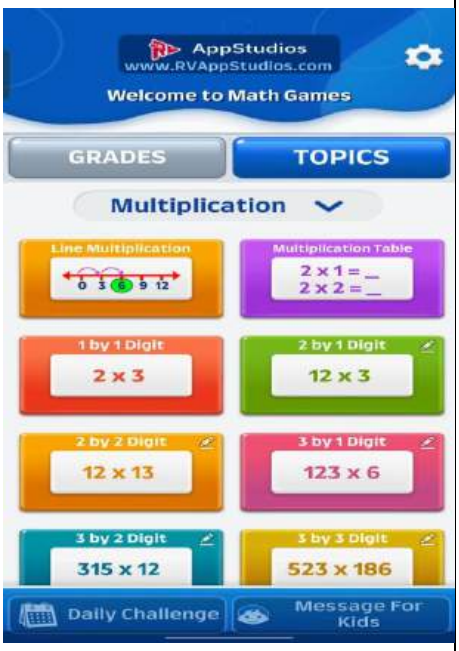
Method: Computer Assisted Instruction method

Learning outcomes:

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

- To understand multiply numbers up to 6 by a 2-digit number using computer-assisted instruction and digital math games.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about simple level of Multiplication Now please let me know 10× 9= 8× 6 = 7× 9= Correct, Good. Begin the lesson by discussing the concept of multiplication and its importance in everyday life.	90 48 63 Students will listen

	Use real-life examples to show how multiplication is used in various situations.	
Announcement of the Topic	So today the topic which we are going to study is Multiplication.	Students' will listen.
Presentation	Teacher will start the game on all computers Which is Math Game.  Introduce a computer-assisted math game that focuses on multiplying numbers up to 6 by a 2-digit number. Allow students to play the game individually, solving multiplication problems and earning points as they progress.	Students' will see the game.

	Students' have to solve the multiplication and got 1 score for each level. After completing 10 levels. Each student will get score. Teacher will repeat the game until each student got 10/10 score. After the game session, gather the students to discuss their experiences and challenges faced during the game. Address any misconceptions and reinforce the key multiplication concepts.	 Students will inform their problems if they have any.
Application	After the ending of session of playing game teacher will give	Student will give answers of those questions

	them 2,3 questions from their multiplication exercise.	
Recapitulation	So, today we have studied multiplication. multiplication means the repeated addition of groups of equal sizes.	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.	

Lesson plan 8

Class: grade 5th **Topic**: Multiplication

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

Method: Computer Assisted Instruction method

Learning outcomes:

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

- To understand multiply numbers up to 6 by a 3-digit number using computer-assisted instruction and digital math games.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about simple level of Multiplication Now please let me know 15× 95= 75× 73 = 69× 93= Correct, Good.	1425 5475 6417
Announcement of the Topic	So today the topic which we are going to study is Multiplication.	Students' will listen.
Presentation	Teacher will start the game on all computers Which is Math Game.	Students' will see the game.

	 Allow students to play the game individually, tackling multiplication challenges and earning rewards. Convene the students to discuss their experiences and the strategies they used during the game. Encourage them to share their insights and learn from each other Students' have to solve the multiplication and got 1 score for each level. After completing 10 levels. Each student will get score.	 

	Teacher will repeat the game until each student got 10/10 score.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their multiplication exercise.	Student will give answers of those questions
Recapitulation	So, today we have studied multiplication. multiplication means the repeated addition of groups of equal sizes.	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.	

Lesson Plan 9

Class: grade 5th **Topic**: Division

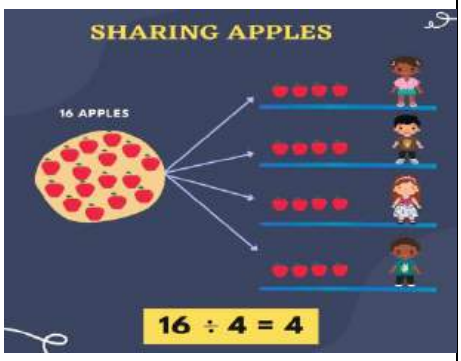
Time: 35 minutes **Av aids:** Digital games, whiteboard and marker.

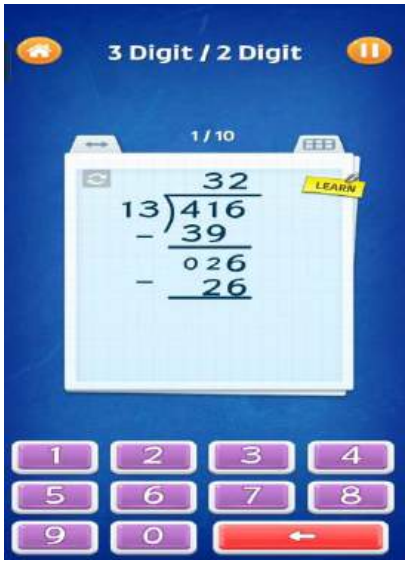
Method: Computer Assisted Instruction method

Learning outcomes:

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

- To solve divide numbers up to 6 by a 2-digit number using computer-assisted instruction and digital math games

Activity	Teacher Activity	Student Activity
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Start the lesson by discussing the concept of division and its importance in sharing and dividing quantities. Use practical examples to show how division is used in daily life situations through picture. 	Fine Students will see the picture.
Announcement of the Topic	So today the topic which we are going to study is Division	Students' will listen
Presentation	Teacher will start the game on all computers Which is Math Game.	

	 Students' have to solve the division level and got 1 score for each level. Introduce a computer-assisted math game that focuses on dividing numbers up to 6 by a 2-digit number. Allow students to play the game individually, solving division problems and earning points for correct answers. After completing 10 levels. Each student will get score. Gather the students after the game session to discuss their experiences and strategies they used during the game.	

	Address any difficulties encountered and reinforce key division concepts. Teacher will repeat the game until each student got 10/10 score.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their division exercise.	Student will give answers of those questions
Recapitulation	So, today we have studied When we divide numbers, we split them down into smaller numbers so that the multiplication of those smaller numbers equals the larger number taken	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. Recap the key points of the lesson and encourage students to continue practicing division using math games and other resources.	

Lesson plan 10

Class: grade 5th **Topic**: Multiplication

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

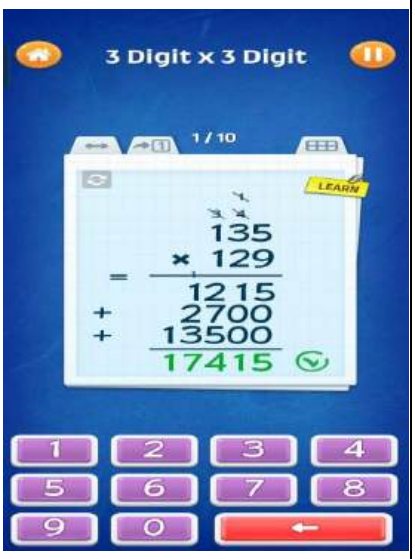
Method: Computer Assisted Instruction method

Learning outcomes:

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

- To understand multiply numbers up to 6 by a 3-digit number using computer-assisted instruction and digital math games.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about simple level of Multiplication Now please let me know 15× 95= 75× 73 = 69× 93= Correct, Good.	Fine. Good 1425 5475 6417
Announcement of the Topic	So today the topic which we are going to study is Multiplication.	Students' will listen.

Presentation	Teacher will start the game on all computers Which is Math Game.  Allow students to play the game individually, tackling multiplication challenges and earning rewards. Convene the students to discuss their experiences and the strategies they used during the game. Encourage them to share their insights and learn from each other Students' have to solve the multiplication and got 1 score for each level. After completing 10 levels. Each student will get score.	Students' will see the game. 

	Teacher will repeat the game until each student got 10/10 score.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their multiplication exercise.	Student will give answers of those questions
Recapitulation	So, today we have studied multiplication. multiplication means the repeated addition of groups of equal sizes.	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.	

Lesson Plan 11

Class: grade 5th **Topic**: Division

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

Method: Computer Assisted Instruction method

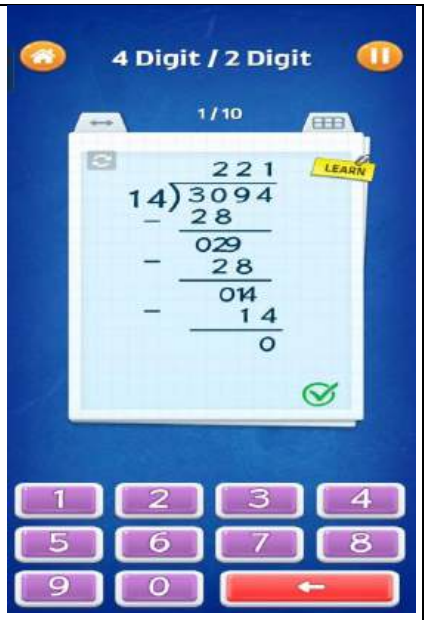
Learning outcomes:

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

- To solve divide numbers up to 6 by a 3-digit number using computer-assisted instruction and digital math games

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Begin the lesson by reviewing the concept of division and its applications in everyday scenarios. Reinforce the idea that division is the inverse operation of multiplication	Fine Students will listen.
Announcement of the Topic	So today the topic which we are going to study is Division	Students' will listen

Presentation	Teacher will start the game on all computers Which is Math Game.  Students' have to solve the division level and got 1 score for each level. Allow students to play the game individually, solving division problems with immediate feedback. . After completing 10 levels. Each student will get score.	

	Gather the students after the game session to discuss their experiences and strategies they used during the game. Address any difficulties encountered and reinforce key division concepts. Teacher will repeat the game until each student got 10/10 score.	 
Application	After the ending of session of playing game teacher will give them 2,3 questions from their division exercise.	Student will give answers of those questions
Recapitulation	So, today we have studied When we divide numbers, we split them down into smaller numbers so that the multiplication of those smaller numbers equals the larger number taken	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. Recap the key points of the lesson and encourage students to continue practicing division using math games and other resources.	

Lesson Plan 12

Class: grade 5th **Topic**: Division

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

Method: Computer Assisted Instruction method

Learning outcomes:

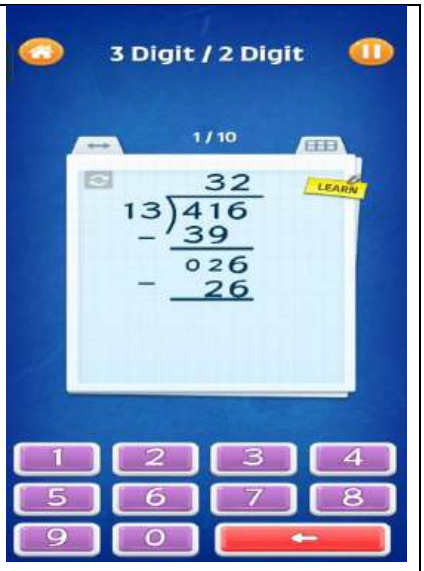
By the end of lesson plan students' will be able to:

- To solve division concepts and practice dividing numbers up to 6 by both 2 and 3-digit numbers through computer-assisted instruction and digital math games.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Begin the lesson with a quick review of division concepts	Fine

	covered in the previous two lessons. Use examples to reinforce the relationship between multiplication and division. Suppose you have 20 candies, and you want to share them equally among your 4 friends. To find out how many candies each friend gets, you can use division. Division: 20 candies ÷ 4 friends = 5 candies each Now, let's use multiplication to check if the division result is correct. We can multiply the number of friends by the number of candies each friend gets: Multiplication: 4 friends × 5 candies each = 20 candies As you can see, multiplication and division are opposite operations and help us solve related problems.	Students will understand the example
Announcement of the Topic	So today the topic which we are going to study is Division	Students' will listen

Presentation	Teacher will start the game on all computers Which is Math Game.  Introduce a computer-assisted math game that includes mixed practice of dividing numbers up to 6 by 2 and 3-digit numbers. Allow students to play the game individually, tackling a variety of division problems. After completing 10 levels. Each student will get score. Gather the students after the game session to discuss their experiences and strategies they used during the game.	

	Address any difficulties encountered and reinforce key division concepts. Teacher will repeat the game until each student got 10/10 score.	 
Application	After the ending of session of playing game teacher will give them 2,3 questions from their division exercise.	Student will give answers of those questions
Recapitulation	So, today we have studied When we divide numbers, we split them down into smaller numbers so that the multiplication of those smaller numbers equals the larger number taken	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. Recap the key points of the lesson and encourage students to continue practicing division using math games and other resources.	

LESSON PLAN 13

Class: grade 5th **Topic**: Fractions

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

Method: Computer Assisted Instruction method

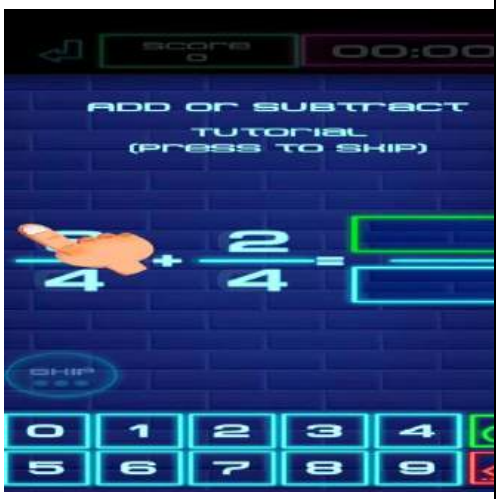
Learning outcomes:

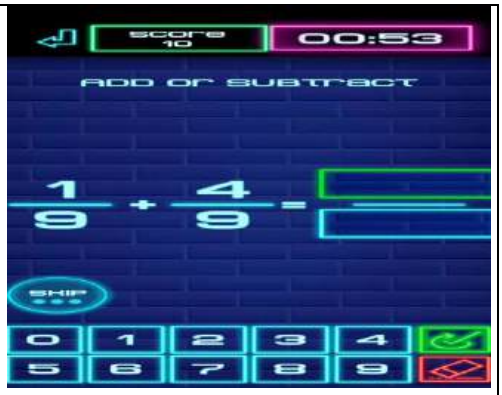
By the end of lesson plan students' will be able to:

1. Add two or more fraction
2. Subtract two or more fraction
3. Add and subtract two or more fraction with different denominator.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great.	Fine. Good

	In previous class you have already learnt about proper, improper and mixed fraction. Like and unlike fraction. Have you remember what the difference between proper, improper and mixed fraction?	Yes, I know Proper fraction where the numerator is less than denominator. Improper fraction where the numerator is greater than denominator. And Mixed fractions consist of a whole number for e.g. $5\frac{6}{10}$
Announcement of the topic	So today the topic which we are going to study is. **Add and subtract fractions.**	Students will listen
Presentation	Teacher will start the game on all computers. Which is fraction challenge: math game.	Students' will see the game

		Students will open the game and open the category of add and subtract. 
	In add and subtract category first teacher will instruct them to open tutorial of the game how to play add and subtract fraction. In add and subtract category there is game A & B. In game A students will give the answer while in game B there is	 After watching tutorial students will play the game.

	an options in which students will select the right option. After giving right answer of each questions students will get score. There is no negative marking if a student gives wrong answer. When student will give right answer 10 score will add in their total score.	 When student will clear game with highest score than they will reach to game B  

Application	After the ending of session of playing game teacher will give them 2,3 questions from their add and subtract fraction exercise	Student will give answers of those questions.
Recapitulation	So, today we have studied add and subtract fractions. In all add and subtract fraction we only add and subtract from numerator when the denominator is same. But when denominator is different we take their L.C.M and make it same denominator and multiply that number with numerator.	Students will summarize the concept together with teacher
Assessment	Teacher will understand the students' performance by their score in games. Scores are mentioned on top bar of the game. These scores helps them to motivate to gain more score in second level as compared to their class fellows.	

LESSON PLAN 14

Class: grade 5th **Topic**: Fractions

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

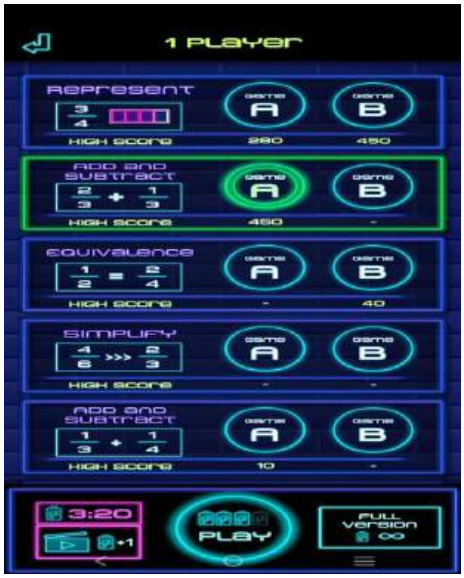
Method: Computer Assisted Instruction method

Learning outcomes:

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

- To add and subtract fractions with different denominators using the "Fraction Challenge: Math Game" for grade 5

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. In previous class you have already learnt about proper, improper and mixed fraction. Like and unlike fraction. Have you remember what the difference between proper, improper and mixed fraction? Review the concept of fractions and their components, including numerators and denominators. Explain the importance of finding a common denominator for adding and subtracting fractions with different denominators	Fine Yes, I know Proper fraction where the numerator is less than denominator. Improper fraction where the numerator is greater than denominator. And Mixed fractions consist of a whole number for e.g. $5\frac{6}{10}$
Announcement of the topic	So today the topic which we are going to study is. **Add and subtract fractions.**	Students will listen
Presentation	Teacher will start the game on all computers.	

	Which is fraction challenge: math game.  Introduce the "Fraction Challenge: Math Game" to the students. Instruct the students to play the game, focusing on adding and subtracting fractions with different denominators.	Students' will see the game Students will open the game and open the category of add and subtract.  After watching tutorial students will play the game.

	In add and subtract category first teacher will instruct them to open tutorial of the game how to play add and subtract fraction. In add and subtract category there is game A & B. In game A students will give the answer while in game B there is an options in which students will select the right option. After giving right answer of each questions students will get score. There is no negative marking if a student gives wrong answer. When student will give right answer 10 score will add in their total score. Gather the students after the game session to discuss their experiences and challenges faced during the game. Address any misconceptions and reinforce the key concepts related to fraction addition and subtraction	 When student will clear game with highest score than they will reach to game B  
Application	After the ending of session of playing game teacher will give	

	them 2,3 questions from their add and subtract fraction exercise	Student will give answers of those questions.
Recapitulation	So, today we have studied add and subtract fractions. In all add and subtract fraction we only add and subtract from numerator when the denominator is same. But when denominator is different we take their L.C.M and make it same denominator and multiply that number with numerator.	Students will summarize the concept together with teacher
Assessment	Teacher will understand the students' performance by their score in games. Scores are mentioned on top bar of the game. These scores helps them to motivate to gain more score in second level as compared to their class fellows.	

LESSON PLAN 15

Class: grade 5th **Topic**: Fractions

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

Method: Computer Assisted Instruction method

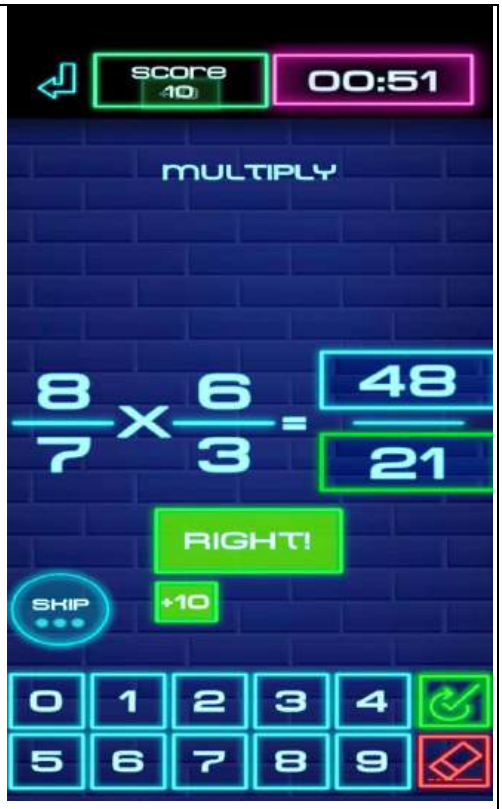
Learning outcomes:

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

- To multiply fractions with either the same or different denominators using the "Fraction Challenge: Math Game" for grade 5.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Review the concept of fraction multiplication, including multiplying fractions with the same denominator and different denominators. Explain the significance of simplifying fractions after multiplication with different denominators.	Fine Yes, I know Proper fraction where the numerator is less than denominator. Improper fraction where the numerator is greater than denominator. And Mixed fractions consist of a whole number for e.g. $5\frac{6}{10}$
Announcement of the topic	So today the topic which we are going to study is. **Add and subtract fractions.**	Students will listen

Presentation	Teacher will start the game on all computers. Which is fraction challenge: math game.  Introduce the "Fraction Challenge: Math Game" to the students. Instruct the students to play the game, focusing on multiplying fractions with same and different denominators. Guide them through the process of simplifying fractions and performing the operations in the game.	Students' will see the game Students will open the game and open the category of add and subtract.  After watching tutorial students will play the game.

	In multiplication category first teacher will instruct them to open tutorial of the game how to play multiply fraction. In multiplication category there is game A & B. In game A students will give the answer while in game B there is an options in which students will select the right option. After giving right answer of each questions students will get score. There is no negative marking if a student gives wrong answer. When student will give right answer 10 score will add in their total score. Gather the students after the game session to discuss their experiences and challenges faced during the game. Address any misconceptions and reinforce the key concepts related to fraction multiplication.	 When student will clear game with highest score than they will reach to game B. 

		
Application	After the ending of session of playing game teacher will give them 2,3 questions from their multiplication fraction exercise	Student will give answers of those questions.
Recapitulation	So, today we have multiplication fraction.	Students will summarize the concept together with teacher
Assessment	Teacher will understand the students' performance by their score in games. Scores are mentioned on top bar of the game. These scores helps them to motivate to gain more score in second level as compared to their class fellows.	

LESSON PLAN 16

Class: grade 5th

Topic: Fractions

Time: 35 minutes

Av aids: Digital games, whiteboard and marker.

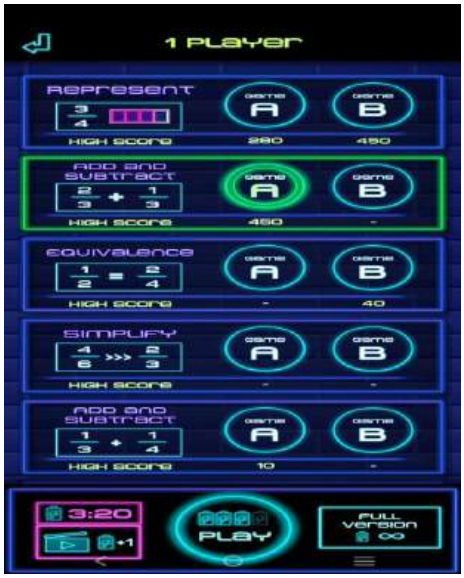
Method: Computer Assisted Instruction method

Learning outcomes:

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

- To divide fractions with either the same or different denominators using the "Fraction Challenge: Math Game" for grade 5.

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Start the lesson by reviewing the concept of fractions and their components, including numerators and denominators. Introduce the concept of fraction division, explaining how it is different from other operations like addition or multiplication.	Fine Students will listen
Announcement of the topic	So today the topic which we are going to study is. **Division fraction .**	Students will listen
Presentation	Teacher will start the game on all computers. Which is fraction challenge: math game.	

	 Introduce the "Fraction Challenge: Math Game" to the students. Introduce the "Fraction Challenge: Math Game" to the students, focusing on the division section. Provide a brief overview of the game's interface and how to access the division challenges. In division category first teacher will instruct them to open tutorial of the game how to play Division fraction. In division category there is game A & B. In game A students will give the answer while in game B there is an options in which students will select the right option.	Students' will see the game Students will open the game and open the category of add and subtract.  After watching tutorial students will play the game. 

	After giving right answer of each questions students will get score. There is no negative marking if a student gives wrong answer. When student will give correct answer 10 score will add in their total score. Gather the students after the game session to discuss their experiences and challenges faced during the game. Address any misconceptions and reinforce the critical concepts related to fraction division.	When student will clear game with highest score than they will reach to game B
Application	After the ending of session of playing game teacher will give them 2,3 questions from their add and division fraction exercise	Student will give answers of those questions.
Recapitulation	So, today we have studied division fraction. to divide one fraction by another, we invert the second fraction (swap the numerator and denominator) and then multiply the two fractions.	Students will summarize the concept together with teacher

Assessment	Teacher will understand the students' performance by their score in games. Scores are mentioned on top bar of the game. These scores helps them to motivate to gain more score in second level as compared to their class fellows.	

LESSON PLAN 17

Class: grade 5th **Topic**: Decimal

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

Method: Computer Assisted Instruction method

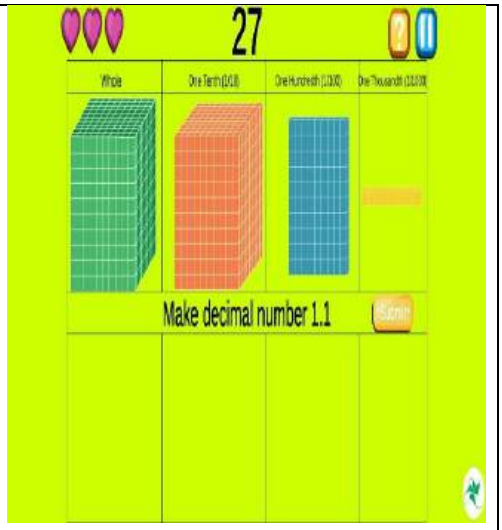
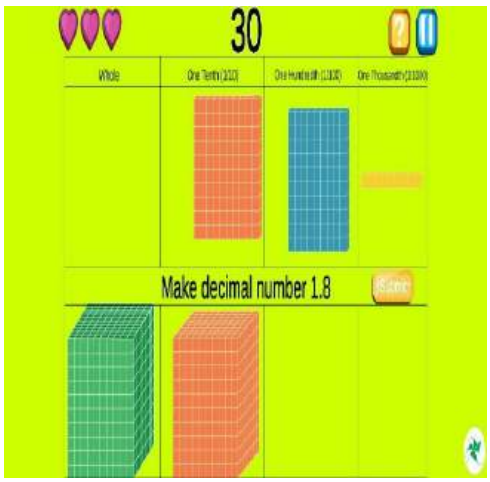
Learning outcomes:

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

- To create decimals using computer-assisted instruction and the "Decimal Game" for grade 5

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Begin the lesson by reviewing the concept of decimals and their representation on the number line.	Fine

	Explain the significance of decimals in everyday life situations	Yes, I know Time: Decimals are used to represent fractions of an hour in timekeeping. For instance, 2.5 hours means 2 hours and 30 minutes. This is especially useful for calculating wages based on hourly rates.
Announcement of the topic	So today the topic which we are going to study is. **Making Decimals**	Students will listen
Presentation	Teacher will start the game on all computers. Which is Decimal Game  Introduce the "Decimal Game" to the students, focusing on the making decimals section. Instruct the students to create decimals by placing digits on the correct places in the game.	Students' will see the game Students will open the category of making decimal number.

	Gather the students after the game session to discuss their experiences and the decimals they created Address any misconceptions and reinforce the key concepts related to making decimal number.	 
Application	After the ending of session of playing game teacher will give them 2,3 questions from their making decimal number.	Student will give answers of those questions.
Recapitulation	So, today we have studied making decimal number.	Students will summarize the concept together with teacher
Assessment	Teacher will understand the students' performance by their score in games.	

	Scores are mentioned on top bar of the game. These scores helps them to motivate to gain more score in second level as compared to their class fellows.	

LESSON PLAN 18

Class: grade 5th **Topic**: Decimal

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

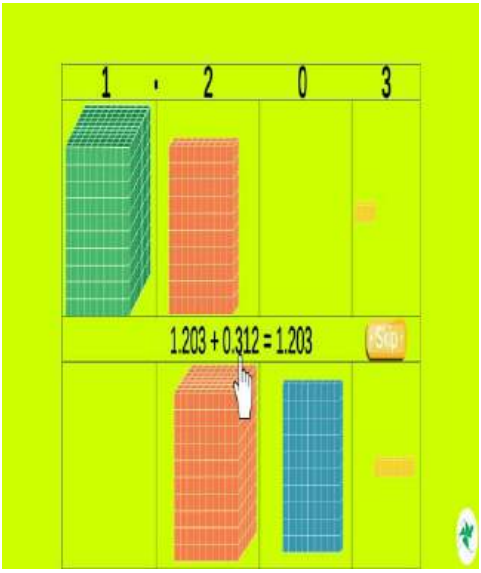
Method: Computer Assisted Instruction method

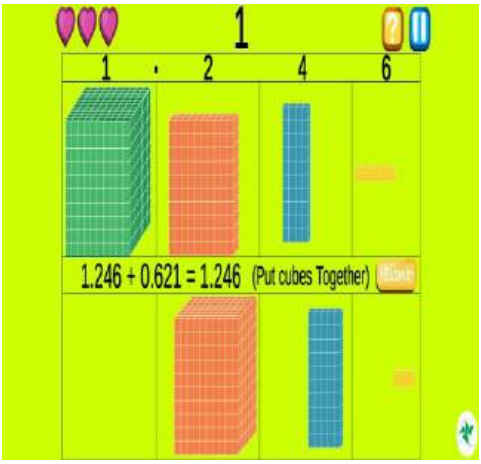
Learning outcomes:

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

- To Add decimal number using computer-assisted instruction and the "Decimal Game" for grade 5

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Review the concept of decimals and the process of addition with whole numbers. Introduce the addition of decimals and its relevance in various real-life situations	Fine Students will listen

Announcement of the topic	So today the topic which we are going to study is. **Adding Decimals**	Students will listen
Presentation	Teacher will start the game on all computers. Which is Decimal Game  Introduce the "Decimal Game" to the students, focusing on the adding decimals section. Instruct the students to add decimals in the game by aligning the decimal points. Gather the students after the game session to discuss their experiences and the decimals they add.	Students' will see the game Students will open the category of adding decimal number. 

	Address any misconceptions and reinforce the key concepts related to adding decimal number.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their adding decimal number.	Student will give answers of those questions.
Recapitulation	So, today we have studied adding decimal number.	Students will summarize the concept together with teacher
Assessment	Teacher will understand the students' performance by their score in games. Scores are mentioned on top bar of the game. These scores help them to motivate to gain more score in second level compared to their class fellows. Encourage students to practice independently to solidify their addition skills	

LESSON PLAN 19

Class: grade 5th **Topic**: Decimal

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

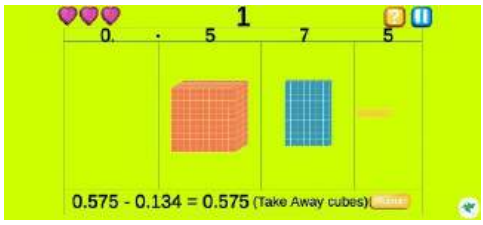
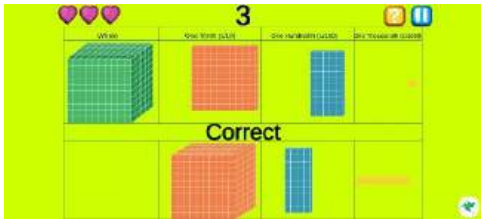
Method: Computer Assisted Instruction method

Learning outcomes:

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

- To Subtract decimal number using computer-assisted instruction and the "Decimal Game" for grade 5

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Review the concept of decimals and the process of subtraction with whole numbers. Introduce the subtraction of decimals and its relevance in various real-life situations	Fine Students will listen
Announcement of the topic	So today the topic which we are going to study is. **Subtracting Decimals**	Students will listen
Presentation	Teacher will start the game on all computers. Which is Decimal Game	

	 Introduce the "Decimal Game" to the students, focusing on the subtracting decimals section. Instruct the students to subtract decimals in the game by aligning the decimal points. After the game session, gather the students discuss their experiences and the decimals they subtract. Address any misconceptions and reinforce the key concepts related to Subtracting decimal number.	Students' will see the game Students will open the category of Subtracting decimal numbers.  
Application	After the end of the playing game session, the teacher will give them 2,3 questions from their Subtracting decimal number.	Students will give answers to those questions.
Recapitulation	So, today we have studied Subtracting decimal number.	Students will summarize the concept together with the teacher
Assessment	The teacher will understand the students' performance by their scores in games. Scores are mentioned on top bar of the game.	

	These scores help them to motivate to gain more score in second level as compared to their class fellows. Encourage students to practice independently to solidify their subtraction skills	

LESSON PLAN 20

Class: grade 5th **Topic**: Decimal

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

Method: Computer Assisted Instruction method

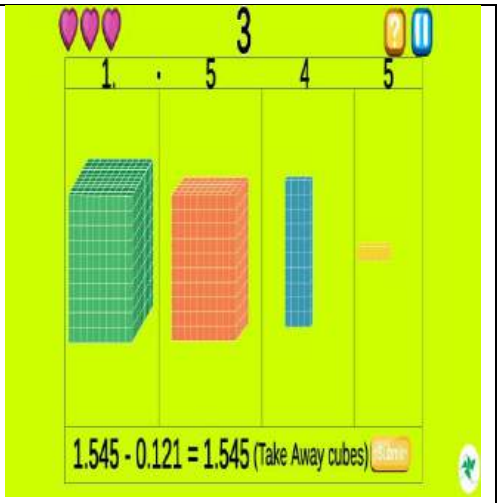
Learning outcomes:

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

- To Subtract decimal number to fraction using computer-assisted instruction and the "Decimal Game" for grade 5

Activity	**Teacher Activity**	**Student Activity**
Previous knowledge	Asalam o alaikum. How are you all hope you are doing great. Review the concept of decimals and the process of subtraction with whole numbers.	Fine Students will listen

	Introduce the subtraction of decimals and its relevance in various real-life situations	
Announcement of the topic	So today the topic which we are going to study is. **Subtracting Decimals**	Students will listen
Presentation	Teacher will start the game on all computers. Which is Decimal Game  Introduce the "Decimal Game" to the students, focusing on the subtracting decimals section. Instruct the students to subtract decimals in the game by aligning the decimal points. Gather the students after the game session to discuss their experiences and the decimals they subtract.	Students' will see the game Students will open the category of Subtracting decimal number.

	Address any misconceptions and reinforce the key concepts related to Subtracting decimal number.	
Application	After the ending of session of playing game teacher will give them 2,3 questions from their Subtracting decimal number.	Student will give answers of those questions.
Recapitulation	So, today we have studied Subtracting decimal number.	Students will summarize the concept together with teacher
Assessment	Teacher will understand the students' performance by their score in games. Scores are mentioned on top bar of the game. These scores help them to motivate to gain more score in second level as compared to their class fellows. Encourage students to practice independently to solidify their subtraction skills	Students will play the game until he gets higher score.

Appendix -2

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

Demographic Information

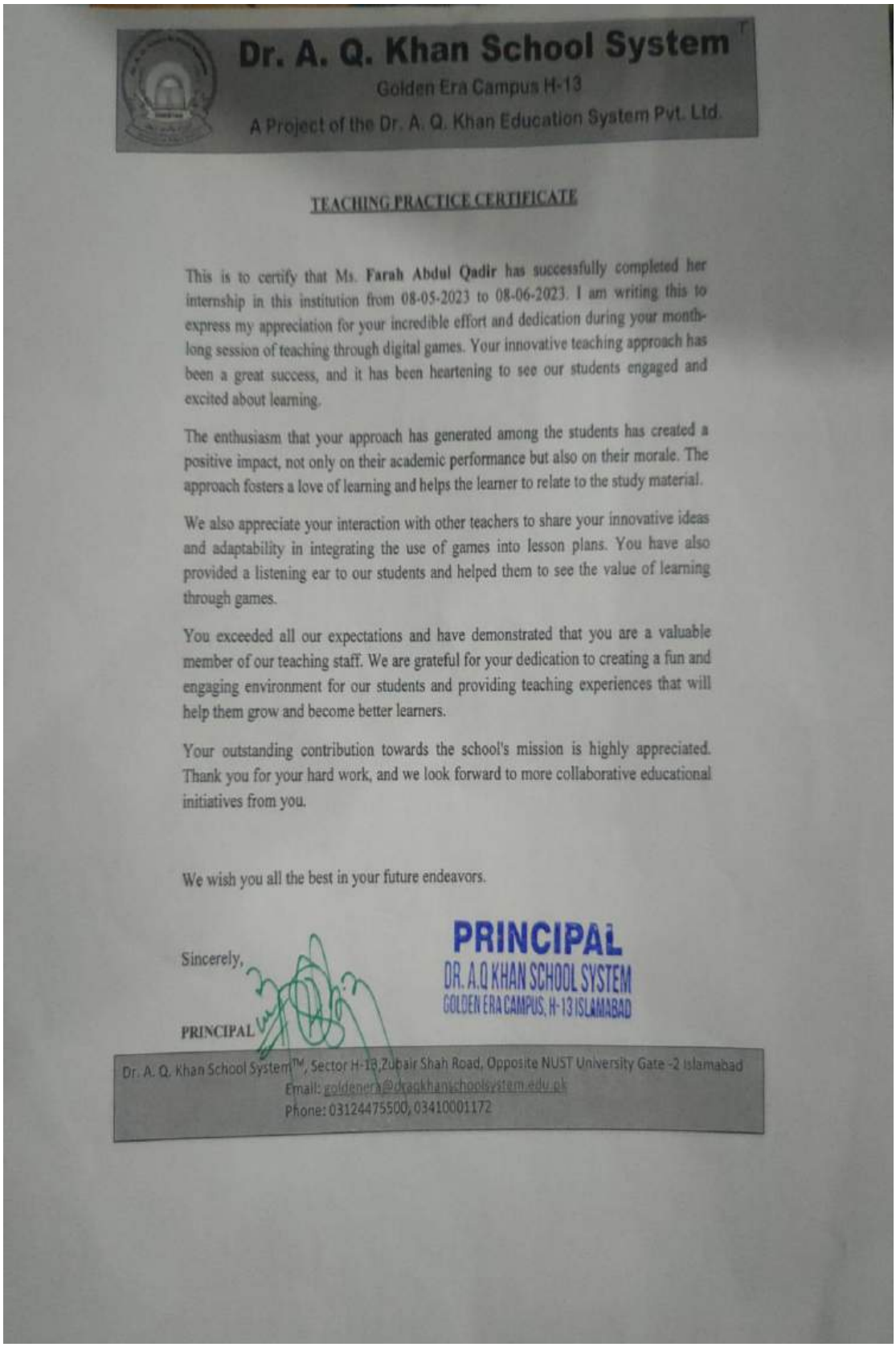
Class: _____ **Date of observation:** _____

Note: 5=Always (A), **4**=Often(O), **3**=Sometimes (S.T), **2**=Rarely(R), **1**=Never(N)

	ENGAGEMENT					
	Persistence	**A 5**	**O 4**	**S.T 3**	**R 2**	**N 1**
1.	Pays attention in class					
2.	Works well with their class fellows					
3.	Complete assigned work					
4.	Is persistent when confronted with complex problems					
5.	Work on new assignments with sincere effort					
6.	Tries to finish assignments even when they are difficult					
7.	Gets not discouraged and continuously trying when encountering an obstacle in schoolwork.					
	Task Management	**5**	**4**	**3**	**2**	**1**
1.	Participates actively in discussions.					
2.	Asks Questions to get more information.					
3.	Raises his/her hand to answer a question or volunteer information.					
4.	Attempts to do his/her work timely and well.					

	Planning	**5**	**4**	**3**	**2**	**1**
1.	The student effectively prioritizes tasks					
2.	Organize their materials and workspace					
3.	The students arrive on time and are ready for class					
4.	The students have all the necessary materials (books, notebooks, stationery, etc.)					
.	**MOTIVATION**					
.	**Positive Body Language**	**5**	**4**	**3**	**2**	**1**
. 1.	Eye contact with the Teacher					
. 2.	Appropriate posture					
. 3.	Nonverbal response					
. 4.	Body Language Consistency					
.	**Learning Focus**	**5**	**4**	**3**	**2**	**1**
. 1.	Active Participation					
. 2.	Attentive listening					
. 3.	Following directions					
. 4.	Asking Questions					
.	**Self-Belief**	**5**	**4**	**3**	**2**	**1**
. 1.	Working independently					
. 2.	Problem-solving to get needed help					
. 3.	Confident to share ideas					

Appendix 3



Dr. A. Q. Khan School System
Golden Era Campus H-13
A Project of the Dr. A. Q. Khan Education System Pvt. Ltd.

TEACHING PRACTICE CERTIFICATE

This is to certify that Ms. **Farah Abdul Qadir** has successfully completed her internship in this institution from 08-05-2023 to 08-06-2023. I am writing this to express my appreciation for your incredible effort and dedication during your month-long session of teaching through digital games. Your innovative teaching approach has been a great success, and it has been heartening to see our students engaged and excited about learning.

The enthusiasm that your approach has generated among the students has created a positive impact, not only on their academic performance but also on their morale. The approach fosters a love of learning and helps the learner to relate to the study material.

We also appreciate your interaction with other teachers to share your innovative ideas and adaptability in integrating the use of games into lesson plans. You have also provided a listening ear to our students and helped them to see the value of learning through games.

You exceeded all our expectations and have demonstrated that you are a valuable member of our teaching staff. We are grateful for your dedication to creating a fun and engaging environment for our students and providing teaching experiences that will help them grow and become better learners.

Your outstanding contribution towards the school's mission is highly appreciated. Thank you for your hard work, and we look forward to more collaborative educational initiatives from you.

We wish you all the best in your future endeavors.

Sincerely,

PRINCIPAL

PRINCIPAL
DR. A.Q KHAN SCHOOL SYSTEM
GOLDEN ERA CAMPUS, H-13 ISLAMABAD

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