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Enhancing Student Engagement and Achievement in Biology through Interactive Slide Presentations

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ABSTRACT

In response to the emergence of Education 4.0 and the COVID-19 pandemic, the need to utilize effective emergency remote teaching technologies to enhance student engagement and achievement has never been more urgent. This Mixed Methods research investigated the effects of Biology Interactive Slide Presentations on the achievement and engagement of Grade 12 STEM students. Biology Interactive Slide Presentations were created using Pear Deck and Nearpod applications. Six Biology lessons about the Central Dogma of Molecular Biology and DNA Recombination were taught to 28 students using the educational tool. The students' achievement was determined using a one-group pre-test-post-test design. The results of the paired-sample t-test revealed that there is a significant difference in the achievement of the students before and after the use of the learning tool. The students' engagement was investigated through focus group discussion with five randomly selected students, and outcomes related to students' engagement were identified as improving their cognitive, emotional, and behavioral engagement.

INTRODUCTION

In December 2019, the virus Severe Acute Respiratory Syndrome – Related Coronavirus 2, which caused the disease COVID-19, spread globally, forcing most governments around the globe to temporarily close their educational institutions. Seventy percent of the world's student population, or more than 1.2 billion learners, are affected by the school closures due to the pandemic (United Nations Educational Scientific and Cultural Organization, 2020). Many countries have started working and studying at home by gradually embracing digital education through various formats. Hence, remote learning has been a buzzword in today's way of instruction. Remote learning allows teachers and students to remain connected and engaged while working or staying at their homes. According to Ray (2020), remote learning is usually linked to emergencies that pose a threat to student safety. It is evoked during a time of stress. Additionally, Hodges *et al.* (2020) describe the concept of Emergency Remote Teaching which refers to the temporary shift of instructional strategy to an alternative delivery mode due to crisis circumstances like this COVID-19 pandemic. Its objective is to provide temporary access to instruction and support in a manner that is quick to set up and is reliably available during an emergency or crisis.

The COVID-19 pandemic changes and affects our educational system but these changes could also prompt educational innovations. Traditional classrooms with centuries-old lecture-based approaches, and outmoded classroom strategies with the slow pace of change in our global academic institutions are lamentable. On a silver lining, COVID-19 could become a catalyst for the educational community to search for innovative solutions in a relatively short period (Tam & El-Azar, 2020).

Additionally, the 4th Industrial Revolution which involves the emergence and applications of new technologies affects every aspect of our lives including education. In response to the COVID-19 pandemic and the emergence of Education 4.0, technology integration and utilization play a big role in allowing both teachers and students to adapt to this new vision of learning.

As schools around the world respond to the COVID-19 pandemic, the need for emergency remote teaching tools has never been more urgent. Presentations still play a significant role in emergency remote teaching but even in the physical classroom setup, the common presentation software is already being criticized. Microsoft PowerPoint is a presentation software that has been downloaded on about 1 billion computers and approximately 350 of these presentations are being exhibited every second around the globe (Parks, 2012). PowerPoint accounts for about 95% of all presentations and has 30 million users a day (Holmes, 2007). This high-level usage of the PowerPoint presentation would suggest that it is a very useful and effective tool for teaching, but this may not always be the case, as the overuse and misuse of this presentation software have led to several criticisms.

LITERATURE REVIEW

At the turn of the 21st century, several critiques and articles began appearing and questioning the use of PowerPoint presentations. One of the most popular criticisms is by Tufte in his article entitled PowerPoint is Evil in 2003. He argues that PowerPoint presentations "induced stupidity, turned everyone into bored, wasted time and degraded the quality and credibility of communication. It set a speaker's dominance over the audience". The article by Weimer (2012) entitled "Does PowerPoint Help or Hinder

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Learning?” also echoes some key concerns in which she believes that using PowerPoint encourages passivity and questions whether it encourages interaction for it does not foster the vibrant exchange of ideas. Several authors also argue that some PowerPoint presentations prompt learners to feel bored, and frustrated and are just a waste of time (Anderson & Williams, 2012; Harman, 2010 cited in (Murugaiah, 2016). Students also get frustrated and feel ignored when their teacher is concentrating on the presentation and not paying attention to the class (Voss, 2004).

According to Carini *et al.* (2006), “Students may become engaged when their academic experience is characterized by meaningful educational activities which include active learning”. Active learning pedagogy coupled with technology opens possibilities for teachers to create interactive and engaging presentations. “Twenty-first-century students are adept at using technology, which means that incorporating appropriate technology into the classroom can excite and engage students” (Metcalf *et al.*, 2016). Utilizing interactive slide presentations could potentially provide interactive and engaging presentations in the classroom.

There are educational technology tools that can be used to allow interaction within the presentation. Pear Deck and Nearpod applications enable teachers to create interactive presentations by allowing the teacher to share slide presentations with their students through the use of the internet and digital devices such as mobile phones, tablets, or computers. It enables teachers to create presentations that allow learners to respond to different types of assessment throughout the presentation. They can answer the assessments by typing, drawing, or dragging. Teachers can view responses in real-time in which the teacher can provide immediate corrective feedback and share the correct answer with the class. Students can see and engage with the presentation using their digital devices by logging into the website with a unique access code (Robinson, 2018). This feature is called Classroom Response System (CRS), Student Response System (SRS), or ‘clicker’.

A technology is considered interactive if it allows interpersonal interaction (Lin *et al.*, 2017, cited in Lew *et al.*, 2018). Interactive learning pedagogy stimulates active learning since it engages students to actively process their learning instead of passively listening to an expert (Freeman *et al.*, 2014). Vonderwell and Turner (2005) postulate that incorporating active learning pedagogy with technology tools can accomplish successful teaching and learning (as cited in Khan *et al.*, 2017). Numerous studies use technology-based systems such as clickers as an active learning pedagogy to enhance student engagement (Caleb & Aloysuis, 2016; Chih-Yuan Sun *et al.*, 2014; Salemi, 2009; Terrion & Aceti, 2012). Furthermore, some researchers argue that active learning pedagogies can promote student engagement and significantly impact on student learning and performance (Riggs & Linder, 2016; Khan *et al.*, 2017). This is supported by other research that found a positive correlation between student engagement

and achievement (Ainley & Ainley, 2011; Dotterer & Lowe, 2011; Lam, *et al.*, 2014). The study of Sumandal (2023) showed that student’s motivation, interest, and cooperation increased using educational games. Similarly, mobile-supported self-learning modules enhances tsusents’ oral communication skills (Santos, 2023).

Generally, several researchers and education scholars argue that the misuse of PowerPoint presentations induces teacher dominance, student passivity, and boredom, impedes student’s learning, and presents a mismatch in preparing students in this technology-based society (Anderson & Williams, 2012; Harman, 2010; Park & Choi, 2014; Tufte, 2003; Weimer, 2012). Although there is an abundance of scholarly literature related to the application of active learning pedagogies coupled with technology in education (Caleb & Aloysuis, 2016; Chih-Yuan Sun *et al.*, 2014; Salemi, 2009; Terrion & Aceti, 2012), there is a limited empirical literature that focuses on the integration of Interactive Slide Presentations to enhance student engagement and achievement in Biology. This study adds to the small, but growing research base about the effect of interactive slide presentations on student engagement and achievement.

Specifically, the researchers aimed to answer the following questions:

1. What is the level of achievement of the students in using the Biology Interactive Slide Presentations?
2. Is there a significant difference in the achievement of the students before and after the use of Biology Interactive Slide Presentations?
3. What are the students’ perceptions of the effect of the Biology Interactive Slide Presentations on their engagement?

METHODOLOGY

Research Design

The researchers utilized the one-group pre-test-post-test research design and thematic analysis to conduct this mixed methods research. One-group pre-test-post-test is a type of research that tests the impact of a treatment on an outcome.

Research Instrument

In this study, the researchers used two research instruments to gather data about student engagement and achievement. One of which is the Achievement Test composed of 50 researcher-made multiple-choice questions answerable within an hour and was used to evaluate the student’s achievement after creating a table of specification (TOS). The instrument was validated by three Biology experts and was modified based on their comments and suggestions. A pilot test was conducted to check its reliability through item analysis in which the item difficulty and discrimination index were analyzed. Second is the Focus-Group Discussion questions used to gather information on the student’s perceptions of the effect of Biology Interactive Slide Presentations on their engagement. It was also validated by three experts, particularly one Qualitative expert.

Data Gathering Procedure

In the development of the educational tool, the researchers chose the Central Dogma of Molecular Biology and DNA Recombination as central topics of the presentations because students find difficulty in understanding topics related to genes, chromosomes, protein synthesis, and genetics (Cimer, 2012; Fauzi & Mitalistiani, 2018; Tabotabo-Picardal & Paño, 2018). Consequently, six detailed lesson plans that developed and were used as guides on how to deliver the lessons using the Interactive Slide Presentations. The lesson plans were validated by three experts. After the validation, the interactive slide presentations were created using Pear Deck and Nearpod applications.

In the beginning, formal letters were provided to the Principal and an Informed Consent Form was secured for the intended participants of the study. During the administration, Grade 12 STEM students were taught using Biology Interactive Slide Presentations by simultaneously joining the videoconference platform -Google Meet. Pear Deck and Nearpod Presentations were used to teach the following topics:

- 1) Introduction to DNA
- 2) DNA Replication
- 3) Transcription & Translation
- 4) Protein and Mutations
- 5) DNA Recombination
- 6) Application of DNA Recombination.

Since the two applications have almost similar features, the researchers divided the six lessons. Pear Deck was used for Lessons 1, 2, and 3 and Nearpod was utilized for Lessons 4, 5 & 6. To gather data on student achievement, students took the pre-test and post-test using the 50

researcher-made multiple-choice questions. Lastly, a focus group discussion was conducted with the participation of five randomly selected students from the Grade 12 STEM students to gather their perceptions on the effects of using the interactive slide presentations on their engagement through the 10 questions. The students' responses were transcribed, translated into English, and analyzed through deductive thematic analysis. The students' scores in the pre-test and post-test were statistically analyzed to determine if their achievement had improved using the Biology Interactive Slide Presentations. A t-test for dependent means was utilized to identify whether there was a significant difference in student's scores from the pre-test to the post-test. All statistical analyses were done using the 0.05 level of confidence. SPSS software was used for the statistical analysis. Effect size and normalized gain were also reported.

RESULT AND DISCUSSION

Problem No. 1: What is the Level of Achievement of the Students in Using the Biology Interactive Slide Presentations?

Table 1 summarizes the students' achievement in using Biology Interactive Slide Presentations. A total of 28 students answered the multiple-choice questions after the discussion. The achievement scores of the Grade 12 STEM students showed that most of them got high scores following the use of the Biology Interactive Slide Presentations with a mean post-test score of 34.11. The median score is 35, the most common score is 41. The distribution was negatively skewed indicating that most of the students got high scores in the post-test. A total of 28 students answered the researcher-made

Table 1: Result of Descriptive Analysis for the Achievement Scores of Grade 12 STEM Students in Using Biology Interactive Slide Presentations

Variable	N	Range	\bar{X}	\bar{X}	\bar{X}	SD	Skewness
Achievement score	28	35	34.11	35	41	9.03	-.700

50-item multiple-choice questions after the discussion of the Central Dogma of Molecular Biology and DNA Recombination using the Interactive Slide Presentations. In general, the result of the descriptive analysis showed that the mean post-test score of the students is 34.11 out of 50 points, with a median of 35 and 41 as the most common score. The distribution was negatively skewed indicating that most of the students got high scores or got scores above the mean and a few relatively very low scores.

Several researches revealed that students find difficulty in understanding topics related to genes, chromosomes, protein synthesis, and genetics (Cimer, 2012; Fauzi & Mitalistiani, 2018; Tabotabo-Picardal & Paño, 2018). Hence, the researchers developed Biology Interactive Slide Presentations which cover topics about the Central Dogma of Molecular Biology and DNA Recombination.

The Central Dogma of Molecular Biology describes the flow of genetic information from DNA to mRNA and protein. It involves the fundamental processes of DNA replication, transcription, and translation in which proteins are produced based on the message contained in the DNA. Another lesson taught using the Interactive Slide Presentations was DNA Recombination wherein students learned about its definition, importance, and the processes involved to form Recombinant DNA to produce large quantities of the gene of interest or the product encoded by the gene. Interactive Slide Presentations were utilized through the use of two online applications named Pear Deck and Nearpod which allow students to respond to different formative questions. The result from the achievement scores of the Grade 12 STEM students showed that most of them got high scores after the use of the Biology Interactive Slide Presentations.

Problem No. 2: Is There a Significant Difference in the Achievement of the Students before and after the Use of Biology Interactive Slide Presentations?

Table 2 shows the result of the t-test for dependent means analysis from the pre-test and post-test scores of the students. The mean pre-test score of the students is 26.04, while the mean post-test score is 34.11. These data were subjected to the paired sample t-test, with the

results showing 8.071 as the mean difference between the pre-test and post-test scores. Since $11.043 > 2.052$, where 11.043 is the t-value and 2.052 is the critical value at $\alpha=0.05$, the researchers rejected the null hypothesis. Paired Sample t-test revealed that there is a significant difference in the achievement of the students before ($\bar{X}=26.04$) and after ($\bar{X}=34.11$) the use of the Biology Interactive Slide Presentations.

Table 2: Paired Sample T-test Result of the Pre-test and Post-test Score of STEM Grade 12 Students

Measurement	N	Mean	Std. Deviation	t-value	df	P-value	g
Pre-test	28	26.04	7.705	11.043	27	.000	0.11
Post-test	28	34.11	8.655				
Post-test – Pre-test	28	8.071					

Analysing the means of the achievement scores and the direction of the t-value, results showed that there was an improvement in the achievement scores of STEM Grade 12 students following the discussion of the six Biology lessons about the Central Dogma of Molecular Biology and DNA Recombination using the Interactive Slide Presentations from the mean of 26.04 to 34.11 ($p < 0.05$). Therefore, Biology Interactive Slide Presentations showed a remarkable impact towards improving the students' achievement.

Six lessons about the Central Dogma of Molecular Biology and DNA Recombination were taught using Interactive Slide Presentations. Biology Interactive Slide Presentations were created through the use of Pear Deck and Nearpod applications that can be described as a combination of slide presentation and clicker. Clicker is also called a student-response system because these are educational tools that enable students to participate and respond to questions presented in the slide presentation. Clickers are pedagogic tools that mainly aim to provide immediate feedback to both students and teachers and survey or monitor the understanding of the students (Blasco *et al.*, 2013). Clickers can be used to find out if the students have misconceptions that need to be addressed, to determine the preparedness of the students, to facilitate peer discussion and instruction, to collect assumptions on the result of the experiment, and to poll opinions for the debate (Sevian & Robinson, 2011). Pear Deck and Nearpod are online applications that provide the means for students to interact in slide presentations. It includes activities like open-ended questions, multiple-choice questions, true or false, drawing, labelling, pairing, and matching, collaborative live board, fill-in-the-blanks, etc. Several researchers have found that the use of clickers as an active learning pedagogy can enhance student achievement (Caleb & Aloysuis, 2016; Chih-Yuan Sun *et al.*, 2014; Salemi, 2009; Terrion & Aceti, 2012).

Problem No. 3: What are the Students' Perceptions of the Effect of the Biology Interactive Slide Presentations on Their Engagement?

A focus group discussion was conducted to determine

the students' perceptions of the effect of the Biology Interactive Slide Presentations on their engagement. Findings were based on the outcomes that the students had identified from their use of the Biology Interactive Slide Presentations. These outcomes were categorized into 3 following the three components of engagement described in the article written by Fredricks *et al.* (2004) namely:

- 1) Cognitive
- 2) Emotional
- 3) Behavioral Engagement.

Cognitive Engagement

According to Fredricks *et al.* (2004), the term Cognitive Engagement is linked to the concept of investment where it refers to the eagerness of students to employ the necessary effort to understand complicated ideas and master difficult skills. One of the outcomes related to cognitive engagement that the students had identified is the capacity of the learning tool to catch their attention and focus on the discussion. Bonwell and Eison (1991) argue that students' being cognitively engaged with learning activities or materials is the best description of active learning.

The findings revealed the following themes and sub-themes related to cognitive engagement with sample responses from the students:

Theme 1: Caught Students' Attention to Listen and Focus on the Discussion

All of the five focus group participants recognized that the Biology Interactive Slide Presentations caught their attention which enabled them to listen and focus on the discussion. At the very beginning of the focus group discussion, Student ST described the Biology Interactive Slide Presentations as an "attention-grabber".

I will describe it as an attention-grabber since the students are more involved in the discussion. Our attention is easily grabbed by the lesson or the presentation being presented.

Additionally, Student AM explained that the Interactive Slide Presentations grabbed her attention to listen and

focus on the discussion about Biology lessons.

I also enjoyed responding to the interactive slide presentations because it really grabbed our attention to focus and listen.

Student AC also mentioned the term “attention-grabber” and shared with the group that she has a low attention span but with the use of the said educational tool, she was able to focus her attention throughout the discussion to respond to the given activities.

The interactive slide presentation is attention-grabbing. Personally, I have a short attention span but because the discussion caught my attention, I was able to respond to the given activities.

She also added about how they are more engaged and motivated to participate during their virtual classes with the use of the Biology Interactive Slide Presentations.

The interactive slide presentation is a good and effective method for a discussion. Just as what AM said, there are a lot of distractions during a virtual class so our focus is unsteady. In the usual activities, sometimes we’re not active in responding. But because we enjoy the activities in the interactive slide presentation, we are motivated to engage and participate in responding to the activities.

Subtheme: Students Look Forward to the Activities throughout the Lesson

A subtheme was identified under Theme 1 wherein several students mentioned that they listened to the discussion because they were looking forward to the activities given throughout the lesson. Student MM believed that some students are only joining their online meeting for attendance but they are not listening during the discussion. However, the interactive slide presentations motivated them to listen throughout the discussion due to the activities given before and after the discussion. She further explained that without the activities, students will not listen to the teacher’s discussion.

Like what they mentioned, in a normal online meeting, students join only for the sake of attendance and won’t listen anymore throughout its duration. In the interactive slide presentation however, students are motivated to listen because of the activities before and after the lesson...The activities before and after the lessons were beneficial for us to understand the lessons. Without the activities, the students may not listen to the discussion.

Student AM reiterated how students’ focus is being diverted during virtual classes since students are in the comfort of their homes. She likewise believed that with the use of the educational tool, they were encouraged to listen and focus on the slide presentations because they were looking forward to the upcoming activities or slide presentations.

They are basically listening because they would like to respond or have an answer on the next activities.

...it encourages the students to listen and participate in the given activities. With the online classes, the students’ attentions are often diverted to other things since they are at home which makes it difficult for them to focus

on the discussions. But with the use of interactive slide presentations, their focus is solely on the presentations for they look forward to the upcoming activities and slides.... We look forward to the discussion so we can answer and participate in the activities that follow.

Theme 2: Concepts Become More Concrete

Central Dogma of Molecular Biology and DNA Recombination comprises topics related to DNA, chromosomes, proteins, and various processes that are complex, intangible, and are usually discussed at the molecular level. All of the focus group participants explained that with the use of the Biology Interactive Slide Presentations, those difficult, intangible, or complex concepts became more concrete and were better understood.

Student AC comprehensively explained how these complex Biology concepts specifically the lessons about the molecular structure and processes that involve DNA became more concrete with the use of the learning tool particularly with the animated pictures and videos included in the slide presentation that helped them understand the processes easily and in much detail.

The interactive slide presentation definitely helped us engage in the lessons, particularly in molecular Biology. Through the presentation, we were able to understand the lessons that can’t be really seen in real life like that of the concept behind the DNA structure and DNA recombination. And like what AM said, through animated images and videos we were able to understand the details thoroughly. We were able to recognize, associate, and remember the terms efficiently. Biology is a complex subject but with the approach used, we understood the topics well.

Student AM mentioned how animated videos and pictures helped clarify the meanings of Biology terms such as in the lesson about enzymes involved in DNA replication. Like those of the pictures of enzymes, the animated pictures grab our attention and because of that, the meaning of the terms from the lessons became even clearer. It also becomes easier for us to remember the terms and concepts

She repeatedly stated that pictures on the slide presentations served as models or representations so they don’t need to imagine or visualize how these complex concepts work or look like for they can already see it on the screen.

The interactive slide presentations were very catchy since we don’t need to visualize things in our minds because we can already see them with the activities given...

As I’ve said earlier, we don’t just visualize the images in our mind but we also see them on the screen.

...it helps us understand more the lessons for we do not just visualize the images in our minds but the slides also show those images

Theme 3: Clarify Understanding through Real-Time Feedback

The Biology Interactive Slide Presentations are

considered as a partial form of a clicker for it allows real-time response and feedback both for the students and teachers. The five participants have recognized this feature and they had identified that real-time, immediate feedback from their teacher helps them clarify their understanding about the lesson.

Student MM expressed her agreement with the idea that their teacher should see her responses so that she could be given feedback if her answers are correct or how can she make her answers correct.

I prefer that my teacher sees my answers so that she can immediately provide feedback and I can be aware of what is actually correct.

Student AC expressed her belief about the benefits of providing immediate feedback, particularly on how it could guide them during the discussion. One particular scenario she provided is when she tried to get the correct answer several times in the activity about arranging the steps in DNA replication by numbering it from the first to the last step. She felt that she strived or tried her best to get the correct answer.

If the teacher can give immediate feedback, then she can readily point out if our answers are right. For example, in the activity where we did numbering, several times I tried and there were mistakes and if the teacher can correct it immediately, then I could try again avoiding the same mistakes and I will be able to arrive with the right answer. It helps me strive more so I can obtain the right answer and the records shown on your screen also serve as a guide.

Theme 4: Remember Terms and Concepts Better

Three students identified this outcome from their use of the Biology Interactive Slide Presentations. Student ST explained how the activities particularly the labelling of the different parts of the cell and the activity that tasked learners to guess the terms with missing vowels helped her remember the terms and concepts even if there were a lot of terms that they needed to remember and memorize, especially in Biology.

It was a more efficient way of learning lessons in Biology since there are a lot of diagrams. It's like applying the concepts. As there are lots of terms we need to memorize, the activities in the interactive slide presentations help us remember those terms better. With the interactive slide presentations, we can immediately apply the concepts we learned. I discovered that I can remember easily the terms using the activity on missing letters.

Animated videos and pictures also helped her remember the concepts better.

...you can visualize a certain image or a certain diagram, we were able to visualize its image and remember it because of the activity.

Student AM also stated that activities after the lesson exercised their brain to remember and retain information. She specifically mentioned the multiple-choice question activity which enabled her to remember the terms and concepts about Proteins and Mutations more effectively. We can easily recall the terms and concepts because of

the activities given after a discussion. Because of these activities, our brain is exercised, which in turn helps us recall the previous lessons discussed.

After the discussion, the multiple-choice activity was given wherein the questions were taken from the discussion. With that, we can recall the topics we learned during the discussion.

Theme No. 5: Students Become Aware That They Don't Know or Forgot the Correct Answer

Three students honestly mentioned that there were times they didn't respond to the teacher's questions because they didn't know or forgot the correct answer. This may imply that the students were aware of the important concepts that they did not understand or missed out on during the discussion and the activities throughout the lesson enabled them to recognize this concern. This may also imply that the students are aware of their learning progress.

Student AM clarified that sometimes she forgot the correct term or answer even if she understood the question.

Yes, there are times when I cannot respond to the questions for I forgot the answers and even though I understand what the question is pointing out, I forgot its answer.

Emotional Engagement

Emotional engagement incorporates positive as well as negative reactions to fellow students, teachers, and school that influence willingness to do work and presume to create ties to an institution. It also refers to students' affective reactions inside the classroom including students' interest, boredom, anxiety, sadness, and happiness (Connell & Wellborn cited in Fredricks *et al.*, 2004). The following are the outcomes identified by the students from their use of Biology Interactive Slide Presentations which are related to their behavioral engagement.

Theme 1: Enjoy and have Fun with the Activities

All of the participants said that they enjoyed and had fun responding to the activities. Student AC described her impression of the educational tool as "enjoyed at first glance". She said that she had fun and was happy to see that all of them could respond and interact with the slide presentation just like a game. She also felt that with the use of the Biology Interactive Slide Presentations, they are enjoying and learning at the same time.

I enjoyed that activity. At first glance, it left a good impression...I really had fun using it for it engages everyone instead of an individual only. It is fun for it's like a game where we don't just enjoy but we also learn. I certainly want to use it again in a virtual classroom.

Student AM also said that she enjoyed responding with the use of the interactive slide presentations because it grabbed their attention to listen to the discussion.

I also enjoyed responding to the interactive slide presentations because it really grabbed our attention to focus and listen.

Theme 2: Felt Confident or at Ease

Four participants stated that they felt confident, comfortable, or at ease in answering the questions embedded in the slide presentations due to the anonymity that the Interactive Slide Presentations provide.

“Confident and at ease” is how Student AC described her experience in answering with the use of the Interactive Slide Presentations. She further explained that it is a great approach for students to participate especially if they are not confident with their answer or are not fond of participating in class.

When I answer anonymously, I become confident or I am at ease. Like what ST said, even though you’re uncertain of your answer you feel assured that no one will recognize that it was you who answered. There are times when we are not confident about our answers though correct, so this interactive slide presentation gives us the opportunity to answer without exposing our identity. It’s a great approach for students who are particularly reluctant to participate in class discussions.

Student DS agreed with the answer of Student AC that some students are not responding because they are not sure about their answer and they are scared to be judged or be embarrassed in front of the class. However, due to the anonymity feature of the educational tools, students could provide whatever their opinion is without being scared to be identified by their classmates.

Like what AC said, I feel confident answering anonymously using the interactive slide presentation. There are students who, despite knowing the answers, do not respond for they feel uncertain of their answers. They feel weary that they may be humiliated and judged so they’ll just opt out. This interactive slide presentation is better because they can provide any answers or opinions or whatever it is they’ve learned from the discussion without exposing their identities.

Theme 4: Share Sentiments with Classmates

Student ST believed that the feature that allowed all of them to respond at the same time brought back the face-to-face class environment wherein students were excited to participate seeing that all of them were answering, sharing the same sentiments either joy or struggle in class.

The part that all of us could respond to the questions at the same time was one of the features of face-to-face classes that were lost in online classes. The interactive slide presentation, however, brought back that feature. In a normal class environment, students are eager to participate with the belief that we have our classmates. We share the same sentiments, struggle, and joy when we respond to questions.

Student DS agreed with the perspective of Student ST that it brought back the face-to-face classroom environment wherein students were motivated to answer seeing that many of them were responding to the teacher’s question. We become motivated to respond and to listen since everybody is participating. As ST also said, it brings back

the feature of the face-to-face classes where everyone is motivated if the others are also participating.

Behavioral Engagement

In accord with the explanation of Fredricks *et al.* (2004) behavioral engagement is related to the concept of participation and it includes academic as well as extracurricular activities. Behavioral engagement may also refer to the conduct or deportment of a student in school (Finn & Zimmer, 2012). Outcomes that are related to students’ behavior were classified into this theme.

Theme 1: Motivated to Participate

The five focus group participants identified the outcome of students being motivated to respond to questions and participate in the discussion using the Interactive Slide Presentations. The Interactive Slide Presentations motivated Student ST to respond more eagerly and enthusiastically to the various formative questions and participate in the discussion.

I responded more eagerly because we were more involved in this interactive slide presentation. The way we responded, and the way we interacted with the lesson, we were more enthusiastic because we could answer and at the same time we were eager to listen and participate.

Another student who comprehensively explained this outcome was Student AC. She described her experience as ‘enjoying and learning at the same time’ and stated that she actively engaged and participated in the discussions.

I was actively engaged and I participated in the discussion as much as I enjoyed the interactive slide presentation. I was more engaged because the various ways of responding to the activities like drawing, using text boxes, and others were really enjoyable. I was enjoying the activities and at the same time, I was learning a lot.

Theme 2: Involved in a Friendly Competition

Four participants believed that using Biology Interactive Slide Presentations created a friendly competition between the students. Student DS mentioned the existence of friendly competition during the discussion. She clarified that friendly competition is not about getting high scores but answering the questions to learn the concepts within the lesson.

...it really grabbed our attention and we became more interested in the lesson because of the activities. We became more competitive in a way everyone was encouraged to respond to the questions eagerly and to learn more.

Student ST likewise described their classroom environment as having a healthy competition allowing everybody to answer and encouraging each other to participate in the discussion.

There is healthy competition among the class. Seeing everyone partake in responding to the questions, makes you want to participate more. It brings excitement to answering together with your classmates.

Theme 3: Would Like to Use the Interactive Slide Presentation Again

All of the students agreed that they would like to utilize the learning tool again in their other classes and two of them mentioned that they would prefer it will be used in all of their classes. Student AM and Student ST affirmed that they would want to use the Biology Interactive Slide Presentations again. Below is the statement from Student AM describing the Biology Interactive Slide Presentations as a good learning tool:

...I find it really good. Unlike the plain slide presentations wherein the teacher discusses all throughout, the interactive slide presentation grabbed my attention so I definitely want to use it again.

Student ST also said the same by saying that she enjoyed using the learning tool.

In terms of experience, I found it enjoyable and I realized that I was eager to participate because of it. And I will definitely want to use it again in a classroom setting.

CONCLUSIONS

The findings and results of this study showed that the use of Interactive Slide Presentations significantly enhanced the student's achievement in Biology wherein there was an increase in the student's scores from pre-test to post-test. The result of the descriptive analysis showed the most of the Grade 12 STEM students got high scores following the use of the Biology Interactive Slide Presentations. Outcomes related to student engagement were identified as improving students' cognitive, emotional, and behavioral engagement. Interactive slide presentations can be utilized as one of the ways to improve the quality of teaching and learning, particularly by improving student engagement and achievement during remote learning. However, this study was limited to determining the effects of using interactive slide presentations on students' achievement and engagement in Biology. This study did not investigate the attitudes of both the students and teachers in using the interactive slide presentations. The researchers utilized a one-group pre-test-post-test design using the researcher-made 50-item multiple-choice questions to determine the student's achievement before and after using the learning tool. Additionally, the methodology used to determine the effects of the educational tool on students' engagement was limited to a focus group discussion with the participation of five randomly selected students. Further studies can be conducted by taking a larger sample, lengthening the amount of time provided for students in using the educational tool and covering more lessons including other branches of Science, and may also investigate the teachers' perceptions of the use of the Interactive Slide Presentations.

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REFERENCES

- Ainley, M., & Ainley, J. (2011). Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science. *Contemporary Educational Psychology, 36*(1), 4-12. <https://doi.org/10.1016/j.cedpsych.2010.08.001>
- Blasco-Arcas, L., Buil, I., Hernández-Ortega, B., & Sese, J. (2013). Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance. *Computers & Education, 62*, 102-110. <https://doi.org/10.1016/j.compedu.2012.10.019>
- Bonwell, C., & Eison, A. (1991). Active learning: Creating excitement in the classroom. ASHE-ERIC Clearinghouse of Higher Education.
- Caleb, E., & Aloysius, E. (2016). Facilitative learning and students engagement in electrical technology for developing critical reasoning and lifelong learning skills in the University of Uyo, Akwa Ibom State, Nigeria. *Journal of Education and Practice, 7*(22), 36-40.
- Carini, R., Kuh, G., & Klein, S. (2006). Student engagement and student learning: Testing the linkages. *Research in Higher Education, 47*(1), 1-32. <https://doi.org/10.1007/s11162-005-8150-9>
- Chih-Yuan Sun, J., Martinez, B., & Seli, H. (2014). Just-in-time or plenty-of-time teaching? Different electronic feedback devices and their effect on student engagement. *Educational Technology & Society, 17*(2), 234-244.
- Cimer, A. (2012). What makes Biology learning difficult and effective: Students' views. *Educational Research and Reviews, 7*(3), 61-71. <http://dx.doi.org/10.5897/ERR11.205>
- Dotterer, A., & Lowe, K. (2011). Classroom context, school engagement, and academic achievement in early adolescence. *Journal of Youth and Adolescence, 40*(12), 1649-1660. <https://doi.org/10.1007/s10964-011-9647-5>
- Fauzi, A., & Mitalistiani, D. (2018). High school Biology topics perceived difficult by undergraduate students. *Jurnal Penelitian Pendidikan Biologi, 2*(2), 73-84. <https://doi.org/10.32502/dikbio.v2i2.1242>
- Finn, J., & Zimmer, K. (2012). Student engagement: What is it? Why does it matter? Handbook of research on student engagement. Springer. http://dx.doi.org/10.1007/978-1-4614-2018-7_5
- Fredricks, J. A., Blumenfeld, P., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*(1), 59-109. <https://doi.org/10.3102/00346543074001059>
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014).

- Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the national academy of sciences*, 111(23), 8410-8415.
- Funda, S. (2011). Why Turkish pre-service teachers prefer to see PowerPoint presentations in their classes. *The Turkish Online Journal of Educational Technology*, 10(3).
- Hanover, R. (2011). Distance education models and best practices. Hanover Research-Practice, Academy Administration.
- Hodges, C., Moore, S., Trust, T., & Bond, A. (2020, March 27). The difference between emergency remote teaching and online learning. Educause. <https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning>
- Holmes, J. (2007, September 11). Could PowerPoint kill? The Michigan Daily. https://www.indiana.edu/~ciec/Proceedings_2011/ETD/ETD-551/ETD-551_Dyrud.pdf
- Khan, A., Egbue, O., Palkie, B., & Madden, J. (2017). Active learning: Engaging students to maximize learning in an online course. *The Electronic Journal of e-Learning*, 15(2), 107-115.
- Lam, S.-f., Jimerson, S., Wong, B., Kikas, E., Shin, H., Veiga, F., . . . Zollneritsch, J. (2014). Understanding and measuring student engagement in school: The results of an international study from 12 countries. *School Psychology Quarterly*, 29(2), 213-232. <https://doi.org/10.1037/spq0000057>
- Lew, S., Ooi, S., Muthukumar, Y., & Rahman, A. (2018). Improving interactivity via iControl: A presentation mobile app. *European Conference on e-Learning*, 308-315.
- Malang, E., & Zapata, R. (2004). Development and evaluation of computer-assisted instructional material on selected topics in Math IV [Unpublished thesis]. Philippine Normal University.
- Metcalf, A., Layton, M., & Goslin, T. (2016). Three ways to improve student presentations. *TESOL Journal*, 7(2), 421-428. <https://doi.org/10.1002/tesj.241>
- Murugaiah, P. (2016). Pecha Kucha style PowerPoint presentation: An innovative approach to developing oral presentation skills of tertiary students. *Teaching English with Technology*, 16(1), 88-104.
- Park, E., & Choi, B. (2014). Transformation of classroom spaces: Traditional versus active learning classroom in colleges. *The International Journal of Higher Education and Educational Planning*, 68(5), 749-771. <https://doi.org/10.1007/s10734-014-9742-0>
- Parks, B. (2012, August 31). Death to PowerPoint. Bloomberg Businessweek. <https://eportfolios.macaulay.cuny.edu/bloom13/2013/02/25/death-to-powerpoint/>
- Ray, K. (2020). The Just in time playbook for remote learning. Tech & Learning. <https://www.techlearning.com>
- Riggs, S., & Linder, K. (2016). Actively engaging students in asynchronous online classes. IDEA. Manhattan, KS: The IDEA Center.
- Robinson, C. (2018). Technology tools for paperless formative assessment. *Science Scope*, 41(5), 24-27. https://doi.org/10.2505/4/SS18_041_05_24
- Salemi, M. K. (2009). Clickenomics: Using a classroom response system to increase student engagement in a large-enrollment principles of economics course. *Journal of Economic Education*, 40. <https://doi.org/10.1080/00220480903237950>
- Santos, E. (2023). Using Mobile-Supported Self-Learning modules in developing oral communication skills of Grade 9 ESL students. *American Journal of Education and Technology*, 2(2), 99-107. <https://doi.org/10.54536/ajet.v2i2.1632>
- Sevian, H., & Robinson, W. (2011). Clickers promote learning in all kinds of classes-small and large, graduate and undergraduate, lecture and lab. *Journal of College Science Teaching*, 40(3), 14-18.
- Sicat, C. (2002). Development and evaluation of interactive multimedia lessons in analytic geometry [Unpublished thesis]. Philippine Normal University.
- Sumandal, A. H. (2023). Development and evaluation of educational games using lumi education in general biology 1 for stem students: Basis for recommended supplementary teaching materials. *American Journal of Education and Technology*, 1(4), 13-23. <https://doi.org/10.54536/ajet.v1i4.1089>
- Tabotabo-Picardal, M., & Paño, J. D. (2018). Facilitating instruction of central dogma of molecular biology through contextualization. *Journal of Teacher Education and Research*, 13(2), 118-132. <https://doi.org/10.5958/2454-1664.2018.00012.5>
- Tam, G., & El-Azar, D. (2020, March). 3 ways the coronavirus pandemic could reshape education. World Economic Forum. <https://www.weforum.org/agenda/2020/03/3-ways-coronavirus-is-reshaping-education>
- Terrion, J., & Aceti, V. (2012). Perceptions of the effects of clicker technology on student learning and engagement: A study of freshmen Chemistry students. *Research in Learning Technology*, 20(2). <https://doi.org/10.3402/RLT.V20i01.16150>
- Tufte, E. (2003, January 9). PowerPoint is evil. WIRED. <https://www.wired.com/2003/09/ppt2/>
- United Nations Educational, Scientific, and Cultural Organization. (2020, May). COVID-19 educational disruption and response. <https://en.unesco.org/covid19/educationresponse>
- Voss, D. (2004). PowerPoint in the classroom: Is it really necessary? *Cell Biology Education*, 3(3), 155-156. <https://doi.org/10.1187/CBE.04-06-0045>
- Weimer, M. (2012, August 1). Does PowerPoint help or hinder learning? The Teaching Professor. <https://www.teachingprofessor.com/topics/for-those-who-teach/does-powerpoint-help-or-hinder-learning/>
- World Health Organization. (2020). Coronavirus disease (COVID-19) advice for the public. <https://www.who.int>
- World Health Organization. (2021). The different types of COVID-19 vaccines. <https://www.who.int/news-room/feature-stories/detail/the-race-for-a-covid-19-vaccine-explained>