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Integration of Artificial Intelligence in Designing Lesson Exemplar for an Improved Students' Engagement and Scientific Attitude

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A B S T R A C T

Recent trends in science education involve the utilization of technology and artificial intelligence to create an interesting teaching and learning experience. The purpose of the study was to design lesson exemplars that integrate Artificial Intelligence and to determine the significant difference in the pre-assessment and post-assessment scores of students on their own classroom engagement and scientific attitude. The study used descriptive-developmental research. The respondents in the study consisted of 41 selected Grade 7 students at San Antonio National High School. In line with the study's findings, the students' Pre-Assessment revealed that they are not engaged and have low positive attitudes towards their Classroom Engagement and Scientific Attitude, respectively. The Post-assessment revealed that Grade 7 students are engaged and positive in their Engagement and scientific attitude, respectively. Therefore, there is a significant difference in the pre-assessment and post-assessment performance of the students in terms of their classroom engagement, including cognitive, behavioral, and social engagement, as well as their scientific attitude, which encompasses curiosity, cooperation, critical thinking, creativity, and persistence. Aligning with this, the respondents perceived the Lesson Exemplar utilizing Artificial Intelligence Application in Science Gamification as very satisfactory. In conclusion, teachers may consider using the Lesson Exemplar Integrating Artificial Intelligence Application as a mode of instruction, gamification, and improvement of classroom engagement and scientific attitude among learners.

Keywords: Artificial Intelligence Application, Science Gamification, Scientific Attitude, Student Engagement

1. Introduction

Learning technologies have become a pivotal component of the teaching and learning process. Contemporary studies indicate that to effectively utilize these technologies, instructors and learners alike must master a range of cognitive and socio-emotional competencies, commonly termed "digital literacy competencies" or "21st century skills" (Silber-Varod et al. 2019). The development of competencies known as 21st-century skills is garnering increasing attention as a means of improving teacher instructional quality. However, a key challenge in bringing about desired improvements lies in the lack of a context-specific understanding of teaching practices and meaningful ways to support teacher professional development (Kim et al. 2019).

Mobile devices, including smartphones and tablets, are widely used by most students. Mobile technology now serves as a powerful platform for communication and entertainment (Routley, 2017). Regarding this, the global digital gaming industry has experienced rapid growth in recent years. Rapid technological advancements are transforming how players interact with video games, both individually and collectively. In addition to the increased penetration of games, the reasons why people play and use games require careful attention (Cheah et al. 2021). Boys are more likely to be players compared to girls, who often play games. Those who play online games typically start at around 11-12 years old and have an average playing time of 3 to 5 hours per day. Playing games for extended periods can reduce their ability to focus on academic tasks. (Huzna et al. 2022). According to Djannaah et al. (2021), playing video games online is a fun pastime that can become addictive. Addiction to video games can be harmful to students. Addiction to mobile games can have several negative effects on education, including students' poor performance in school, mental health issues, and general well-being. It might result in poorer cognitive abilities, social isolation, poor academic achievement, sleep disturbances, difficulties managing time, and detrimental effects on physical health.

The internet has grown in importance manifold over the past decade. Its importance in the education world can never be undermined. Despite the risks of fraud and drawbacks, the internet is a blessing for students. Today, the internet is present in almost everything we use. From television to gaming consoles and our phones, the internet is everywhere. The use of the internet allows students to find amazing convenience, as they can access various kinds of help, tutorials, and other assisting materials that can be used to academically improve and enhance their learning (Raja and Nagasubramani, 2018). Despite the advantages that the internet can offer, some disadvantages significantly impact education. Powered by the internet, social media platforms, mobile and online games, and other online endeavors can distract students from academic work, making the internet a source of distractions.

Students may experience information overload due to the abundance of information available online, making it challenging for them to distinguish between reliable and suspicious sources. There is a mixture of legitimate and fraudulent content on the internet (Fernandez and Alani, 2018). Since students may miss out on in-person interactions and the interpersonal aspects of traditional education, an excessive dependence on the internet can worsen social isolation (Puri and Sharma, 2016).

Artificial intelligence is being progressively incorporated into education in various ways, revolutionizing traditional teaching and learning strategies. Using an individual's weaknesses, strengths, and learning preferences as a basis, AI algorithms evaluate student data to generate personalized learning pathways. Students can concentrate on their areas of need for improvement and learn at their own pace thanks to this. By using learning analytics, students can enhance their performance in class by understanding the predictive outcomes associated with their performance at the start of the course (Rincon-Flores et al., 2020). Moreover, the applications of artificial intelligence have a profound impact on teachers and students, affecting numerous aspects of education. Artificial intelligence (AI) enables the development of online learning environments and tools that provide students with access to learning resources at any time and from any location, thereby fostering continuous learning outside of regular school hours. Artificial intelligence (AI) applications, such as interactive simulations and educational games, can enhance student engagement and enjoyment of learning and foster a positive mindset toward education (Chen et al., 2020). Exposing students to AI technologies in the classroom helps them develop proficiency in digital literacy and gain a deeper understanding of how AI is applied in various fields, preparing them for a future driven by technology.

Teachers have the main responsibility of teaching learners in any educational setting. However, there are various other tasks that teachers must also perform. Besides their academic duties, most teachers' time and educational resources are dedicated to administrative work (Ahmad et al. 2022). The advancement of artificial intelligence in education (AIED) has the potential to transform the educational landscape and impact the roles of all stakeholders involved. In recent years, the applications of AIED have been gradually adopted to advance our understanding of students' learning and enhance their learning performance and experience (Nguyen et al. 2022). The penetration of AI in every sphere of educational practices has undeniably impacted the personal and professional development of teachers and students, offering numerous opportunities (Xu and Ouyang, 2021).

The growing shift toward online learning has brought new expectations for teachers, including skills needed to combine content knowledge with engaging pedagogical strategies that leverage the affordances of technology. As a result, online pedagogy has become increasingly relevant in modern-day schools. The challenge lies in understanding the nature of online pedagogy, the skills required for teachers to succeed in online settings, and the theoretical underpinnings that explain why these skills are essential (Archambault et al. 2022).

Adolescence is the phase of life between childhood and adulthood, from ages 10 to 19. It is a unique stage of human development and an important time for laying the foundations of good health. Adolescents experience rapid physical, cognitive and psychosocial growth. This affects how they feel, think, make decisions, and interact with the world around them (WHO). According to Schweder and Raufelder (2022), interest and self-efficacy are two key components of motivation and learning, both of which decrease during adolescence. Several motivational strategies must be explored to promote meaningful learning. Conducting experiments to observe and understand scientific phenomena firsthand can be highly motivating for learners. Students can also gain a deeper understanding of the relevance of science in their lives by making connections between scientific concepts and real-world issues, challenges, and applications. Students are encouraged to think critically, pose questions, and solve problems through inquiry as a means of fostering curiosity and a sense of control over their education through inquiry-based learning. Through the application of their knowledge and skills in real-world settings, project-based learning is also a good way to stimulate students' creativity, teamwork, and problem-solving skills. Students can be driven to actively participate in gamified activities, monitor their progress, and aim for mastery of scientific concepts. To meet the needs of each unique student, teachers can adapt their teaching methods, offer options and choices for learning activities, and provide individualized support using differentiated instruction.

Gamification involves incorporating game mechanics into non-game environments to enhance participation. The goal of gamification is to engage with consumers, employees, and partners to inspire collaboration, sharing, and interaction (BIWorldwide). To address the issues of student evasion, disengagement, and lack of motivation in educational environments, recent research has employed gamification along with its associated activities (Battistella and von Wangenheim, 2016). Gamification in education typically aims to enhance students' concentration, engagement, and performance, while also reducing their frustration and demotivation within educational systems (Cózar-Gutiérrez and Sáez-López, 2016).

Student engagement refers to 'students being actively involved in their learning tasks and activities' (Lei et al. 2018). Chang et al. (2016) define it as 'the degree to which students are engaged in learning in the formal education process and it refers to the time, effort, and energy they commit to educational learning tasks. Student engagement is a multidimensional construct that includes behavioural, affective, and cognitive engagement.

Every year, the problems facing education become increasingly apparent, and one of the most pressing issues is the lack of effective motivation among students to study. There is no universal solution to this problem, and each teacher must find their solution using their pedagogical talents. The conventional carrot-and-stick method can sometimes force students to learn, even against their wishes. At the same time, the knowledge gained by force breaks the human psyche, because every pressure there is a response, which is unacceptable in the pedagogical process (Rozhenko et al. 2021)

The researcher observed poor classroom engagement among students in San Antonio National High School. The school prohibits the use of smartphones, specifically playing mobile games inside the school and recording videos that show the classroom environment with classmates and teachers to be uploaded to social media platforms. Despite the rules, Grade 7 students continue to use their smartphones for entertainment, messaging, and other non-academic tasks. Students nowadays are slowly losing the driving force to learn, the curiosity in science, which is one of the attitudes scientists exhibit during their early stages of development. Since students are more interested in fun activities, such as playing video games, this trend is concerning. With these problems existing inside the schools, the researcher recognizes that he is also interested in using Artificial Intelligence

Applications in Science Gamification, specifically Quizizz, Classcraft, and QuizDojo, to discuss science. The study aimed to design lesson exemplars that integrate Artificial Intelligence Applications to enhance student engagement and determine the significant effect on students' scientific attitudes. The content, specifically the IDEA Exemplar and interactive gamification activities using Artificial Intelligence Applications, to be created by the researcher, covers the different topics and under light, such as the How Human Eye Perceives Light, Sources of Light, Law of Reflection and Refraction, Electromagnetic Spectrum, and Anatomy and Characteristics of Light. Therefore, the researcher conceptualized the study.

2. Methodology

2.1 Research Design

This study employed a descriptive-developmental method. The descriptive method focuses on describing one's engagement from the student's perspective. Developmental is concerned with crafting the IDEA Lesson Exemplar that demonstrates how Artificial Intelligence can be used to gamify the teaching and learning process in science discussions. Descriptive-developmental research was employed in this study because it aimed to describe students' classroom engagement and scientific attitudes through the use of an Artificial Intelligence Application in an Interactive Science Classroom. The researcher aimed to create an effective lesson plan to help teachers visualize activities that can enhance students' classroom engagement and scientific attitude through the use of artificial intelligence-integrated gamification in Science 7.

2.2 Respondents of the Study

The respondents in the study were selected using purposive sampling, a common method of non-probability sampling (Sharma, 2017), based on specific criteria relevant to the research objectives. Forty-one (41) students were selected from the Grade 7 class of San Antonio National High School, San Antonio, Quezon, who were enrolled during the 2023-2024 school year. The respondents consisted of 16 males and 25 females, who were purposively selected from five sections of Grade 7 students supervised by the researcher. The purposive sampling technique aligns with the study's goals through the selection of participants who meet various criteria, including those who use smartphones excessively for gaming, primarily for social media, and for educational queries and research. The choice of selecting Grade 7 students relates to the issue of an increase in the number of students in this grade level who violate the school's rules against using smartphones inside the institution. Additionally, grade 7 students are considered adolescents who undergo changes in attitudes and behaviors that impact their classroom engagement and scientific attitudes.

2.3 Research Instruments

The research instruments of the study included a teacher-made survey questionnaire assessing the perception of student-respondents regarding their own classroom engagement and scientific attitude, a lesson exemplar for artificial intelligence application in science gamification, and an adapted survey questionnaire evaluating the level of acceptance of the lesson exemplar.

The student engagement survey questionnaire is teacher-made and serves the purpose of assessing students' classroom engagement before and after exposure to Artificial Intelligence Integrated Science Gamification. The questionnaire, composed of 21 item statements divided into three components of student engagement—cognitive engagement, behavioral engagement, and social engagement —will be assessed using a four-point scale: 4—strongly agree, 3—agree, 2—disagree, and 1—strongly disagree.

The research instrument used in determining the perception of students on their scientific attitude prior and after the use of Artificial Intelligence Integrated Science Gamification is a self-made survey questionnaire consisting of 35-items statements divided into five components of scientific attitude such as curiosity, critical thinking, cooperation, creativity, and persistence, will be assessed using four-point scale such as 4-strongly agree, 3-agree, 2-disagree, and 1-strongly disagree**.**

The researcher also utilized an adapted survey questionnaire to assess the level of acceptance of the lesson exemplar, which head teachers and experts completed. The evaluation survey questionnaire consists of 6 general indicators, such as content, structure and sequence, functionality/usability, design composition and layout, language and mechanics, and inclusivity, which will be assessed using a three-point scale, such as 3-highly acceptable, 2-moderately acceptable, and 1-slightly acceptable.

2.4 Research Procedure

Phase I consisted of constructing the survey form and questionnaire based on the reviewed related literature and study. Phase II involved administering the pre-assessment questionnaire to students to assess their classroom engagement. Phase III involved administering a pre-assessment questionnaire to assess scientific attitude. Phase IV covered the implementation of artificial intelligence-integrated science gamification. In this phase, the researcher created a lesson plan that utilizes Quizizz, Classcraft, and Class Dojo. It also includes group activity worksheets, quizzes, video clips, quests, battles and a reward system in the form of badges, points, experience, levels, and powers for every task accomplished. Phase V involved administering a post-assessment questionnaire to measure students' classroom engagement and gauge their engagement after exposure to artificial intelligence-integrated science gamification. Phase VI involved administering a post-assessment questionnaire to measure students' scientific attitude after exposure to artificial intelligence-integrated science gamification. The final phase involves collecting, interpreting, and discussing the gathered data.

2.5 Data Analysis

After the implementation of the study, the questionnaires and the pre-assessment and post-assessment scores were collected and tallied immediately and were given to the statistician for treatment. The data was statistically computed, interpreted, and verbally analyzed.

2.6 Ethical Consideration

With utmost confidentiality, the respondents' information and results were assured to be limited and accessible only to the researcher and to the researcher adviser.

2.7 Statistical Treatment of Data

Appropriate statistical treatments were employed to analyze the data and provide evidence that will address the problems posed by the study.

Descriptive statistics, such as frequency count, percent distribution, mean and standard deviation, were utilized to measure and describe student-respondents' profiles.

A frequency count was used to determine the number of student-respondents who participated in and were exposed to Artificial Intelligence Application in Science Gamification.

The mean was used to measure student-respondents' perception of their classroom engagement and to assess their scientific attitude before and after exposure to Artificial Intelligence Application in Science Gamification.

Standard Deviation was used to calculate the average distance of individual scores or perceptions from the mean of the test.

Paired and Independent t-Test was used to determine the difference between the student engagement and scientific attitude of student-respondents before and after exposure to Artificial Intelligence Application in Science Gamification.

3. RESULTS AND DISCUSSION

Table 1. Perception of the Students as to Their Pre and Post-Cognitive Engagement

Statements	**Pre-perception**			**Post-perception**		
As a student, I can…	Mean	SD	R	Mean	SD	R
1. give a logical reasoning towards a specific scientific argument.	1.44	0.55	NE	3.41	0.50	E
2. measure my own thinking process based on my strengths and weaknesses.	1.98	0.27	SE	3.17	0.38	E
3. showcase a clear understanding about a science topic by being able to organize and explain ideas.	1.46	0.50	NE	3.54	0.50	HE
4. apply the newly perceived science ideas in a practical everyday life.	1.39	0.54	NE	3.39	0.49	E
5. communicate essential questions to initiate meaningful scientific discussions.	1.37	0.54	NE	3.49	0.51	E
6. find useful science resources aside from the prescribed reference books to expand my knowledge.	1.20	0.46	NE	3.88	0.33	HE
7. solve complicated science-related problems using practical techniques to overcome obstacles and challenges.	1.46	0.55	NE	3.44	0.50	E
Overall Mean	1.47	0.19	NE	3.47	0.16	E

Legend: 1-1.49 not engaged (NE); 1.5-2.49 slightly engaged (SE); 2.5-3.49 engaged (E); 3.5-4 highly engaged (HE)

Table 1 presents the students' pre-perception and post-perception of their cognitive engagement. In pre-perception, with an overall mean of 1.47, statement 6 has the lowest mean of 1.20, interpreted as indicating not being engaged. However, the post-perception, with an overall mean of 3.47, shows that statement 6 has the highest mean of 3.88, which is interpreted as indicating a high level of engagement.

It only shows that, before the implementation of AI applications, the majority of students often rely solely on the books provided by the school without exploring alternative and additional sources of knowledge. The findings highlight the effectiveness of engagement as part of the Day 1 of the lesson (IDEA) exemplar in transforming meaningful learning experiences for students. Students accomplished a quest in a classcraft activity by reading the introduction part first, followed by watching a video on how the eye works. Then, students answered the guide questions based on the video they watched. They also answered the second and third questions about introduction to light and different sources of light, respectively, wherein the XP points to be gained are based on the time they submitted the output and how organized the thought or idea of their answers. There is no rule in the game that prohibits using other educational websites for additional information. It is observed that most students explored other sites as additional sources of information. During the use of the AI application, Classcraft, students were allowed to explore platforms that share knowledge and concepts

of science. AI applications played an active role in utilizing the internet, not just for entertainment purposes, but also to redirect users to sites that clearly explain complex science concepts. As a result, students become more participative in discussion and raise essential questions about the topic. It implies that the result contradicts the study by Furio (2019), which showed that students exposed to conventional methods have a better conceptual understanding than those taught via gamification.

Table 2. Perception of the Students as to Their Pre and Post-Behavioral Engagement

Statements	**Pre-perception**			**Post-perception**		
As a student, I can…	Mean	SD	R	Mean	SD	R
1. initiate impactful participation during science group activities and discussion.	1.24	0.49	NE	3.44	0.50	E
2. finish my science output in-time while following properly on classroom rules.	1.22	0.42	NE	3.39	0.49	E
3. come to science class on or before the subject lesson or discussion starts.	1.32	0.52	NE	3.56	0.50	HE
4. interact positively with my teacher and classmates during science time.	1.37	0.54	NE	3.49	0.51	E
5. focus myself despite the presence of environmental distractions while finishing my assignments.	1.88	0.33	SE	3.10	0.30	E
6. respect my classmates' opinion by listening to their point of view on specific scientific arguments.	1.34	0.57	NE	3.59	0.50	HE
7. show independence in completing my assignments and ask help in times of confusion about the specific topic.	1.17	0.44	NE	3.90	0.30	HE
Overall Mean	1.35	0.19	NE	3.50	0.19	HE

Legend: 1-1.49 not engaged (NE); 1.5-2.49 slightly engaged (SE); 2.5-3.49 engaged (E); 3.5-4 highly engaged (HE)

Table 2 presents the students' pre-perception and post-perception of their behavioral engagement. In pre-perception, Statement 7 had the lowest mean of 1.17, which is interpreted as indicating not being engaged. However, in post-perception, Statement 7 achieved the highest mean of 3.90, which is interpreted as indicating a high level of engagement. The pre-perception has an overall mean of 1.35, while the post-perception has an overall mean of 3.50, indicating a remarkable improvement from not engaged to highly engaged.

Before the actual conduct of the study, most students were often confused by complex topics but did not admit it during class discussions. The teacher always wrapped up the lesson by asking if anyone had questions, to which everyone nodded, implying they fully understood the lesson and had no questions. However, on the day of assignment submission, most students provide similar answers, as if they had only one source. Surprisingly, they also have the same grammatical errors, misspellings, and poorly constructed ideas, which suggests they are simply copying without understanding the assignment. During the implementation of AI applications, students were encouraged to share their knowledge with their groupmates.

In particular, after completing and submitting their tasks in the quest, students were asked to share their thoughts with others about how an eye works, the difference between luminous and non-luminous objects, and the difference between natural and artificial sources of light in the discussion section of Classcraft. Students who were unsure about some aspects of the topic gained clarity through the help of their more knowledgeable classmates. In return, the more knowledgeable students were allowed to share their understanding of the topic, which helped reinforce and deepen their mastery of it, additionally, instead of spending their free time playing mobile games (Shrivastava (2014), which can potentially cause stress for teachers and often disrupt the teaching process by affecting students' concentration in class, they now use their smartphones to enhance their understanding of the topics by engaging with classmates' ideas, which helps them answer their questions and overcome confusion. The study emphasizes the effectiveness of the lesson (IDEA) exemplar, integrating an AI application that enables more interactive, collaborative and self-directed learning experiences among students.

Table 3. Perception of the Students as to Their Pre and Post-Social Engagement

Statements	**Pre-perception**			**Post-perception**		
As a student, I can…	Mean	SD	R	Mean	SD	R
1. show my ability to work actively with my groupmates on every science activity that requires group effort.	1.29	0.46	NE	3.46	0.50	E
2. create a friendly atmosphere and positive relationship with others.	1.24	0.43	NE	3.41	0.50	E
3. accept roles that leads group members to a better cooperation and communication.	1.41	0.50	NE	3.54	0.50	HE
4. respect differences in perspectives, opinions, culture, and background among group members.	1.37	0.49	NE	3.49	0.51	E
5. participate in other social activities aside from classroom lecture about science inside the school.	1.32	0.47	NE	3.59	0.50	HE
6. engage in volunteer works concerning solving social issues related to science.	1.56	0.55	SE	3.10	0.30	E
7. promote self-fulfillment and belongingness by supporting my peers, classmates and group members.	1.15	0.42	NE	3.88	0.33	HE
Overall Mean	1.33	0.19	NE	3.50	0.20	HE

Legend: 1-1.49 not engaged (NE); 1.5-2.49 slightly engaged (SE); 2.5-3.49 engaged (E); 3.5-4 highly engaged (HE)

Table 3 presents the students' pre-perception and post-perception of their social engagement. In pre-perception, Statement 7 has the lowest mean of 1.15, which is interpreted as not engaged; however, it achieved the highest mean of 3.88 in post-perception with a verbal interpretation of being highly engaged. The overall mean improves from not engaged to highly engaged as pre-perception and post-perception got an overall mean of 1.33 and 3.50, respectively.

This implies that, prior to the integration of AI applications in gamification, the majority of students were not willing to work collaboratively with their peers or group members. Unwillingness to work with others leads to students' inability to accept others' opinions and to foster a positive, friendly atmosphere. Consequently, McIntyre et al. (2018) stated that students who lack social engagement are more likely to experience isolation and loneliness, which can lead to a reduction in self-esteem. The post-perception results reveal that the lesson exemplar (IDEA), which integrates AI applications, enables students to develop a sense of responsibility and effectively fulfill the roles assigned to them.

In the assimilation part of the lesson exemplar (IDEA), students were asked to log in to Quizizz, an AI application designed for teacher-paced quizzes. Codes were sent to students so they could quickly create an account and join the quiz game. Students are tasked with correctly answering a combination of multiple-choice and identification-type questions about the process of how the eye retrieves light, luminous and non-luminous light, natural and artificial sources of light, incandescent, bioluminescent and reflector of light within a given time limit. Three winners were selected after the game, ranked first, second, and third, with corresponding points awarded to their respective teams. Afterwards, students were asked to log back in to their Classcraft accounts to publish a Kudos, either to praise classmates who performed excellently or to encourage those who were struggling, after seeing their actual rank from first to last in Quizizz. In this game, students' competitive efforts to win and earn rewards, in the form of experience points from challenges and quests, are evident. To achieve a common goal, victory, students fulfilled their roles and responsibilities. For every mistake made, students constructively discuss it within the group and offer praise and commendations to group members who make valuable contributions. Similarly, McIntyre et al. (2018) mentioned that social engagement is categorized with the 'unwritten' rules of the learning environment, such as cooperation, listening to others, attending class on time, and maintaining a balanced teacher–student power structure. All of these improvements occurred amid the friendly competition among students.

Table 4. Perception of the Students on Their Scientific Attitude as to Their Curiosity

Statements	**Pre-perception**			**Post-perception**		
As a student, I can…	Mean	SD	R	Mean	SD	R
1. raising relevant questions and actively finding possible answers.	1.41	0.59	LP	3.37	0.49	P
2. imparting my own thoughts in participating science discussion.	1.54	0.50	SP	3.46	0.50	P
3. finding alternative solutions by thinking critically about the problems or issues.	1.27	0.45	LP	3.54	0.50	HP
4. initiating a small group study about science with my classmates outside the classroom.	1.37	0.54	LP	3.07	0.26	P
5. looking for other references to study science aside from the prescribed resources on the table.	1.37	0.54	LP	3.41	0.50	P
6. focusing on learning more about science rather than getting higher grade.	1.34	0.48	LP	3.39	0.49	P
7. displaying a high level of eagerness to acquire knowledge about new science ideas, concepts, and techniques.	1.15	0.42	LP	3.90	0.30	HP
Overall Mean	1.34	0.21	LP	3.45	0.19	P

Legend: 1-1.49 low positive (LP); 1.5-2.49 slightly positive (SP); 2.5-3.49 positive (P); 3.5-4 high positive (HP)

Table 4 presents the students' pre-perception and post-perception of their curiosity. In pre-perception, Statement 7 had the lowest mean of 1.15, with a verbal interpretation of low positive. Conversely, Statement 7 received the highest mean of 3.90, which was verbally interpreted as high positive in post-perception. Pre-perception's overall mean of 1.34 significantly improved to an overall mean of 3.45 in post-perception, resulting in a change from a low positive to a positive interpretation.

Before the implementation of gamification incorporating AI Applications, the majority of students displayed a low level of willingness to learn new concepts. This was evident in their frequent yawning during class, while others stared out the window instead of paying attention to the discussion. According to Myungi (2014), computers and the internet in the classroom may be essential for instruction and research for both teachers and students. Their level of internet addiction significantly influences the degree to which students engage in distracting activities, the degree of mismatch between their learning and instructional styles, and a few other individual factors. Through the use of lesson exemplars (IDEA) with the integration of AI Applications, students become active in asking related questions about the topic.

In reflection part of the lesson exemplar (IDEA), after publishing a kudos to commend, praise and uplift their classmates, students were tasked to complete the 3-2-1 reflection namely three things they have learned, two things they found interesting, and one question they still have about how an eye works and the different sources of light. The messaging feature in Classcraft is an important tool for sending messages to individual students and teachers. It can also be used to send a message to all the classcraft users within a specific classcraft group. Students raised important questions without any hesitation using this application. For instance, a student asked what would likely happen to light from different sources if time were to stop suddenly. The questions were addressed and discussed during the recitation the next day before class officially started. Additionally, during recitation, if students are not fully satisfied with their classmates' explanations, they tend to ask the teacher which websites could help provide a better explanation for their questions. AI applications help bridge the significant gap between instructional materials and students' learning styles, as students are more engaged when learning is exciting and interesting.

Table 5. Perception of the Students on Their Scientific Attitude as to Their Cooperation

Statements	**Pre-perception**			**Post-perception**		
As a student, I am…	Mean	SD	R	Mean	SD	R
1. participating in a group activity without being forced by my groupmates.	1.56	0.55	SP	3.05	0.22	P
2. commending the positive contributions of my classmates and celebrating the group's achievement.	1.15	0.42	LP	3.90	0.30	HP
3. motivating and supporting my groupmates especially in difficult times.	1.39	0.54	LP	3.37	0.49	P
4. contributing wide array of ideas while respecting other opinions.	1.56	0.55	SP	3.44	0.50	P
5. utilizing calm environment to solve conflicts within the group.	1.56	0.55	SP	3.44	0.50	P
6. accepting the assigned roles to achieve group success and individual learning.	1.49	0.55	LP	3.49	0.51	P
7. showing intelligent and respectful communication with other group members.	1.46	0.55	LP	3.59	0.50	HP
Overall Mean	1.46	0.23	LP	3.46	0.14	P

Legend: 1-1.49 low positive (LP); 1.5-2.49 slightly positive (SP); 2.5-3.49 positive (P); 3.5-4 high positive (HP)

Table 5 presents the students' pre-perception and post-perception of their cooperation. In pre-perception, Statement 2 had the lowest mean of 1.15, with a verbal interpretation of low positive. However, statement 2 had the highest mean of 3.90, which is verbally interpreted as a high positive in post-perception. Overall mean improves from 1.46 to 3.46 for pre-perception and post perception, interpreted as low positive and positive, respectively.

Prior to the integration of AI applications, most students were self-centered and less likely to commend their classmates' achievements after they performed well in activities. Since they cannot appreciate others' efforts, they tend to view themselves as always superior to others, leading to clashes of ideas and opinions. In this case, conflicts arise inside a group. Instead of supporting and helping each other, they argue most of the time, leading to the group's poor performance. According to Shahmohammadi (2014), student conflict is a prevalent issue in schools. If they are not effectively monitored and controlled, the school may struggle to meet its goals and objectives, and the school atmosphere may suffer as a result.

In Day 2 of the introduction part of the lesson exemplar (IDEA) with an integrated AI application, students were divided into two groups for collaboration by playing the Halloween Race Game. There were two teams, the Witch and the Ghost, who took turns choosing a letter and answering the corresponding question. The first team to reach the finish line and collect the candy was the winner. All the members of the winning group received 500 XP, which was added to their Classcraft account. Afterwards, the teacher picked a random event on Classcraft from which students should follow the instructions. Obeying the instruction leads to the acquisition of XP points, and violating the instruction leads to losing hearts. Losing all hearts corresponds to game over. The complete downfall of a team member meant losing group experience points (XP), which group members tried to prevent at all costs. Students utilized their superpowers, such as Dedication Immunity, Delayed Dedication, and Heart Donation, to help their groupmates avoid elimination from the game. Moreover, in the development part of the lesson exemplar (IDEA), students were divided into five groups to play the Hidden Picture Game. Each group took turns suggesting one color to be removed from the screen until the picture behind the colors was fully revealed. The pictures are about mirrors, reflection, refraction, surfaces, and the laws of reflection and refraction. The first group that guessed the word was given 100 XP.

AI applications also taught students to communicate positively by supporting their groupmates, especially during challenging tasks that create pressure. They use simple gestures, such as the thumbs-up sign and the Korean heart sign, to convey congratulatory greetings and praise. Verbally, they often say the word "nice one" to commend and support their classmates. Additionally, according to Lan (2020), when students receive praise and recognition for their good behavior, they become more engaged and committed in their studies as well as more creative and active learners. It is evident in this study that the lesson exemplar incorporating AI application not only fostered a more supportive and collaborative learning environment but also encouraged learners to recognize and celebrate the efforts of others, thereby enhancing both their individual and group performance.

Table 6. Perception of the Students on Their Scientific Attitude as to Their Own Critical Thinking

Statements	**Pre-perception**			**Post-perception**		
As a student, I am…	Mean	SD	R	Mean	SD	R
1. asking sensical scientific questions to promote deeper understanding of the topic.	1.12	0.40	LP	3.95	0.22	HP
2. evaluating different perspectives to further develop group's strengths and strengthen weaknesses.	1.37	0.54	LP	3.41	0.50	P
3. developing new scientific ideas that may add or oppose to the existing scientific concepts.	1.41	0.55	LP	3.56	0.50	HP
4. reflecting on my own way of thinking as I seek answers to variety of questions about science.	1.85	0.42	SP	3.07	0.26	P
5. using step by step techniques and logical reasoning to solve issues related to science and my environment.	1.44	0.55	LP	3.54	0.50	HP
6. separating complex scientific arguments into its simpler understandable parts to appreciate its relevance.	1.56	0.55	SP	3.56	0.50	HP
7. using supporting evidences to avoid biases towards the existing scientific issues.	1.51	0.55	SP	3.44	0.50	P
Overall Mean	1.47	0.17	LP	3.50	0.18	HP

Legend: 1-1.49 low positive (LP); 1.5-2.49 slightly positive (SP); 2.5-3.49 positive (P); 3.5-4 high positive (HP)

Table 6 presents the students' pre-perception and post-perception of their critical thinking. In pre-perception, Statement 1 had the lowest mean of 1.12, with a verbal interpretation of low positive. In post-perception, Statement 1 had the highest mean of 3.95, verbally interpreted as high positive. The overall mean for pre-perception is 1.47 with verbal interpretation of low positive. On the other hand, post-perception had an overall mean of 3.50, verbally interpreted as high positive.

Before the use of AI applications, most students were content with spoon-fed discussions, through which they acquired only surface-level knowledge. They know the presence of light, but they do not show interest in exploring the properties and characteristics of light. Lack of interest is evident among students, as some of them engage in unrelated activities, such as sketching and conversing with their seatmates. During the implementation of gamified activity utilizing AI applications, students can construct meaningful questions about the topic.

In the engagement part of the Day 2 lesson exemplar (IDEA), where an AI application was integrated, students performed quests related to the reflection of light, the law of reflection, and the refraction of light. After turning in their answers, they encode their thoughts on the discussion part of the classcraft. Through the use of the messaging tool in Classcraft, they communicated their 3-2-1 reflection, wherein they raised significant questions about the topic. For instance, students wondered what would happen if their eyes were removed. Some students infer that it is as if we are closing our eyes, and we see total darkness. Some students also proposed that we would not see anything at all, as if we were trying to see using our elbow, since our sense of sight is removed. Students were also arguing about what would happen if time stopped. Most students are brainstorming in groups, while others are working in pairs. To verify their answers, they opened other educational websites. Afterwards, they found out that if time stops, we will also not see anything. They added that since light travels, it requires distance and time. If time is zero, then light will stop moving. The study suggests that lesson exemplars incorporating AI applications play a vital role not only in deepening their understanding but also in engaging them in collaborative thinking and problem-solving, fostering an improved classroom dynamic. Moreover, Szmyd and Mitera (2024) also claimed that AI can provide features and tools that support learning and stimulate critical thinking, as it can positively and negatively affect the development of students' critical thinking skills. Excessive dependence on AI may limit their capacity to solve problems independently and evaluate information critically.

Table 7. Perception of the Students on Their Scientific Attitude as to Their Creativity

Statements	**Pre-perception**			**Post-perception**		
As a student, I am…	Mean	SD	R	Mean	SD	R
1. accepting scientific ideas based from different perspectives and appreciate its usefulness.	1.41	0.55	LP	3.29	0.46	P
2. showing unique way to approach and solve scientific problems.	1.27	0.50	LP	3.07	0.26	P
3. utilizing techniques brought by latest trends to address scientific issues.	1.39	0.54	LP	3.27	0.45	P
4. taking risks to explore new scientific ideas and not being afraid to failures.	1.49	0.55	LP	3.44	0.50	P
5. experimenting with various ways of learning.	1.12	0.40	LP	3.93	0.26	HP
6. exploring new scientific concepts and considering various techniques to accomplish an activity.	1.44	0.55	LP	3.41	0.50	P
7. creating original scientific techniques and models that shows personal touches to solve scientific problems.	1.46	0.55	LP	3.44	0.50	P
Overall Mean	1.36	0.24	LP	3.40	0.16	P

Legend: 1-1.49 low positive (LP); 1.5-2.49 slightly positive (SP); 2.5-3.49 positive (P); 3.5-4 high positive (HP)

Table 7 presents the students' pre-perception and post-perception of their creativity. In pre-perception, Statement 5 had the lowest mean of 1.12, verbally interpreted as a low positive. On the other hand, post-perception reveals that statement 5 also received the highest mean of 3.93, with a verbal

interpretation of high positivity. The overall mean of 1.36, verbally interpreted as low positive, progresses to an overall mean of 3.40, with verbal interpretation of positive, from pre-perception to post-perception.

Before being introduced to AI applications, most students showed little interest in expanding their knowledge of scientific concepts. They viewed conventional methods, such as classroom discussions and recitations, as the sole means of learning. They showed no willingness to take risks while learning. However, in the introduction part of the Day 4 lesson exemplar (IDEA), where integrating AI applications was emphasized, students were able to engage in trial and error and take risks. They played the mystery box game, wherein students were divided into two groups. Each team alternately picked a letter and answered a question about the previous lesson regarding diffraction and characteristics of light and the visible spectrum. After correctly answering the question, the team should decide whether to keep the box or give it away. Points inside the box are either good (plus XP) or bad (minus heart points). After the game, all team members received additional XP and subtracted heart points on ClassDojo, an AI application that enables students to explore various learning methods and socially communicate with one another anytime and anywhere. The study highlighted the effectiveness of lesson exemplars (IDEA), incorporating AI applications, in enabling students to try various approaches to learning and engage in risk-taking to acquire new ideas and creatively solve existing problems.

Table 8. Perception of the Students on Their Scientific Attitude as to Their Own Persistence

Statements	**Pre-perception**			**Post-perception**		
As a student, I am…	Mean	SD	R	Mean	SD	R
1. exhibiting continuous effort to achieve a specific goal.	1.24	0.49	LP	3.49	0.51	P
2. considering obstacles as a way to improve myself and not as a distraction to success.	1.37	0.54	LP	3.51	0.51	HP
3. demonstrating a strong desire to go beyond challenges in order to succeed.	1.32	0.52	LP	3.56	0.50	HP
4. allocating enough time and resources for a certain goal to be completed.	1.51	0.55	SP	3.49	0.51	P
5. maintaining a positive mindset on facing never ending challenges in life.	1.32	0.52	LP	3.41	0.50	P
6. establishing clear objectives and persistently pursuing them in the face of obstacles.	1.29	0.51	LP	3.51	0.51	HP
7. demonstrating capacity to uplift myself amidst failures and keep going after one's objectives.	1.32	0.52	LP	3.46	0.50	P
Overall Mean	1.34	0.16	LP	3.49	0.24	P

Legend: 1-1.49 low positive (LP); 1.5-2.49 slight positive (SP); 2.5-3.49 positive (P); 3.5-4 high positive (HP)

Table 8 presents the students' pre-perception and post-perception of their persistence.

In pre-perception, statement 1 got the lowest mean of 1.2 while statement 4 got the highest mean of 1.51, which are verbally interpreted as low positive and positive, respectively. However, statement 5 of post-perception received the lowest mean of 3.41, with a verbal interpretation of 'positive', while statement 3 received the highest mean of 3.56, verbally interpreted as 'high positive'. Overall, pre-perception obtained a mean of 1.34, while post-perception obtained 3.49, making the verbal interpretation improve from a low positive to a positive level.

The results suggest that before the implementation of AI applications, the majority of learners often adopted a 'come-what-may' mentality, showing little motivation to improve their output or performance as long as they received average grades or merit points. During the actual conduct of the study, particularly on the engagement part of day 4 of the lesson exemplar (IDEA), students accomplished an activity in ClassDojo, posted on the “All Portfolio Posts”, wherein they watched separate videos about the science of color and the Tyndall effect. Afterwards, they answered the questions, during which some students experienced difficulties. Since no strict time limits were provided, students took the opportunity to rewatch the video multiple times until they could identify the answers to the guide questions. Some students explored the application further and discovered that subtitles could be activated, making video viewing more convenient.

Artificial intelligence applications empower students to explore ways to simplify tasks and produce higher-quality learning outputs. On the assimilation part of the lesson exemplar (IDEA), students were instructed to log in to Quizizz, where they answered a teacher-paced quiz about how the eye perceives color, the Tyndall Effect, and the importance of light in our lives. Afterwards, they published a post to commend and praise not only their team members but also their opponents who scored and performed excellently on the quiz. AI applications enhance students' persistence, as evident in their ability to compete with other teams, demonstrating strong determination to complete tasks and overcome obstacles. Xu (2024) also claimed that AI integrated into education improves learning outcomes, as AI algorithms are designed to enhance student engagement, motivation, and academic achievements, enabling students to persevere in accomplishing tasks.

Table 9. Level of Acceptance of the IDEA Exemplar for Artificial Intelligence Application

Elements/Categories	Mean	SD	R
Content	2.70	0.48	HA
Structure/Sequence	2.90	0.32	HA
Functionality	2.90	0.32	HA
Design	2.70	0.48	HA
Language/Mechanics	3.00	0.00	HA
Inclusivity	2.60	0.52	HA
Overall Mean	2.80		HA

Legend: 2.3-3 highly acceptable (HA), 1.6-2.2 moderately acceptable (MA), 1-2.1 slightly acceptable (SA)

Table 9 presents the level of acceptance of the lesson exemplar (IDEA) for Artificial Intelligence Application in Science Gamification. Ten subject experts evaluated the lesson exemplar using a 3-point scale. Language got the highest mean of 3.00, while inclusivity got the lowest mean of 2.60, both with verbal interpretation of highly acceptable. All the elements of the lesson exemplar had an overall mean of 2.80, with a verbal interpretation of 'highly acceptable'.

The result implies that the lesson exemplar displays a good choice of words and proper sentence construction. It also provides clear and concise direction on how to complete an activity suitable for grade 7 learners, such as the dancing game, which requires students to recall the previous topic about waves. Students read the sentence, but are limited to 1 or two words to be read by each student. The student who read the last word dances. They also played a soccer game, in which students were divided into two teams. Each team alternately chose a letter and answered a question of their choice about the previous topic, which was the reflection and refraction of light. Each correct answer will move their team's ball forward until it reaches the goal. The result also suggests incorporating content related to the social aspects of students, including social responsibility, global citizenship, nation and community building, health and safety, well-being, and support for sustainable development goals. For instance, the topic "How human eye perceives light" can be related to the moral and social responsibility of avoiding pointing direct beam of light towards the eye of other person as iris and retina may not be able to quickly adjust to high amount of incoming light particles that may result to temporary or permanent damage of the eye. The topic of light reflection can also be used to highlight the importance of using side mirrors on vehicles to avoid unexpected road collisions and accidents. Incorporating values into the activity not only makes the teaching and learning process more engaging, but it also raises students' awareness of the consequences of their actions. Safety is defined as the absence of accidents and incidents (Aven, 2022).

As a whole, the lesson exemplar (IDEA) requires additional related content not only to fully guide the teacher in implementing instruction through AI application and gamification, but also to enable students to use science in considering the safety of others.

Table 10. Significant Difference in the Pre-perception and Post-perception of the Students on Their Own Engagement

Engagement	**Pre-perception**		**Post perception**		**Mean diff**	**t**	**df**	**Sig. (2-tailed)**
	Mean	**SD**	**Mean**	**SD**				
Cognitive	1.47	0.19	3.47	0.16	2.00	57.93	40	0.000
Behavioral	1.35	0.19	3.50	0.19	2.14	54.25	40	0.000
Social	1.33	0.20	0.19	3.50	2.17	47.64	40	0.000

Legend: Sig (2-tailed) $\leqslant$ .05 (Significant); Sig (2-tailed) $\geqslant$ .05 (Not significant)

Table 10 illustrates the significant difference in the students' pre-perception and post-perception of their classroom engagement.

It can be seen that, in the actual conduct of the study, all the variables of classroom engagement have significantly increased from students' pre-perception to post-perception. The result reveals that, after the use of lesson exemplar (IDEA) incorporating Artificial Intelligence application in science gamification to improve student engagement, students were able to invest in thinking and comprehending the scientific concept, exert effort to perform assigned tasks and academic activities, and be involved in the activities inside and outside the school while interacting with people.

The Lesson Exemplar (IDEA) integrating Artificial Intelligence applications enhances student engagement in cognitive aspects through gamification. It is also emphasized by Lo and Hew (2018) that students' cognitive engagement was enhanced by gamification, as peer interactions in the classroom significantly improved student achievement and cognitive engagement. The use of gamification in the online learning environment makes learning that may look difficult or boring more interesting and easier to understand.

The Lesson Exemplar (IDEA) integrating AI applications in gamification also enhances the behavioral aspect of student engagement, depending on the time frame in which the gamification is used. Moreover, Kim and Castelli (2020) stated that gamified short-term interventions are a good way to

improve the behavioral engagement of learners and enhance learning outcomes. A helpful motivational strategy to improve learners' behavioral outcomes and engagement is gamification. A short-term gamification intervention involving K–12 students at varying participation levels has demonstrated that learners' behavioral changes have a relatively greater impact.

Social engagement was also improved by lesson exemplars incorporating AI applications through gamification, as students act as players who interact, cooperate, or compete with other players to obtain points and earn a victory. It is further stated by Nah et al. (2013) that additional game mechanics improve player interaction with one another, described as social engagement. It includes roleplay, marketplaces/economies, explicit and player-generated rules, feedback, teams/social dynamics, visual/3D space/sounds, customization, narrative context, and avatars. Players can compare their performance to that of other players using leaderboards. Users can be given challenges through quests. Quests and onboarding go hand in hand to balance abilities and challenges, which is a prerequisite for users' social engagement.

Table 11. Significant Difference in the Pre-perception and Post-perception of the Students on Their Own Scientific Attitude

SA	Pre-perception		Post perception		Mean diff	t	df	Sig. (2-tailed)
	Mean	SD	Mean	SD				
Curiosity	3.45	0.19	1.34	0.21	2.11	46.78	40	0.000
Cooperation	3.46	0.14	1.46	0.23	2.00	48.90	40	0.000
Critical	3.50	0.18	1.47	0.17	2.04	58.10	40	0.000
Creative	3.40	0.16	1.36	0.24	2.04	50.13	40	0.000
Persistence	3.49	0.24	1.34	0.16	2.15	47.43	40	0.000

Legend: Sig (2-tailed) $\leqslant$ .05 (Significant); Sig (2-tailed) $\geqslant$ .05 (Not significant)

Table 11 illustrates the significant difference in the pre-perception and post-perception of students regarding their scientific attitude. It is evident from the actual conduct of the study that all variables related to scientific attitude have increased significantly from students' pre-perception to post-perception. The result reveals that the use of the lesson exemplar (IDEA) incorporating Artificial Intelligence application in science gamification will improve students' scientific attitudes as it awakens the eagerness of the students to acquire new scientific concepts, enhance their willingness to praise and commend their classmates as well as to celebrate group achievements, encourage them to ask meaningful scientific questions to have deeper understanding of the topic, explore different ways of learning science, and develop a strong desire to defy challenges and obstacles to succeed.

The Lesson Plan (IDEA) integrating AI applications in a gamified activity in science promotes and improves students' curiosity, as they are driven to seek new knowledge about scientific concepts. Moreover, Morris et al. (2013) asserted that gamification promotes curiosity, as students have optimal levels of uncertainty. For instance, games enable students to discover the rules for action, solve a series of puzzles by creating portals through which the character and objects teleport, immersion of players in a virtual world, navigate underwater to survive and may prompt curiosity about the world itself and the capacities/limitations of the character being played.

Cooperation and teamwork were also enhanced through the use of the lesson exemplar, which incorporated an AI application in gamification. Students selected as teammates share a common goal, primarily to earn points and outdo their opponents. Additionally, Morris et al. (2013) stated that AI gamification enables students to cooperate and collaborate to create solutions for specific scenarios. Forecasting games promote thinking about the future. As the game reflects a real-world problem, players think and plan about something that will occur. In addition to engaging students in thinking about a problem, the game also led some students to change their habits. Turning a future problem into a game enables us to leverage the voluntary participation component of gaming.

Gamification through lesson plans (IDEA), integrating AI applications, can also be used to foster students' critical thinking attitudes by triggering their prior knowledge and explaining current issues discussed alongside scientific concepts. Additionally, Morris et al. (2013) noted that gamification is also designed to teach critical thinking skills to students. For instance, the educational game called Operation ARA. The key concept of identifying flawed scientific research is embedded in the gameplay and made more engaging by situating the problem within the context of an alien conspiracy to deceive humans. Results indicate that students who played Operation ARA demonstrated a greater understanding of scientific research methods. Thus, it revealed that students who played games are more critical thinkers than those who do not.

The creative minds of students can be awakened by lesson plans (IDEA) in gamification aided by AI applications, as problems that need solutions can only be solved through creativity. Similarly, Galleta (2013) stated that gamification stimulates creativity and improves education, accelerating Innovation Processes. Game-based applications will be increasingly used to motivate workers and students, improving learning and performance. Game mechanics are highly effective because, based on human desires and needs, they provide targets to be reached and rewards to be gained by facilitating the expression of the self within communities, allowing problem-solving in a simple and engaging way, while stimulating creativity and finding alternative solutions.

Lastly, the lesson plan (IDEA) integrating AI applications can be used to gamify science, enhancing students' perseverance in learning amidst challenges and obstacles. Failure to submit an output may lead to students losing interest. However, in gamification, failure can lead to perseverance

and ultimately, success. Similarly, Morries et al. (2013) emphasized that failure to make progress in educational contexts can result in students' disengagement from the activity. Failure can cause students to internalize their shortcomings as proof of their incapacity or incompetence, which can result in low self-esteem and a disinterest in their studies. On the other hand, failure in a gamified activity often results in persistence.

CONCLUSION

The findings of the study showed that there is a significant difference in the pre-perception and post-perception of students regarding their classroom engagement, specifically in terms of cognitive, behavioral, and social engagement. Thus, the null hypothesis is not supported. Similarly, it also showed that there is a significant difference in the pre-perception and post-perception of the students on their scientific attitude as to curiosity, cooperation, critical thinking, creativity, and persistence. Thus, the null hypothesis is not sustained. Since AI applications can improve student performance, teachers may consider using Lesson Exemplar Integrated Artificial Intelligence in Science Gamification as a mode of facilitation, improvement, and assessment, particularly in enhancing classroom engagement and scientific attitudes of learners.

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