Physics Quest: Digital Game-Based Lessons for Seventh Grade

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Abstract- *This study sought to create a digital game-based physics lesson for seventh-grade students. It sought answers to respondents' least mastered competencies in physics by identifying their preferred game-based learning activity and determining their level of critical thinking, creative thinking, and problem-solving. A descriptive-developmental design was used in the study of selected learners from 129 grade 7 students, carried out at Bukal Sur National High School in Candelaria, Quezon, during the academic year 2022-2023. The study's findings revealed that the respondents' least mastered competency in Physics was describing an object's motion in terms of distance or displacement, speed or velocity, and acceleration, as well as creating and interpreting visual representations of object motion such as tape charts and motion graphs and inferring that waves carry energy. Respondents prefer to play digital games, particularly puzzle games, on their mobile devices. The respondents' mean pre-test score indicated low critical thinking, creative thinking, and problem-solving, whereas the mean post-test score was very satisfactory. Finally, there is a significant difference between the respondents' pre-test and post-test scores for critical thinking, creative thinking, and problem-solving.*

Keywords*:* critical thinking skills, creative thinking skills, problem-solving skills, developed digital game-based lesson

I. INTRODUCTION

Quality education is a fundamental right for all people, including students in the Philippines. The Philippine Education for All (EFA) policy emphasizes the importance of comprehensive, high-quality primary education that meets the diverse needs of all students, including those with special needs (Adarlo & Jackson, 2016). It recognizes the importance of collaborative, effective, and efficient delivery of basic education services, appropriate educational resources, and high-quality instruction (Madani, 2019). Despite these efforts, research shows that many Filipino students struggle to meet functional literacy standards, limiting their ability to adapt to a rapidly changing world (Agayon et al., 2022).

Integrating science content and processes into the curriculum is an important aspect of quality education. The K-12 Science Curriculum Guide (2016) emphasizes the importance of science education that effectively applies skills by structuring the curriculum around real-world situations and problems (Balagtas et al., 2019). According to Yacoubian (2018), scientific literacy enables students to make informed decisions about the practical applications of scientific knowledge in society, health, and the environment. However, the quality of education in the Philippines has suffered, as evidenced by the 2018 Programme for International Student Assessment (PISA) results, which showed the country ranking low in reading comprehension, mathematics, and science (Schleicher, 2019).

To address these educational challenges, recent efforts have focused on raising teachers' basic education levels and developing critical tools for the advancement of science education (Wells, 2019). In this context, game-based learning has gained popularity as an engaging educational strategy. Digital game-based learning, which involves incorporating educational content or learning principles into computer or video games, has grown in popularity as technology and the internet have advanced (Casañ-Pitarch, 2018).

Digital games have the potential to improve learning experiences, assist teachers in creating 21st-century classrooms, and reflect the preferences and interests of today's digital-native learners (Montilla et al., 2023). Creating a stimulating and immersive learning environment can also increase learner motivation. The interactive nature of games, combined with elements like challenges, rewards, and feedback, can promote a sense of accomplishment and intrinsic motivation. (Chen et al., 2021).

As the demand for technology in the classroom grows, educators must adapt quickly to reap the benefits (Panergayo & Aliazas, 2023). Digital games, particularly puzzle games, provide an engaging and interactive platform for developing modern educational models. Puzzle games require critical thinking, spatial reasoning, pattern recognition, and logical reasoning, so they are ideal for

promoting cognitive skill development. According to Whitton (2014), educators can promote active learning, collaboration, and a sense of accomplishment among students by incorporating digital puzzle games that are aligned with specific learning objectives and subject areas.

Given the COVID-19 pandemic's impact on education worldwide, there is an urgent need to investigate novel approaches to ensuring quality education in the post-pandemic era, particularly for Filipino students (Pelayo-Decanay et al., 2023). The shift to remote and online learning has accelerated education's digital transformation, requiring educators to use digital tools and platforms that are tailored to learners' preferences, interests, and learning styles (Reyes & Aliazas, 2021). The disruptions caused by remote learning have created learning gaps that must be filled, and quality education should go beyond information transmission to foster critical thinking, problem-solving, creativity, and other 21st-century skills (Guevarra & panoy, 2022).

Digital games are a promising solution for engaging students and improving educational quality (Falcão et al., 2018). According to Woo (2014), digital game learning can benefit learners' cognitive abilities, knowledge retention, problem-solving skills, and motivation. Puzzle games provide unique educational benefits by encouraging critical thinking and cognitive skill development. Using digital puzzle games in science education allows educators to provide meaningful problem-solving activities that reinforce knowledge and skills while engaging students in an interactive and enjoyable learning experience (Huang et al., 2020).

As a result, this research aims to create a digital game-based Physics lesson for grade 7 students. The lesson will use digital puzzle games to improve learning outcomes in the subject. The open-source application ProProfs Build and Test Knowledge will be used to develop an educational digital puzzle game. The findings of this study will provide valuable insights and data for educators and instructional designers about the potential benefits of incorporating DGBL, with a focus on digital puzzles, into science education.

Background of the Study. DepEd Order No. 42, s. 2016 is consistent with the Department of Education's commitment to research-based approaches that address learning deficiencies and ensure high-quality learning outcomes for students. It offers a comprehensive framework that encourages the use of research and data-driven practices to improve teaching and learning processes at the elementary and high school levels.

The existing literature highlights the persistent challenges to achieving quality education in the Philippines despite recognizing education as a fundamental right. One major challenge is Filipino learners' struggle to meet functional literacy standards, which severely limits their ability to comprehend and adapt to the demands of the modern world (Barrot, 2019). The literature also identifies a number of contributing factors, including insufficient resources, outdated teaching methods, and inadequate support for students with special needs.

The government has launched several initiatives and policies in response to these challenges. For example, the Philippine Education for All (EFA) policy emphasizes the importance of inclusive education and providing appropriate resources to meet the needs of students with special needs (Traya & Lopez, 2023). Furthermore, the Department of Education has placed a strong emphasis on teacher competency enhancement through professional development programs, with the goal of improving overall educational quality (Alemayehu, 2021). Furthermore, efforts have been made to align the curriculum with learners' diverse needs and foster collaborative and effective delivery of education services.

The Department of Education is constantly implementing measures to meet the educational needs of students. NAT Result Analysis is carried out to improve educational quality, and intervention programs, projects, and activities are initiated. However, Parrish & Sadera's (2020) study found that science education in the Philippines, particularly in basic education, lags behind that of other countries. According to international and local studies, Filipino students have poor concept retention as well as inadequate reasoning and analytical skills. The MPS results indicated that intervention is required to meet the needs of the learners. At Bukal Sur National High School in Candelaria Quezon, Division of Quezon, the MPS for Science subjects has dropped dramatically from 51.65 in S.Y. 2019-2020 to 49.78 in S.Y. 2021-2022, significantly lower than the national target of 75.0 sets for EFA 2015. To address this issue, educators must be sensitive to their students' needs and use a variety of teaching and learning tools and strategies to make the learning experience more realistic and meaningful.

The literature review findings provide valuable insights into the current educational landscape and emphasize the importance of addressing the identified challenges to ensure quality education in the Philippines. Implementing research-based approaches, as emphasized in DepEd Order No. 42, s. 2016 can help to overcome these challenges and promote positive educational outcomes for Filipino students. (Sandoval et al., 2022).

Sardone and Devlin-Scherer (2010) discovered that game-based learning can help students learn a wide range of skills, including problem-solving, critical thinking, and creative thinking. However, as Martin & Shen (2014) points out, games are evolving to help students learn. Connolly et al. (2012) conducted a systematic review of studies on digital games in education and discovered evidence that games can improve learning outcomes; however, more research is needed to determine the most effective types of games and game features.

In this context, the researchers plan to create a digital game-based physics lesson for Grade 7 students at Bukal Sur National High School in Candelaria, Quezon, for the 2022-2023 school year.

The researchers hope to improve student learning by incorporating digital puzzle games into lessons, thereby encouraging critical thinking, creativity, and problem-solving abilities. The researchers will specifically focus on creating a digital game-based physics lesson for seventh-grade students. The study will focus on the students' least learned competency in Physics within the Science and Technology concentration for Grade 7. The researchers intend to create a lesson that incorporates digital puzzle games at different stages to improve the learning experience.

Specifically, it sought to answer the following questions:

1. What is the least mastered competency of the respondents in physics?
2. What is the preferred game-based learning activity of the learners?
3. What are the respondents' mean pre-test and post-test scores regarding critical thinking, creative thinking, and problem-solving?
4. Is there a significant difference between the respondents' mean pre-test and post-test scores in terms of critical thinking, creative thinking, and problem-solving?
5. How do validators perceive the development of digital game-based lessons?

II. METHODOLOGY

Research Design. The descriptive-developmental method was used by the researchers. Marual-Gillaco (2014) discussed the descriptive method that seeks true facts about a current situation. This method focuses on describing, comparing, analyzing, and interpreting existing data. The developmental method is also defined as a body of research literature that is directly related to instructional development, implying that output will be developed following the completion of this research. To put it another way, a descriptive developmental method is a systematic study of designing, developing, and carefully evaluating instructional programs, processes, and products that must meet the standard or criteria (Tijsma et al., 2020). A descriptive and developmental design is appropriate since the research attempts to develop a digital game-based lesson. Data collection and analysis were used, with quantitative data derived from respondents' critical thinking, creative thinking, and problem-solving scores. A series of pre-and post-assessments were used to measure the students' learning and skills carefully. The major purpose of descriptive research design is to provide information on the characteristics of a population or phenomenon (Kim et al., 2017). Descriptive research is used as a precursor to quantitative research designs as it provides a general overview, giving some valuable pointers as to what variables are worth testing quantitatively.

Respondents of the study. The respondents of this study are limited to 44 heterogenous students from Grade 7-Bonifacio, 42 students from Grade 7-Jacinto, and 43 students from Grade 7-Silang with a total of 129 students at Bukal Sur National High School Year 2022-2023.

Population and Sampling. The study was conducted at Bukal Sur National High School, which is located at Buenavista West Candelaria, Quezon, in the Division of Quezon. The population was composed of 129 students who came from the three sections handled by the researcher. Purposive sampling was used by the researchers to collect the sample.

Research Instrument. The tools used in gathering relevant data for this study were the diagnostic test to identify the least mastered competency of the learners, a survey questionnaire to identify the preferred digital game of the students, and the pre-assessment and post-assessment tests to determine the performance of the students in terms of critical thinking, creative thinking, and problem-solving, and the development of a digital game-based lesson in physics for Grade 7 learners.

The first instrument was a self-created diagnostic test with 50 multiple-choice questions based on physics' least learned learning competencies. A table of specifications was created to come up with the 50-item test: describe the motion of an object in terms of distance or displacement, speed or velocity, and acceleration with 13 items; create and interpret the visual representation of the motion of objects such as tape charts and motion graphs with 5 items. Infer that waves carry energy with nine items. Describe the characteristics of sound using nine items of wavelength, velocity, and amplitude. Explain the color and intensity of light in terms of its wave characteristics using four items. With six items, determine the conditions

required for heat transfer to occur, and with four items, describe the various types of charging processes.

The second instrument was a self-created survey questionnaire designed to determine the learners' preferred digital games. The third instrument was a digital game-based physics lesson designed for Grade 7 students that focused on the respondents' least learned physics competency. The fourth instrument was a self-created assessment tool that included 30 multiple-choice questions for both the pre-assessment and post-assessment tests, with 10 items each for critical thinking, creative thinking, and problem-solving. The test was administered before and after the program was implemented.

Prior to the study's implementation, the necessary permits were obtained from the principal and the Superintendent of Schools. The diagnostic test, survey questionnaire, and the 30-item pre- and post-assessment of the researcher were validated both externally and internally. The Principal, Master Teachers, Headteachers, and teachers from the school evaluated the acceptability of the developed lesson exemplar.

Research Procedure. Before beginning this study, the researchers obtained a letter requesting permission from the authorities. The researchers sent a request letter to the external and internal validators to validate the study's instrument before moving on to the study's actual phase.

The study made use of the IPO system, which includes input, processing, and output. The input includes the respondents' least mastered physics competency, their preferred digital game, and scientific cognitive skills such as critical thinking, creative thinking, and problem-solving. The process includes creating digital game-based physics lessons for grade 7 students, pilot testing, and a pre-test and post-test. The result is the Digital Game-based Physics Lesson for Grade 7 Students.

During the preliminary phase, the researchers identified the groups of Grade 7 students who would participate in the study. In this case, the sections selected were Grade 7-Bonifacio, Grade 7-Jacinto, and Grade 7-Silang. Prior to implementation, the researchers administered a diagnostic test to determine the respondents' least mastered competency in physics. This test assisted the researchers in identifying the specific competency areas where students needed to improve. The researchers asked participants to complete a survey questionnaire to determine their preferred digital game. This assisted the researchers in selecting an appropriate digital game to include in the lesson that is more engaging and relevant for the students. A digital game-based physics lesson was then created, focusing on the respondents' least mastered competency. The digital puzzle game featured in the lesson was created with the ProProfs application. ProProfs offers a platform for creating and sharing games, which can be hosted on a website or social network. This open-source game development software allows you to create games like word search, crossword puzzles, jigsaw puzzles, word scramble, sliding puzzles, and quiz games. The developed digital game-based physics lesson was pilot-tested in a section other than that of the respondents, such as Section Mabini. This allowed the researchers to identify and become acquainted with the parts of the lesson that required adjustment or improvement.

During the implementation phase, the researchers interviewed the selected respondents (Grade 7-Bonifacio, Grade 7-Jacinto, and Grade 7-Silang). Before the study began, a pre-test assessment was given to the students to determine their understanding of the least mastered competency. The researchers then implemented the digital game-based physics lesson for a set period.

To evaluate and validate the results, the researchers administered a post-assessment to measure the students' improvement in understanding the least mastered competency in physics following the study. The post-test questionnaire included a 30-item test on critical thinking, creative thinking, and problem-solving. Three science and math teachers, including the researchers, reviewed the assessment tool. The data from the pre-test and post-assessment were compiled and statistically analyzed.

Statistical Treatment. Several statistical tools were used to address the issues raised in the study. First, descriptive statistics such as standard deviation and mean were used to determine the respondents' least mastered competency in physics. Additionally, frequency count and percentage were used to determine the respondents' preferred digital games. Descriptive statistics were also used to assess the respondents' pre-test and post-test critical thinking, creative thinking, and problem-solving abilities, such as frequency count, percentage, mean, and standard deviation. Finally, to see if there was a significant difference between the respondents' pre-test and post-test mean scores, a t-test was used in this study.

III. RESULTS AND DISCUSSION

Table 1. *Least Mastered Competency of the Respondents in Physics*

Least Mastered Competencies	Mean	SD	Remarks
Describe the motion of an object in terms of distance or displacement, speed or velocity, and acceleration.	30.54	1.615	**LM**
Create and interpret visual representations of the motion of objects, such as tape charts and motion graphs.	59.00	1.096	**LM**
Infer that waves carry energy.	59.56	1.718	**LM**
Describe the characteristics of sound using the concepts of wavelength, velocity, and amplitude.	70.11	1.718	**MTM**
Explain the color and intensity of light in terms of its wave characteristics	69.25	1.072	**MTM**
Infer the conditions necessary for heat transfer to occur.	68.50	1.330	**MTM**
Describe the different types of charging processes.	62.50	1.054	**MTM**

Note: 60 below (Low Mastery); 61-79 (Moving Towards Mastery); 80 above (Mastered).

Table 1 shows a breakdown of the findings of the respondents' least developed competency in the discipline of Physics. The average scores for Competencies 1, 2, and 3, which include tasks like elucidating object motion in terms of distance or displacement, speed or velocity, and acceleration; generating and deciphering visual representations of motion; and calculating the energy carried by waves, are 30.54, 59.00, and 59.56, respectively. The constant feedback for these competencies suggests a general lack of mastery, implying that participants only have a basic comprehension of these specific concepts.

Students that demonstrate low mastery struggle to understand the lesson material, especially when it comes to assessing offered scenarios or solving issues, interpreting provided images, and deducing wave properties. This challenge originates from a fundamental lack of comprehension, which limits their ability to connect fully with the subject matter and effectively learn and apply. As a result, addressing these areas of weakness is critical in developing students' overall comprehension of Physics.

Competencies 4, 5, 6, and 7 delves into the complexities of sound, light, heat, and electricity, requiring students to express their understanding utilizing fundamental concepts such as wavelength, velocity, amplitude, and numerous principles of energy transfer. In Competency 4, students are asked to describe the qualities of sound, including wavelength, velocity, and amplitude. Similarly, in Competency 5, students are expected to describe the color and intensity of light using their understanding of wave properties. Furthermore, Competency 6 entails calculating the conditions required for heat transfer, and Competency 7 entails defining the various processes involved in charging.

The mean scores for these competencies (70.11, 69.25, 68.5, and 62.5, respectively) show that students are making significant progress toward mastery. This implies that the respondents have a thorough knowledge of the lessons, as they can successfully describe the important facts about light, color, heat, and electricity. The findings indicate a degree of understanding that allows students to connect with the subject matter in a meaningful way, demonstrating their capacity to apply theoretical knowledge to real-world settings.

These findings highlight the effectiveness of the instructional approaches used to teach these topics, as well as students' ability to understand and absorb complicated scientific concepts. Moving forward, it is critical to build on this understanding by promoting further exploration and application of these ideas to promote continued growth and proficiency in Physics (Rethman et al., 2021). The data's implications also suggest that additional attention and targeted interventions are required to improve mastery of competencies 1, 2, and 3. These competencies related to motion, wave energy, and visual representations require additional assistance to improve participants' comprehension.

Table 2. *Preferred Digital Game-Based Learning Activity of the Learners*

Indicators	F	%
1. Do you like to play digital games/computer games?		
• Absolutely, I love playing digital games/computer games.	114	88.4
• I enjoy playing digital games/computer games from time to time.	6	4.7
• I'm neutral about playing digital games/computer games.	4	3.1
• No, I'm not a fan of playing digital games/computer games.	4	3.1
• I actively dislike playing	1	0.8

digital games/computer games		
2. Where do you usually play digital games/computer games??		
• Computer shop	6	4.7
• Cellphone/mobile phones	117	90.7
• PC/Laptop	6	4.7
3. What types of digital games do you like to play?		
• Multiplayer Online (Example: Gartic Phone, Krunker)	44	34.1
• Real-Time Strategy (Example: StarCraft, Northgard)	23	17.8
• Stealth Shooter (Example: the Dark world, The Loony Tunes: Carrot Crisis)	22	17.1
• Combat (Example: Dragon Ball FighterZ, Skullgirls)	28	21.7
• First-Person Shooters (Example: Battlefields, Plant versus zombies)	48	37.2
• Role-Playing (Example: Dungeons and Dragons, Battletech, and Star Wars)	26	20.2
• Action (Example: Doom, Street Fighter)	11	8.5
• Adventure (Example: King's Quest, Myst, Return to Zork, Ultima)	30	15.5
• Sports (Example: NBA Jam, Ken Griffey's MLB, NHL '94)	36	27.9
• Puzzle (Example: Candy Crush, Fairy puzzle)	109	84.5

Table 2 describes learners' preferences for digital game-based learning activities. The statistics show that the vast majority of respondents (88.4%) have a good attitude about playing digital or computer games. Only a small percentage, 3.1%, are neutral on the subject, while 3.9% oppose digital gaming. In terms of gaming devices, the vast majority, 90.7% of respondents, use their cell phones or mobile devices, while only 4.7% use PCs or laptops, and another 4.7% visit computer stores for gaming.

When it comes to the types of digital games that respondents like, puzzle games are the obvious preference, attracting the interest of 84.5% of the questioned population. Following closely after are first-person shooters, with a huge 37.2% of respondents preferring this genre, followed by sports games, which are appreciated by 27.9%. In contrast, action games are the least popular, with just 8.5% of respondents exhibiting interest, while stealth shooter games are moderately popular, appealing to 17.1% of respondents.

The findings reveal an intriguing association between the popularity of puzzle games and respondents' use of mobile gaming. Given that the majority of respondents prefer to play games on mobile devices, it is possible that puzzle games' appeal stems from their ubiquitous availability and fit for mobile platforms. Furthermore, the second most popular genre is first-person shooter games, which are also popular on mobile devices.

Schabas (2023) notes that learning about students' digital gaming preferences and behaviors, instructors can adjust instructional tactics and classroom activities to their interests. Incorporating game-based learning or gamification approaches into the curriculum can be a powerful tool for increasing student engagement and motivation in the classroom, resulting in a more enriching and successful learning experience (McLaughlin and Bailey, 2023).

Various research projects have investigated gamers' preferences and habits regarding game genres and platforms, giving light on trends and patterns in the gaming community. According to Rasool et al. (2023), puzzle games are a popular choice among gamers, particularly on mobile devices. The survey found that a large proportion of players like puzzle-solving activities, demonstrating the genre's ongoing appeal. Furthermore, the study highlighted the widespread use of mobile phones for gaming activities, indicating a significant shift toward mobile platforms as the preferred option among gamers.

Furthermore, Semanova's (2020) insights support the importance of mobile gaming, particularly first-person shooter (FPS) games. The analysis of Young (2021) revealed a strong presence of FPS games in the mobile gaming market, with popular titles such as Fortnite and Call of Duty Mobile drawing a substantial player base to mobile platforms. This finding highlights the adaptability and attraction of FPS games across a variety of gaming platforms, as well as the growing significance of mobile devices in molding gaming tastes and consumer behaviors.

These findings highlight the gaming industry's dynamic landscape, which is defined by changing player preferences and the growing relevance of mobile gaming platforms. Understanding these trends is critical for developers, marketers, and educators who must navigate the ever-changing landscape of digital entertainment and education technology.

Table 3. *Pretest and Posttest Scores of the Respondents in Critical Thinking, Creative Thinking and Problem-solving*

Scientific Cognitive Skills	Pre-test		
	Mean	SD	Remarks
Critical Thinking	3.48	1.755	Poor
Creative Thinking	3.36	1.605	Poor
Problem-Solving	3.43	1.672	Poor
	Post-test		
Critical Thinking	5.98	1.549	Very Satisfactory
Creative Thinking	6.52	1.888	Very Satisfactory
Problem-Solving	6.55	1.936	Very Satisfactory

Note:1-3 (Poor); 4-5 (Fair); 6 (Satisfactory); 7-8 (Very Satisfactory); 9-10 (Excellent)

Table 3 shows the results of pre- and post-test evaluations designed to assess participants' critical thinking, creative thinking, and problem-solving skills. The assessments were given both before and after the intervention, allowing for a comparison of skill growth across time.

Participants initially demonstrated relatively low levels of critical thinking, creative thinking, and problem-solving skills, as evidenced by mean pre-test scores of 3.48, 3.36, and 3.43. These results demonstrated a weak comprehension of the scientific idea being examined. Individuals in this range generally struggle with data analysis, idea generation, and problem-solving tasks. They may have difficulty detecting patterns, connecting ideas, and critically analyzing diverse perspectives.

However, the post-test findings showed that participants' performance improved significantly after the intervention. The average scores for critical thinking, creative thinking, and problem-solving skills increased to 5.98, 6.52, and 6.55, respectively. The higher mean scores indicate a significant improvement in proficiency across these skill categories. In terms of critical thinking, participants displayed the ability to effectively explain and assess information, allowing them to engage in more rigorous analytical and evaluation processes. Students demonstrated an improved capacity to conceptualize, reason about, and explore novel ideas and perspectives, transcending conventional limits to produce complex and original solutions. Furthermore, participants demonstrated increased problem-solving skills, including problem identification, active participation in constructive brainstorming sessions, and the application of effective solutions to a wide range of challenges.

The intervention's effectiveness in helping participants develop critical thinking, creative thinking, and problem-solving skills. The observed results demonstrate the transformative power of focused educational interventions in improving students' cognitive capacities and preparing them for success in academic and professional settings.

Several studies have delved into the efficacy of digital puzzle games in enhancing critical thinking, creativity, and problem-solving skills. Chen et al. (2020) conducted research to explore the impact of digital puzzle games specifically on critical thinking skills. In their study, the results revealed that participants who played digital puzzle games demonstrated improvements in critical thinking skills, particularly in areas such as analysis, evaluation, and inference. Similarly, Ivcevic & Hoffmann (2022) investigated the effects of digital puzzle games on creativity findings suggested that playing digital puzzle games had the potential to enhance creative thinking, especially among individuals who already possessed high levels of creativity.

In a study conducted by Huang et al. (2020), the effects of a digital puzzle game on the problem-solving abilities of elementary students were examined. The results indicated that engaging with digital puzzle games led to improvements in problem-solving skills, particularly among students who initially had lower levels of problem-solving abilities.

These studies collectively underscore the beneficial effects of digital puzzle games on cognitive skills such as critical thinking, creativity, and problem-solving. They highlight the potential of incorporating digital puzzle games into educational settings to foster the development of these essential skills among learners of varying ages and abilities. Such findings provide valuable insights for educators and game developers alike, emphasizing the potential of digital gaming as a tool for enhancing cognitive abilities and promoting learning in diverse contexts.

Table 4. *Test of Difference Between the Pretest and Posttest Scores of the Respondents in Critical Thinking, Creative Thinking and Problem-solving*

	Mean Difference	t	df	Sig. (2-tailed)
Critical Thinking	2.496	15.993	128	.000
Creative Thinking	3.163	17.150	128	.000
Problem-Solving	3.116	16.783	128	.000

Table 4 provides a complete examination of the difference in pretest and post-test scores for critical thinking, creative thinking, and problem-solving skills. The statistics show a considerable improvement in all three skill areas after the intervention or training program.

Specifically, the mean critical thinking score increased from 3.48 to 5.98, resulting in a significant mean difference of 2.496. Similarly, creative thinking showed a significant rise, with the mean score rising from 3.36 to 6.52, or a 3.163-point difference. Furthermore, problem-solving abilities showed significant progress, as shown by a mean score increase from 3.43 to 6.55, generating a mean difference of 3.116.

The paired-sample t-tests used to determine the statistical significance of these improvements produced convincing results. The reported p-values for all three talents are represented by 000, indicating values less than the customary threshold of 0.05. This statistical result provides strong evidence to reject the null hypothesis, indicating that the observed improvements in critical thinking, creative thinking, and problem-solving abilities are statistically significant.

These findings support the intervention's efficacy, indicating that the digital puzzle game intervention significantly improves participants' critical thinking, creative thinking, and problem-solving abilities. The fact that students chose and participated in the intervention demonstrates its appeal and efficacy, indicating a positive learning experience that resonates with them. Overall, our findings emphasize the value of digital puzzle games as tools for promoting cognitive skill development in educational settings.

Schrier's (2021) study dives into the various features of games that contribute to learning, emphasizing the importance of digital puzzles in improving creative thinking, critical thinking, and problem-solving abilities. Several significant properties of games, including digital puzzles, were uncovered during her research, which shed light on their impact on learning and skill development.

Games, especially digital puzzles, have an inherent incentive component. Their interactive and goal-oriented character gives players a sense of purpose and accomplishment, which encourages them to actively participate in puzzle-solving activities (Liew et al., 2023). This motivation boosts engagement and enriches the learning experience, creating an ideal setting for skill acquisition and improvement.

Furthermore, Zeng (2020) suggest that games are intended to be interesting and amusing, with aspects of pleasure that make learning a more engaging and rewarding experience. The intrinsic fun aspect drives people to devote time and effort to solving puzzles, which promotes creative thinking, critical analysis, and problem-solving techniques.

Furthermore, games inherently need problem-solving by presenting players with obstacles or riddles that require the use of critical thinking skills (Videnovik et al., 2020). Individuals improve their problem-solving skills through an iterative process of trial and error, developing their ability to understand problems, investigate potential solutions, and adopt successful tactics to overcome hurdles.

Furthermore, the intriguing narratives woven into games increase engagement and emotional involvement, establishing a stronger connection between players and the obstacles they face. This emotional resonance encourages people to use critical and creative thinking as they work to move through the story by solving puzzles and overcoming obstacles.

Similarly, Gomez et al. (2020) investigated the impact of a puzzle-based digital game on children's creativity, critical thinking, and problem-solving abilities. Their findings highlighted the remarkable increases seen in children's creative thinking, critical thinking, and problem-solving abilities after playing the puzzle-based digital game. This study supports the effectiveness of puzzle-based digital games as instruments for promoting cognitive skill development in children.

Together, these studies provide persuasive evidence that puzzle-based digital games improve creative thinking, critical thinking, and problem-solving skills. Digital puzzles serve as powerful instructional tools by using the incentive and interactive features inherent in games, stimulating cognitive growth, and fostering greater engagement with learning.

Table 5. *Perception of Validators to Develop Digital Game-based Lessons.*

Evaluation of the lesson plan	Mean	SD	Remarks
1. The lesson demonstrates strong achievement targets, objectives that meet the lesson's intent, and thoughtful considerations to preparations, and the lesson flows smoothly.	4.00	0.00	HO
2. The lesson has a well-organized introduction	3.90	0.30	HO

and well-planned modifications for diverse students.			
3. Instructions are clear and concise to keep the students on task and to perform the target skill.	3.90	0.30	HO
4. The lesson addresses and meets all the necessary competencies indicated in the Curriculum Guide.	4.00	0.00	HO
5. Uses a variety of informal and formal assessment methods to measure students learning, growth, and progress toward achieving standards.	3.80	0.40	HO
6. Uses instructional practices that motivate and engage some students in the content of the lesson and create learning experiences that guide students to identify their strengths, interests, and needs and challenge themselves to learn.	4.00	0.00	HO
Overall	**3.93**		**HO**
Evaluation of the Digital game			
1. **Motivation.** The game is potentially useful for activating learning.	4.00	0.00	HO
2. **Fun and engagement.** The game demonstrates the harmony between enjoyment, hard work, amusement, and learning.	4.00	0.00	HO
3. **Social interaction.** The game encourages the students to collaborate and interact effectively with teams.	3.90	0.30	HO
4. **Problem-solving.** The game enables the student to resolve a problem. The game represents a problem space that inspires the development of specific solutions.	4.00	0.00	HO
5. **Story.** The game gives the students a chance to present a fresh viewpoint and aids them in giving an abstract idea a more relevant and personal meaning.	3.80	0.40	HO
Overall	**3.94**		**HO**

Note: 0.01-1 (not observed), 1.01-2 (less observed), 2.01-3 (moderately observed), 3.01-4 (highly observed)

Table 5 presents a detailed summary of the validators' perspectives on the development of digital game-based courses, with a particular emphasis on a physics lesson tailored for seventh-grade pupils. The examination of both the lesson plan and the digital game used in the course yielded highly observed results across multiple categories, indicating a well-structured and successful teaching strategy.

The lesson plan for the digital game-based physics class was praised for its clear attainment goals, well-aligned objectives, and painstaking preparation, resulting in a lesson that flows smoothly and successfully addresses the competencies indicated in the Curriculum Guide. The introduction is organized clearly and coherently, with adaptations made to fit students' various needs. Clear and straightforward instructions help students stay focused and actively engaged in the essential abilities. Furthermore, a variety of informal and formal assessment methods are used to evaluate students' learning, development, and progress toward fulfilling standards. The instructional approaches used in the class are commended for their capacity to encourage and engage students, allowing them to determine their own abilities, interests, and needs while also supporting self-directed learning.

Similarly, the digital game utilized in the class has been regarded as an effective tool for activating learning and encouraging pupils. It creates a perfect mix between enjoyment, hard work, entertainment, and learning, resulting in a captivating and immersive learning experience. The game encourages students to communicate socially, collaborate, and work effectively as a team, so improving their interpersonal skills. Furthermore, it promotes the development of problem-solving skills by presenting students with a problem space that fosters the production of precise answers. Furthermore, the game allows pupils to get a new

viewpoint, giving abstract topics greater relevance and personal importance.

Overall, both the lesson plan and the digital game achieved high observer evaluations, with average scores of 3.93 and 3.94, respectively. These findings demonstrate the efficacy of digital game-based teaching in increasing student engagement, motivation, and skill development, showing their potential as novel and impactful educational tools.

Wang et al. (2022) focused on designing and evaluating a digital game-based lesson to improve science learning among middle school students. The study found that implementing a digital game-based lesson resulted in significant gains in student motivation, engagement, and overall learning results. Students demonstrated increased topic understanding, scientific inquiry abilities, and curiosity in the subject of biology. The study emphasized the need of precise instructional design, good game mechanics, and strong feedback systems in creating an impactful digital game-based lesson.

Liburd and Jen (2021) investigate the effectiveness of digital puzzle-based learning in mathematics instruction. This study investigated how the use of digital puzzles influenced student engagement and learning results in mathematics teaching. The findings demonstrated that digital puzzle-based learning greatly improved student engagement, as evidenced by higher levels of motivation, enthusiasm, and active participation among learners. Furthermore, the intervention resulted in significant gains in students' learning outcomes, particularly in mathematical problem-solving skills and conceptual comprehension of mathematical principles.

These studies highlight the potential of digital game-based and puzzle-based learning approaches to increase student engagement, motivation, and academic accomplishment in a variety of educational environments. Using interactive and immersive digital platforms, instructors may create a dynamic and engaging learning environment that encourages active involvement, critical thinking, and skill development among students. Furthermore, these findings emphasize the significance of careful instructional design and the strategic integration of educational technologies in order to optimize learning outcomes and improve student achievement across multiple subject areas.

IV. CONCLUSION

There is a significant difference between the pre-test and post-test scores of the students in critical thinking, creative thinking and problem-solving. Based on the results and conclusions posted in the study, the following recommendations are hereby formulated:

1. School leaders are encouraged to use digital game-based learning, specifically digital puzzles, in a variety of subject areas to improve students' learning experiences and foster the development of critical thinking, creative thinking, and problem-solving skills. It is recommended that teachers be given the necessary support by utilizing the developed digital game based on Physics by the researchers to be used by teachers as a reference in their lessons. This assistance will allow teachers to design engaging learning experiences that encourage student engagement and result in positive learning outcomes.
2. Teachers are advised to incorporate digital puzzle games into their lesson plans to enrich student's learning experiences and foster critical thinking, creative thinking, and problem-solving skills. It is important to explore a variety of game options that align with lesson objectives and cater to students' interests. Additionally, ongoing assessment and evaluation should be conducted to gauge the effectiveness of digital game-based learning in improving students' learning outcomes.
3. Parents are encouraged to support their children's engagement in digital puzzle games that foster critical thinking, creative thinking, and problem-solving skills. It is important to monitor the types of games their children are playing and ensure they are age appropriate. Parents are also encouraged to support the school's efforts in implementing game-based learning to enhance students' learning experiences.
4. Students are advised to embrace game-based learning, specifically digital puzzle games, as an opportunity to enrich their learning experiences and cultivate critical thinking, creative thinking, and problem-solving skills. They are encouraged to explore various types of games and select those that align with their interests and support their learning goals.
5. Future researchers may conduct further studies on the effectiveness of digital game-based learning in fostering critical thinking, creative thinking, and problem-solving skills across various subjects and grade levels. They are encouraged to explore different types of games and their effects on students' learning outcomes. Additionally, it is recommended to include the validation of the lesson and investigate the factors that influence the success or failure of game-based learning

interventions.

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