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Using Kahoot as an Instructional
Tool in Biology

A Thesis Presented to
The Faculty of Graduate Teacher Education
College of Graduate Studies and Teacher Education Research
Philippine Normal University
Manila

In Partial Fulfilment
Of the Requirements for the Degree
MASTER OF ARTS IN SCIENCE EDUCATION
with Specialization in Biology

JONALYN G. POSERIO

April 2019

APPROVAL SHEET

This thesis entitled “**USING KAHOOT AS AN INSTRUCTIONAL TOOL IN BIOLOGY**” prepared and submitted by **JONALYN G. POSERIO** in partial fulfillment of the requirements for the degree of **Master of Arts in Science Education with Specialization in Biology**, is hereby recommended for approval and acceptance.

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Dedication

I dedicate this thesis to my mother, Aileen G. Poserio. I hope I make you proud of all my achievement and accomplishments. I love you, Ma!

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Abstract

Name : **Jonalyn G. Poserio**

Title : **USING KAHOOT AS AN INSTRUCTIONAL TOOL IN
BIOLOGY**

Key Concepts : Incorporating Kahoot in teaching and learning Biology,
conceptual understanding, engagement, motivation, experiences,
impressions

Degree : Master of Arts in Science Education

Specialization : Biology

Adviser : Arlyne C. Marasigan, Ph.D.

Kahoot is an online application which offers different forms of assessment such as multiple-choice quizzes, discussion, surveys, and jumbles. The present study sought to determine the conceptual understanding, motivation, and engagement of the learners after integrating Kahoot in Biology class daily. It also explored the experiences and impressions of the teachers and learners after using it in Biology class. The primary data gathering technique was participant observation, mainly observational case study. The researcher gathered qualitative data from the participants using observation protocol, interview protocol, and daily reflection. The data were carefully analyzed through the following steps: obtaining the general sense of data, coding and categorizing.

Moreover, the multiple cases of teachers' and learners' data were analyzed through within-case analysis and after this, cross-analysis followed. Member checking and triangulation of multiple data were observed to establish the credibility of data. The results of the quantitative data indicate that the learners' conceptual understanding was average while the engagement and motivation were high. Key findings yield the following teachers' experiences: pedagogy-related, class-management, and technology-related experiences while the learners' experiences are subject-related, group-related, technology-related, content-related, and game-related experiences. Moreover, the teachers' views of Kahoot include pedagogy related views, content related views and technology related views, the learners, on the other hand, are subject-related views, group-related views, content-related and game-related views. Overall, the results suggest positive outcome expectancy and perceived usefulness of Kahoot and enhanced teaching and learning experience in Biology.

Chapter 1

The Problem and Literature Review

Background of the Study

“Our students have changed radically. Today’s students are no longer the people our educational system was designed to teach” (Prensky, 2001, p.1). According to Prensky, teachers should learn to speak the language of their students. One way of speaking their language is through adapting technology used in the classroom, specifically the use of computer games. Studies reveal that student engagement and learning improved after the introduction of new formative assessment like clickers, which immediately provide feedback (Bird, 2014). One accessible game-based technology today is Kahoot. Kahoot is an online game application which offers different forms of assessment such as survey, jumble, quizzes, and discussions. It has a gamified environment which provides points, ranks, leader boards, and immediate feedback. Several studies show that Kahoot positively affects the academic motivation¹, engagement, and motivation of learners (Pede, 2017; Plump & LaRosa, 2017).

According to the NSBC (as cited in Viray, 2016) survey, 96% of the students with online access reported using social networking technologies, and on average they spend 9 hours per week chatting, blogging, and visiting online communities. Wu (as cited in Viray, 2016) stated that the purpose of using technology in education should focus on meeting students where they are in their development; therefore digital games might be a place to start.

Kahoot, with its theme, “Make Learning Awesome,” was based on the research carried out by Professor Alf Inge Wang and his colleagues at Norwegian University of Science and Technology. It is a popular eLearning tool that can easily be used to add vitality, student

engagement, and metacognitive supports higher education classrooms with the limited instructor and student training required. Kahoot is a free online learning platform which has gained wide acceptance globally with thirty million users worldwide (Plump & LaRosa, 2017). It is fast-paced and fun, which supports creative energy and student participation. It offers a variety of activities in different areas, including Science, Mathematics, English, History, and others. Also, Kahoot is a certified educational quality product 2017, which was analyzed with Kokoa expert evaluation method, designed to evaluate a product's educational quality and to learn engagement.

The use of Kahoot received positive feedback from the learners, wherein they often debated the correct answer and related their interpretation. Upon utilizing this in the classroom, the learners tend to ask more questions about the topic on a particular day. According to Plump and LaRosa, the eLearning experts state that the forty years of the study says that games are effective learning tools. Boller (as cited in Plump & LaRosa, 2017) said that people learn more from a game than from other forms of learning. The knowledge about Kahoot provides ideas to the teachers to utilize the platform in the classroom as a supplemental learning tool to assess the knowledge of the learners before, during, and after the lesson. The study reveals that the utilization of Kahoot in post-secondary schools promotes engagement and motivation among learners.

The gamified environment in Kahoot makes the learning more engaging, stimulating, and enjoyable to the learners. This gamification in Kahoot entails the following elements: points; ranks; and leaderboards. The game keeps a record of the students' or team's answers, awards points, and ranks based on the speed and accuracy. Also, the teacher can embed a video clip before the quiz, add color, music, and excitement. According to Singer (2016), these elements can encourage students to focus and promote an exciting classroom environment. Moreover, the

competition-based environment of Kahoot can increase the motivation of the learners, thus improve their engagement in class.

Moreover, the immediate feedback system of Kahoot is one of its features which enhance students' learning (Cutri, Marim, Gil & Guerard, n.d.). In Canada, computer games increasingly become part of the daily activities of the students of all ages and have been shown to support student motivation and learning. Also, the incorporation of gamification elements for the post-secondary students motivated learners and supported academic achievement (Lister & College, 2015). Consequently, the literature shows little knowledge with the experiences and impression of the teachers and learners in utilizing Kahoot in Biology. The present study fills the gap in the literature by focusing on the effectiveness of Kahoot as an instructional tool in Biology.

This research on the integration of Kahoot in Biology is needed to understand better the experiences of the teachers and the learners using an online application in Biology classroom despite the country's weak Internet connection. In 2011, the Philippine government put a national strategy for improving Internet access, identifying education as a critical area that would benefit from ICT development (Garcia, 2016). Among the targets were all secondary schools and 80% of elementary schools in the country should have Internet access by 2016. This is an indication that the public schools in our country have big chances of having an Internet connection in the classroom. Internet access would help the teachers in incorporating digital game-based learning in their classroom context.

By understanding that teachers are digital immigrants and learners as digital natives, teachers can integrate Kahoot in their instructions to speak the learners' language. Thus, this research provides a deeper understanding of the teachers' and learners' experiences and impressions using Kahoot in Biology.

Significance of the Study

The present study was conducted to determine the effectiveness of using Kahoot in teaching and learning Biology. Specifically, it aimed to determine how the incorporation of Kahoot affect the learners in terms of conceptual understanding, engagement, and motivation. Furthermore, it was administered to determine the experiences and impressions of the teachers and the learners after using Kahoot. Thus, the outcomes of this study are valuable to the following stakeholders:

To the **students**, the employment of Kahoot would help them gain a better understanding of the Cell Cycle and cell concepts. The learners would learn the differences between Mitosis and Meiosis and their role in the cell division. The employment of Kahoot as a game-based technology can increase their conceptual understanding, engagement, and motivation through its gamified environment.

To the **teachers**, the introduction of game-based technology Kahoot would allow them to be more effective and efficient facilitators of learning. The use of Kahoot would help them to engage the learners, and increase their motivation and conceptual understanding. Additionally, the results of this study would help them modify their conventional teaching pedagogies and their teaching strategies.

To the **school heads and coordinators**, the result of the study would help them garner ideas on ways to improve the school's performance and achievement through the employment of various techniques which can enhance science instructions.

To the **educational technology experts**, the results of the study would help them create and design more game-based technology platform that would help the learners in understanding science concepts.

Lastly, to the **future researchers**, the results in this study would serve as a springboard in conducting a similar study in addressing issues and concerns with the incorporation of the game-based technology in teaching and learning Biology.

Literature review

A significant problem related to this study is the lack of qualitative research about the experiences and impressions of the teachers and the learners regarding the use of Kahoot in the classroom. Several studies have been conducted on the learners' utilization of Kahoot in the classroom (Licorish, Owen, Daniel & Li George, 2018; Pede, 2017; Plump & Larosa, 2017), yet little is known about the teachers' and learners' experiences and impressions in Biology for Grade Eight science. Therefore, the purpose of this multiple case studies was to describe how the integration of Kahoot in Biology classrooms affect the teaching and learning based on the constructs of SDT and TAM.

Educational Technology

Studies show that use of technology increased the academic performance, engagement, and motivation of learners. The employment of various educational technology such as computer-assisted instructional materials, game-based technology, virtual laboratories, and virtual environment in Biology education improved not only the academic performance of the learners but also the experience towards the subject.

The literature shows that game-based technology through Kahoot has improved the motivation of the learners. However, only a few studies investigated its effects on students' and teachers' experiences and impressions. The primary objective of the study was to determine the effects of using Kahoot in the teaching and learning Biology. Specifically, it aimed to investigate its effects on the learners in terms of their conceptual understanding, engagement, motivation, and to determine the teachers' and learners' experiences and impressions.

Computer-Assisted Instructional Materials

According to Pepper, Beckler, Schunn, and Revak (2016), computer-assisted instructional materials (CAIM) and simulation-based learning environment offer new opportunities for an authentic science classroom. These technologies allow the students to engage in inquiry activities that are otherwise feasible in a typical classroom setting. The investigation found the use of simulations effective to the learners, specifically in altering their perceptions of the authentic science process. Also, the use of sci-simulation improved their conceptual understanding of the subject.

Arcilla (2006) in his study about the development and evaluation of an interactive computer-assisted instruction (CAI) found that there was a need in CAI material on Earthquake and Volcanism in Elementary Science. Thus, the CAI material was found as a useful tool in the teaching and learning processes in science.

Virtual Laboratories in Biology

One of the ways to improve the teaching and learning process in Biology is the use of virtual laboratories in the classroom. Virtual laboratories allow the students to manipulate experiments by predicting, observing, and explaining the results of their experiments in a

simulation. Also, it allows the students to be engaged in the learning process through discovery, and experimentation with the use of a laptop or Internet. Virtual laboratories allow our learners to present essential science concepts, principles, and processes. Through the use of virtual laboratories, learners have the chance of doing an incorrect experiment again or to deepen the intended experiences (Tatli & Ayas, 2013). Moreover, the students become more engaged in the learning process by manipulating variables in the experiment. Also, it makes learning fun and exciting through the simulation. When the learners are more engaged, the more likely the learning experience is to be positive (Huang, 2004). Undergraduate and medical students have reported that virtual laboratories were fun, engaging, and helped them learn. This supports the idea that virtual laboratories support the teaching and learning process in a more engaging and fun way.

Trowbridge, Bybee, and Power (as cited in Guzey & Roehrig, 2009) emphasized that educational technology tools such as computers, probeware, data collection, and analysis software, digital microscopes, students response system, and interactive whiteboards can help the students actively engage in the acquisition of scientific knowledge. The learners become engaged actively in the construction of their knowledge and improvement of their thinking and problem-solving skills. According to Woodfield (as cited in Tatli & Ayas, 2013), virtual laboratories simulate a real laboratory wherein students convert their theoretical knowledge into practical knowledge by conducting experiments. The simulation of experiments or activities in a virtual laboratory helps the learners to construct their knowledge by letting them engaged in the activity. It is vital that the students are the ones who build his/her understanding of a particular science topic while the teachers facilitate the teaching and learning process through guiding the students in forming the concepts. Through this, teachers can practice a student-centered environment by challenging the learners to be responsible for their learning.

Bajpai and Kumar (2015), found that laboratory exposure in Physics crucial in developing the science process skills of the learners in the subject. The study explored the effectiveness of virtual laboratory to the undergraduate students who were taking up Laboratory in Physics. The study compared the virtual laboratory and the real laboratory in photoelectric effect and found that the virtual laboratory was more effective. In teaching Physics concepts, the use of virtual laboratory was recommended.

Maldarelli et al. (2009) recommended the integration of instructional video as part of the learners' preparation before an actual experiment. The study reveals that the incorporation of an instructional video has the potential to standardize the techniques in the laboratory. It was found out in the study that it promotes successful outcomes in the Physics experiment.

Digital Game-based Learning

The literature shows that the use of computer-assisted instructional material (CAIM) can improve the performance of the learners in Biology as well as in the other fields. Aside from this platform, the use of digital game-based learning has also emerged in educational settings. Digital game-based learning has evolved as the paradigm shift in the educational theories started. It is an indication that the design of digital game-based learning evolves the way our learners receive an education. In other words, learners are changing the way they receive new information. Our students are considered 21st-century learners, and they are more exposed to different technologies such as computer, tablets, mobile phones, and even social media. The trends in technology also shape how learners behave and receive information (Prensky, 2001). This is a calling to all the teachers to make a paradigm shift in the technology and teaching pedagogies. Thus, the utilization of game-based technology or digital game-based learning becomes a trend in education.

Bjørner and Hansen (2011) conducted a study on the design principles of an educational game on a holistic perspective, and the participants were teachers, pupils, and game designers. It utilized purposeful sampling and qualitative design in describing the difficulties encountered by the teachers and pupils when using an educational game. The teacher perceived that the use of educational game was crucial in motivating the learners, but aside from the fun it gives, game learning content should be taken into consideration. The teacher was also concerned about the content of the game that would be utilized in the classroom. Moreover, pupils perceived the educational game as a useful platform in learning, and also observed the technical difficulties that their teachers faced when utilizing educational game. The researcher formulated different principles in designing an educational game from the collected data. The principles include the incorporation of the educational game in the curriculum. There should be a balance between the learning content and the game. Second, a tutorial on how to manipulate the game should also be considered. The tutorial would help the teachers to master how to use the game quickly. The teachers, pupils, and game designers should be considered in designing game. Also, there should be synergy between the learning content and the game.

Gros (2007) examined the evolution of the design of video games. The researcher defined digital games as user-centered, promote challenges, cooperation, engagement, and the development of problem-solving methods. The study supports the use of digital games, showing an increase in the learning of Language and Mathematics. Gameboy was used as the platform of learning among the learners. It also discussed the evolution of video games and how it was used in the classroom. The author implies that the teacher has a huge role in implementing educational games in the classroom. The teachers' mastery or knowledge of the game will help him/her to determine how and when to use a game in the classroom. Besides, it also tells us that the knowledge

in the game can help the teachers contextualize digital games, especially with the kind of learners they have. The author differentiates e-learning from a game, e-learning focuses more on the content of the learning, whereas the game magnifies the effect of the game itself, where there is fun, competition, and enjoyment. The article emphasizes the balance between learning and game, and the content should not be compromised. There were few studies conducted on conceptual learning that the game-based environment brings. Also, few studies have investigated the integration of game-based technology in the daily lesson, especially with the use of the gamified environment in taking up formative assessment. This study gives us an idea on the unexplored portion of the game-based technology, especially to the teaching and learning in Biology. The teachers have a significant role in integrating digital game in the classroom, and this assumption serves as the springboard of the study to use game-based technology in teaching and learning Biology and determine how it affects both the learners and the teacher.

Integration of Kahoot

Kahoot is an online application widely used and accepted worldwide (Plump & LaRosa, 2017). Several studies show that the use of Kahoot in the classroom significantly improved the engagement, motivation, and learning of the learners (Pede, 2017; Plump & Larosa, 2017).

Licorish, Owen, Daniel and Li George (2018) explored the experience of third-year Information System students using Kahoot in the classroom. The study specifically aimed to investigate the experience of the learners and the Kahoot's features. Its elements flourish the classroom dynamics, engagement, motivation, and learning experience. The study utilized the explorative case study qualitative to unravel the learners' perceptions of the use of Kahoot. The learners and the teaching staff made the quizzes for a total of 13 lectures. The duration of using Kahoot was 30 minutes per session. A semi-structured interview was conducted with 14 learners

who agreed to participate in the said interview. The questionnaire in the interviews addressed the research problems in the study. The data were analyzed through open coding, axial coding, and thematic mapping. The primary themes yield in the study: fun and enjoyment, attention and focus, interaction and engagement, and learning and retention of knowledge. Among these themes, fun and enjoyment was an unexpected theme which explained the feeling of leisure and enjoyable distraction experienced by the students. The students found the use of Kahoot fun and helped them to have sustained attention and focus in the classroom despite the long and enduring lecture.

Moreover, Kahoot facilitated positive break among the students, which re-energized them and facilitated motivation in the classroom. The study provides insights on the use of Kahoot to the tertiary level and how it improved the teaching and learning among IT students. Its employment enhances the classroom dynamics, engagement, motivation, and learning of the students. It serves as an avenue for the teachers to incorporate game-based technology in the classroom for more sustained attention and focus of the learners. The findings imply that technology, specifically Kahoot, serves as a tool in enriching the classroom experience of the learners.

Pede (2017) explored the use of Kahoot in the classroom, specifically its effectiveness in the vocabulary acquisition of Grade Eight students with learning disabilities in Central New Jersey Suburban School. The researcher investigated the effects of using Kahoot in vocabulary acquisition, enjoyment, and ease of use. The data obtained from the scores in the assessment revealed that the use of Kahoot as an intervention enhanced the vocabulary acquisition of students with specific learning disabilities. The research design used was ABAB Multiple baselines across participants. There were only six participants, which become its limitation. Also, the time frame was limited, and the participants were exposed to technology before the implementation. The

results from the Likert-scale survey showed that all the participants found Kahoot easy to use, while 75% perceived that it helped them to remain focused on a particular task, 92% did not think that Kahoot was a form of distraction. This study supports the empirical studies using technology in the classroom. The findings from the investigation show that the learners found the integration of Kahoot helpful, enjoyable, easy to use, keep them on accomplishing a task and have the desires to share the technology to other learners. This implies that other researchers can look for another subject to explore using the game-based technology Kahoot.

In the study of Plump and LaRosa (2017) the quantitative data show that both the graduate and undergraduate students in business courses had a favorable impression with the use of game-based technology, Kahoot. 98.2% of the learners reported that they enjoyed playing Kahoot, 92.9% claimed that they found Kahoot easy to use, all of the students said that the use of Kahoot made the class more interactive, while 86.5% perceived Kahoot as a tool in helping them understand the concepts. This study shows that game-based technology, when incorporated in the classroom, serves as an avenue of an engaged and motivated classroom environment. However, some students reported that they could not think well due to its fast-paced transition. Moreover, the learning experience of the students showed that they were more motivated to learn; it encouraged them to debate the correct answers in the quiz and asked more questions to the teacher. The qualitative data obtained from the learners implied that the students look forward and feel excited to attend their class when they knew that there would be a Kahoot quiz.

According to Bolkan (2017), Kahoot is a game-based learning platform that allows the teachers to create their preferred learning games or utilize the available games online. The learners can answer games as homework which allow them to practice anywhere, anytime they would like, alone or with others.

There are several free digital game-based applications available online such as Kahoot, Class Dojo, Classcraft, and Socrative. The study of Bicen and Kocakoyun (2017) revealed that among these gamified applications, Kahoot was the most preferred application for gamification by the undergraduate students of Information and Technology. Android, on the other hand, was the most preferred operating system by the learners. The study emphasized that “Kahoot would be the learning platform of the future, and it should be integrated into the classroom activities” (p. 1).

A comparative study conducted by Cutri, Marim, Gil, and Guerard (n.d.) between the use of clickers and immediate feedback response system reveals that clickers were more expensive to use than Kahoot. This study discussed the different features of Kahoot, which include the following; multiple choice quiz, survey, and discussion. The questions can also be embedded by Video or image. The time limit of the question ranges from 5-120 seconds, which becomes the choice of the teacher. The free application requires the use of the Internet, which becomes the weakness of the platform. In this study, Kahoot was used in Physics I and II and Chemistry undergraduate students. The scores of the two groups were tallied. They were also asked to answer a survey regarding the use of game-based technology. Most of the learners had positive feedback towards the use of Kahoot and would like to recommend it to other learners.

Moreover, the use of cellphone also promotes motivation and increase learning since this is the trend of technology that our students have nowadays. Allowing the learners to use their gadget in the classroom can improve their learning and engagement. The use of cellphone which is a distracting tool during the lesson can increase engagement and learning. In addition to the above findings, it was also found out that the learners prefer to use Kahoot at the beginning and middle of the lesson because they were not yet tired by this time (Cutri et al., n.d.).

Gamified Learning Activities

According to Lister and College (2015), gamification is incorporating the elements of a game in a non-game context. Several studies show that gamification has improved the learning performance of the learners and academic motivation (Guanzon, 2017; Lister & College, 2015; Tolentino & Roleda, 2017).

The study explored by Guanzon (2017) proposed collaborative learning materials in Mathematics in a gamified environment. The study aimed to determine the effectiveness of the proposed collaborative materials in Mathematics in a gamified environment. The investigations to the forty-five Grade Eight students used descriptive analysis method to know the effectiveness of the materials. The results show a significant difference in the performance of the learners before and after using the proposed materials. The materials used with the incorporation of gamification increased the learning of the Grade Eight students in Mathematics. This study implies that teachers can design collaborative learning materials which promote teamwork among the learners, thus, enhancing learning. Gamification, on the other hand, is an effective way to stimulate the learners by giving points, ranks, and having leaderboards. Moreover, the findings in this study support the socio-cultural learning theory by Vygotsky. This theory indicates that collaboration and interaction among learners can enhance or improve learning.

Tolentino and Roleda (2017) made a detailed and exciting study which also incorporated gamification. The study examined the effect of gamification in learning physics and was anchored on self-determination theory (SDT). SDT claims that humans are inquisitive, active, and self-motivated. The results reveal out that gamification is a contributing factor in the achievement in Physics. The researcher determined the effects of a gamified environment to her Grade nine classes who were taking up Physics during the last quarter of the school year 2016-2017. The elements

used in the gamification were points, badges, leaderboards, rules or levels. The researchers gave a three-to-four quest in a day instead of the traditional method of teaching. The students were given points for accomplishing the quest given by the teacher either five hundred or one thousand depending on the complexity of the tasks. XP points were given to the learners who showed exemplary performance during the quest as well as to those students who behaved well. The XP points were one thousand points while the XP incentives were five thousand points. Each week, the leaderboards were updated for the top ten students who performed well, and they also received Facebook notifications. The data from the mean scores of the pre-test and post-test showed that there was an increase in learning.

Moreover, the researcher used a graph to show the increase in the quarter mark of the class. All of the classes improved in their quarter mark except for class C, which did not have a better performance based on the quarter marks. This study also demonstrated that gamification is an effective strategy in teaching Physics by motivating the learners to work hard and reciprocating their efforts and proper behavior in class. However, giving of points would not be enough, levels can be used effectively to make it more appealing to the learners,

Lister and College (2015) examined nineteen peer-reviewed journals from Google Scholar, Erick. The study aimed to determine the impact of gamification on post-secondary students in terms of their motivation and learning. Gamification involves the elements of points, ranks, badges, achievements, leaderboards, and competition. The nineteen sources were analyzed through a qualitative meta-analysis by identifying the elements of the game from 2008-2015. One out of the nineteen studies were from the post-secondary students. The results were discussed based on the different elements of gamification. A point is an element of gamification which is given to the learners for every correct answer, answered quizzes, and assignments.

The results from the analysis show that it enhanced the learners' motivation by providing immediate feedback system. Badges and achievements were also the elements found to be effective in increasing the motivation of the post-secondary students, especially to the low performing learners. However, some studies reveal that it has no or negative effects on the learners, especially to those students who do not like a competition-like environment. When it comes to leaderboards, some studies reveal that there was an increase in motivation while others were due to the competitive nature of the environment. The use of leaderboard was found to have no or negative impact on the motivation of the learners. The studies chosen did not provide further information in terms of its impact on learning. The common elements in gamification were points, badges, and achievements, and leaderboards. From the analysis, the participants became motivated when gamification was incorporated in their course or subject. The study also showed that not all students prefer competition.

The work of Cheong, Cheong, and Filippou (2013) focused on the impact of gamified learning activity on the learners' enjoyment, engagement, and learning, and primarily aimed to improve learning using software called QuickQuiz. The participants of the study were three undergraduate class of Information Technology (IT) courses. The gamified environment consisted of two parts: the first part was a player who was the student answering the quiz in a non-synchronized manner. The second part was the instructor role of discussing the graph showing the results of each question in the QuickQuiz. As the name implies, the player has a limited time of one minute to answer the given question. Formative feedback was given to the learners specifically in discussing their wrong answer on a particular question in the quiz. Through the feedback given by the instructor, learners became knowledgeable not to commit the same mistake during the formative assessment.

The work of Cheong et al. (2013) used a five-point Likert-scale in determining the level of enjoyment, engagement, and learning of IT technology courses. The data obtained from the survey showed that the learners found the gamified learning activity enjoyable, engaging, and helpful in enhancing learning. The results of the survey were: 46.05% found the QuickQuiz enjoyable, 77.63% perceived that they were engaged during the activity, while 60.53% learned with the use of QuickQuiz. One of the limitations of the QuickQuiz was the time limit for each question, which made it challenging to answer. Also, the items used in the QuickQuiz were classified as lower order thinking skills in Bloom's Taxonomy, such as recall and retention. It was recommended in this study to use higher order thinking skills in formulating questions, as well as, use the gamified learning activity as an activity only, and not as a formative assessment. Moreover, with regards to the participation, the researchers suggested that participation should be voluntary to retain its game-like nature to the learners. Overall, this study on QuickQuiz shows that gamified learning activity was effective software in enhancing the learning of the learners as well as enjoyment and engagement.

Teaching and Learning Biology

In the study of Lawsin (2017), it was found out that Transmission Genetics is one of the topics for the fourth quarter of the school year in the K-12 Curriculum Guide of Grade 8 with low conceptual understanding based on the survey conducted with the in-service teachers coming from the different schools in the National Capital Region. This topic was ranked number six, with the least mastered competency as perceived by the in-service teachers and ranked number 9 with several alternate conceptions. The reasons for this include the inability of the teacher to explain the lesson clearly, the complexity of the topic and time constraints.

Bird (2014) explored the different literature in Biology specifically to quantify the type and content of articles written about assessment identifying the problems of biology educators and discussing the solutions to it. The study aimed to document the trends in research about assessment in Biology. The study found out that exam or test was the most frequently discussed assessment form. Designing higher-order thinking skills questions was one of the primary problems encountered as well as developing critical thinking skills and self-regulating capacity to the learners. The researcher categorized the journal found in the web of science database in three ways: genre, assessment theme, and the nature of tasks. The most dominant genre was empirical studies, while the use of new technology in the assessment was the least. Multiple-choice exam remains the most effective assessment tool, and it is, therefore, essential to creating items which effectively improve critical-thinking skills as well as the content. One way to improve the engagement of the learners in administering formative assessment was the use of clickers, which also provided immediate feedback to the learners. Moreover, the use of Blooming Biology Tool (BBT) was anchored on Bloom's taxonomy and also suggested in analyzing and creating the cognitive level of a question specifically higher-order thinking skills. Overall, the study serves as a framework on how to create a formative assessment in Biology effectively where the learners are engaged and would develop their capacity in self-regulating their learning.

Sesli and Kara (2012) identified misconceptions in the topics cell division and mitosis, which is vital in solving the alternate conceptions of the learners in these topics. The study aimed to develop a two-tier multiple-choice item in order to know the understanding of the learners in cell division and reproduction. The researchers made a two-tier multiple choice questionnaire that was used in diagnosing the alternate conceptions of the Grade ten students in the province of Turkey. The information collected from the interviews were tallied and tabulated by the

researchers in creating a two-tier multiple-choice questionnaire. The first-tier assessed the learners' knowledge, while the second tier was an open-response system. The most frequent responses were used, as well as the data obtained from the interview. The development of a two-tier diagnostic test was the primary objective of the study and was made based on the list of proportion knowledge. The response of the students in the interview and the two-tier multiple-choice items were utilized by the researcher to make distractors authentic to the learners. The product which was the diagnostic test was a fourteen-item two-tier multiple-choice was created and administered to 403 high school students of the four provinces of Turkey. Item analysis was conducted in order to know the difficulty indices, reliability, discrimination indices, and the functionality of the distractors. The data obtained showed that the two-tier diagnostic test was reliable based on the data obtained using Cronbach's reliability. The difficulty indices show that there was a balance between easy and hard items. The first-tier obtained higher scores compared to the second tier of the test. This implies that the learners have knowledge but do not have enough scientific reasoning. Sesli and Kara (2012) pointed out that this kind of results show that learners have alternate conceptions. The alternate conceptions can be attributed to the reasoning of the learners. The teleological is one of the reasoning that the learners practice when explaining scientific facts. This kind of reasoning of the learners was due to their lack of understanding in the subject or phenomenon, as well as the inability to explain concepts correctly. Also, the knowledge about it can help the teachers identify the learning difficulties as well as the misconception in Biology lessons.

Conceptual Understanding

According to Ferido (1995), students' conceptions are formed through a process of interaction between the students' cognitive system and their physical and social environment. They

are inclinations which are incorporated in acts such as experiencing, perceiving, or conceptualizing something. Also, they are specific to a particular phenomenon. The understood phenomenon may vary from an individual to another or between tasks, but the structure of understanding of a specific phenomenon to which those tasks relate do not.

Chin (as cited in Ferido, 1995) stated that meaningful understanding is evidenced by a learner's ability in various situations. It enables one to integrate all these situations and to "see" them as essentially the same knowledge presented. Moreover, conceptual understanding differs from problem-solving. A student may pass an assessment in problem-solving without conceptual understanding. Also, conceptual understanding may be gauged in an array of contexts.

Learning is not repeating the knowledge of other people. Obtaining a passing mark in the school examinations without appropriate conceptions of the knowledge serves as challenges and responsibilities for the teachers. "Changing the nature of students' learning demands changing teaching practices and changing conceptions of learning and teaching" (Ferido, 1995, p. 15).

Ramsden (as cited in Ferido, 1995) provides a view of learning, which has the following aspects: (a) learning is about modifying conceptions. This learning is about the quality of an individual's understanding and not the quantity of information he/she can reproduce on demand. It entails a transformation in an individual's way of conceptualizing something. (b) Learning always has content and a process. (c) Enhancing learning is about connections between learners and subject matter. It involved the explorations of the students' conceptions of subject matter and how these can be changed. A conception always has two parts to it: the idea being conceptualized and the person doing the conceptualizing. (d) Enriching learning is about understanding the students' views. A student's performance on different tasks may vary, not because of weakness in teaching but because of factors that derive from his perceptions and experiences.

According to Gabel (2003), the aims of science education at all levels should be conceptual understanding and scientific inquiry. Unfortunately, segments of population equate science achievements with how the students perform in science exams Goodland (as cited in Gabel, 2003). This reduces science to rote learning and becomes annoying to the learners. In promoting conceptual understanding in science, teachers must be selective in the concepts to be included in the instructions. Also, teachers should use various teaching approaches such as Science, Technology and Society STS, learning cycle approach, jigsaw approach, collaborative learning, analogies, wait-time, concept-mapping, inquiry, and mathematical problem-solving. These strategies can promote conceptual understanding of science by making science concepts relevant to the learners.

Academic Performance, Engagement, and Motivation

Smith (2014) explored the use of virtual science computer game from Arizona State University. The investigation reveals that there was significant learning based on the results of the pre-test and post-test of the students. The mixed-method study also investigated the engagement and the 21st-century competencies of the learners after utilizing the virtual environment. The results of the investigation reinforce the effectiveness of game-based learning through having engaged and motivated students. Moreover, the 21st-century skills that became evident based on the observations of the teachers: collaboration, problem-solving, critical thinking, inquiry, and global awareness.

Tan and Waugh (2013) conducted a study among the male students in Singapore, and the participants found Molecular Biology challenging to understand, intimidating, abstract, requires rote memorization, and crucial where visualization is needed to understand. This study suggests the use of technology in teaching and learning the subject and found a significant increase in

learning through the use of the virtual environment. The use of visualization in learning Molecular Biology was known to be critical and should be addressed by the teachers.

Shawaqfeh (2015) made a study somehow related to the study of Lister and College (2015). The study also analyzed 11 articles focusing on the effects of gamification and found out that gamification may help pharmacy students to better prepare in real-life scenarios. The research reveals that gamification or injecting game elements in the curriculum improves the students' engagement and learning. The study shows that learners in the field of medicine, pharmacy, nursing, and psychology gained more confidence when their knowledge was applied in real-life situations. The investigation lasted for six weeks; the control and experimental group were assigned randomly, mostly were pharmacy students. The students in the experimental group were asked to play Nintendo video games for four weeks, while the control group did not. The students were asked to answer a pre-assessment before the implementation of the study, and they answered the same test on the sixth week. Also, the students were asked to answer the VARK test, which assessed their learning preference: visual, auditory, kinesthetic.

Moreover, a twenty three-item open-ended questionnaire was also given to the learners to determine their experience with regards to the use of the game. Overall, the implementation of gamification into the pharmacy curriculum enhanced learning and classroom engagement. The study of Shawaqfeh (2015) supports the use of gamification in the classroom, as it enhances not just the learning but also the confidence of the learners to apply their knowledge in real-life situations.

Cervantes (2016) investigated the learners' understanding of the cell concepts in genetics, such as mitosis and meiosis to two intact homogeneous groups. The researcher used the web-based inquiry science environment (WISE) technology and found that there was an increase between the

pre-test and post-test of the experimental group. WISE technology was found to be an effective tool in making the concepts in science meaningful to the learners through inquiry-based learning.

Leoveraz (2014) stated that the exposure of the undergraduate students in the web-based module in Circulatory System resulted in a significant increase between their pre-test and post-test. There was no significant change on the before and after the exposure to the material in terms of the learning styles dimension specifically on the active/reflective and sensitive/intuitive ($p < 0.05$). However, there was a significant change in the learners' visual/verbal learning styles. The learners viewed the web-based module as an accessible learning tool that can help them enhance their academic performance. Moreover, the students' computer attitude before the web-based module exposure was found to be correlated with their academic achievement.

Zapanta (2006) explored the use of web-based computer-assisted learning language (CALL) and found to have no significant difference in the language skills of the learners such as listening, comprehension, and vocabulary development. However, the learners who were exposed to the Web-based CALL had higher progress in terms of reading comprehension than the control group who were instructed with the lecture method.

The study of De Asis (2004) on the effects of the web-based resources as a tool in learning the mole concept in Chemistry, yielded improved performance of the learners using a validated ten-item multiple choice questionnaire. The attitude and the perception of the learners were also collected using a questionnaire and interview, and the results suggest that the learners were motivated in solving problems using the materials.

Case Study

Merriam (2004) defined a case study as the search for meaning and understanding; it

gathers information about human behavior through the unique, in-depth collection, and analysis of data. This type of descriptive research method utilizes the content analysis of documents and records, including the observations and interviews which serve as primary instruments of data collection. It refers to an individual, a program, a group, an institution, a community, or a specific policy. Miles and Huberman (as cited in Merriam, 2009, p.25) defined a case as “a phenomenon of some sort occurring in a bounded context.” A case study is also defined based on the research process “a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not evident” (Yin, 2009). Moreover, a case study is used when the main researcher questions are “how” and “why” and when he/she has little or no control over behavioral events. It focuses on the study of a specific phenomenon.

Conducting Case Study Research

A case study is used to contribute knowledge to individual, group, organization, health, and education. Yin (2009) discussed the definition of the case study, research questions, data gathering, and how it differs from other types of qualitative designs. It seeks to identify whether a case study can be used in the evaluation.

The case study is soft research. It does not necessarily contain the accurate or complete rendition of actual events in teaching. Yin (2009) highlighted that a case study is not used as a form of recordkeeping, though a case record or case evaluation may follow the same procedures. Merriam (2009) described how a particular topic becomes a “case,” which becomes the focus of the investigation. When the phenomenon, the researcher is interested in, is not intrinsically bounded, it is not a case.

Moreover, different fields which conduct a case study have a different procedure of collecting and analyzing data (Yin, 2009). Relationships among the methods are not hierarchical. The kind of research questions found in the case study requires the behavior of events and their focus. This indicates that in conducting a study using a case study, “how” and “why” the kinds of questions posed by the researcher. It also shows that a case study method does not manipulate the behavior of events or the participants, unlike the experimental method, which controls it. A case study is preferred when examining events without taking control of it. Furthermore, the behaviors of the participants are not controlled.

To determine whether a particular topic is bounded, the researcher needs to look at the number of participants or to see how finite the data collection would be. When the data collection is finite, then, it cannot be considered as a case. The limited system or a case might be selected because it is an instance of some process, issue, or concern. The “case” is identified as a bounded system. The most straightforward examples of “bounded system” are those in which the boundaries have a common sense or obviousness, for instance, a teacher, a student, a single school, or perhaps an innovating program Adelman, Jenkins, and Kemmis (as cited in Merriam, 2009).

Some researchers believe that a case study requires a thick and rich description of a phenomenon, but according to Gertz (as cited in Yin, 2009) case study need not always engage in the thick description or detailed observational evidence that makes most of the qualitative designs.

Strengths of a case study

A case study does not claim any particular method for data collection or data analysis (Merriam, 2009). Any methods of data gathering from testing to intervening is possible in a case study. There are direct sources of evidence such as interviews and observations which can be

conducted to the persons involved in the situations. The case study deals with a full variety of pieces of evidence, documents, artifacts, interviews, and observations (Yin, 2009).

This qualitative research design focuses on a “case” while retaining a holistic and real-world perspective, such as school performance (Yin, 2009). Merriam (2009) agreed to Yin (2009) that the case study focuses on holistic description and explanation. This shows that this design does not investigate with limited views about a subject, but the researcher substantially and comprehensively explains it through observations and interviews.

It is an empirical inquiry that investigates a contemporary phenomenon (the case) in-depth and within its real-world context, especially when the boundaries between phenomenon and context may not be evident. This means that a researcher dwells on case study to have an understanding of a real-world case and assume that such understanding is likely to involve important contextual conditions pertinent to the case (Yin, 2009).

Unlike other types of methods which has limited variables and controlled situation, this method may have more variables embedded on a situation and uncontrolled situations. It is not only a qualitative research method but can also become quantitative. This serves as a reminder that a case study is not confined to words and texts but can also be used in a quantitative design.

It focuses or more interested in gaining insight, discovery, and interpretation than hypothesis testing (Merriam, 2009). It contributes to a new body of knowledge to the people, group, organization, school, and others. Instead of concluding manipulating a variable, a researcher can make his or her interpretation, and insight in a phenomenon. This means that numbers are not the only means to make insights but also from the context, themes, and meaning which are interpreted by the researcher.

Furthermore, a case study can be used in conducting evaluations because it can illustrate specific topics within an evaluation descriptively. Also, it may enlighten a researcher in some situations in which interventions being evaluated have no clear, single, and set of outcomes.

Special features of the case study

Merriam (2009) described qualitative case studies as *particularistic, descriptive, and holistic*. A. *particularistic* case study is more specific in studying a particular phenomenon. The focus of this method lies in a specific situation, event, program, or a phenomenon (Merriam, 2009). The particular case itself is crucial for it reveals the phenomenon, and for what it might represent. The “specificity” of focus makes it especially good design, especially for practical problems. Merriam (2009). B. A *descriptive* case study provides a rich and thick description of a particular person, group, organization, school performance. The “thick” and “rich” description of the phenomenon becomes the ultimate product of a case study. The “thick description” is a term from anthropology which means “complete,” an accurate description of the incident or entity. Case studies have as many variables as possible and observe their interaction in a short period. C. *Heuristic* case studies explore without limiting the behavior of the participants or controlling the situation being investigated. Case studies illuminate the readers’ understanding of the phenomenon under study. They can bring about the discovery of new meaning, extend the readers’ experience, or confirm what is known (Merriam, 2009).

The three special features; particularistic, descriptive and heuristic, make a case study good research design in investigating a single entity, specifically, when the researcher wants to gain insight, discovery, and knowledge from a phenomenon. These unique features make a case study a preferable design in conducting a study depending on the research questions that the researcher wants to explore (Merriam, 2009).

Aside from its unique features; particularistic, descriptive and heuristic, Stake (as cited in Merriam, 2009) claimed that the knowledge gained from a case study is different from other research knowledge in different ways. Case study knowledge is: *a. more concrete*. Case study resonates with our own experience because it is more vivid, concrete, and sensory than abstract. This becomes possible from the multiple sources of evidence which the researcher may utilize, such as observations, interviews, and others. *B. More contextual*. The knowledge gains from the studies are rooted in the context of the phenomenon. *C. More developed by the readers' interpretation*. When the reader reads the results of the case study, the reader can bring his or her experience and understanding which can lead to the generalizations of new data for the case is added to the old data. This means that the interpretations, insights, and discoveries from the case study depend on the readers' interpretation and analysis. *D. Based more on reference populations determined by the reader*. The reader participates in extending generalizations to reference population Stake (as cited in Merriam, 2009).

Overall, the literature provided above shows that the strengths of the case study outweigh its limitations. The limitations of the case study may discourage us not to use it, but as the literature provides more comprehensive details on its strengths and unique features, the researcher may consider that the strengths discussed above may outperform its limitations (Merriam, 2009). Furthermore, the strengths of the case study give us an idea of why the qualitative case study is a good research design in exploring a phenomenon. Although there are limitations, there are more exciting and unique features that a case study has, such as thick and rich description providing us with the exact results of the study.

Self-determination Theory (SDT)

The children whose parents are supportive and let their children choose or decide on their own with enough supervision tend to have a feeling of autonomy. They have more interest, enthusiasm, and energy to perform tasks. The children's intrinsic motivation enhance due to the autonomy that they experience; this implies that parents and teachers should balance their role in nurturing the children. The children or the learners should not be controlled in choosing and making a decision; instead, they should experience the feeling of autonomy over things. Deci and Ryan (2000) stated that a controlling environment lowers the intrinsic motivation of the learners. Also, when a particular behavior is imposed on them, they tend not to do it or become amotivated.

According to de Charms (as cited in Deci & Ryan, 2000), the feeling of competence is not sufficient to increase the intrinsic motivation (IM) of a learner believed that a sense of autonomy should accompany it. IM is evident when a learner feels competent and at the same time experiences his/her behavior as self-determined. However, deadlines, incentives, pressured evaluation, and important goals also diminish IM.

On the other hand, the following may improve the IM: the feeling of a having a choice; acknowledgment; and opportunities for self-direction. Deci and Ryan (2000) stated that there are things that allow the learners to have a greater sense of autonomy by letting them make a decision and receive commendation from the people around them.

A study shows that teachers who give autonomy to their students were found to have greater IM, curiosity, and desire for challenge. However, the learners who do not have a sense of autonomy; those who are controlled by the dominant teacher in the classroom tend to have less

initiative, especially when the lessons require complex concepts. Similarly, the children whose parents practice autonomy and supportive have more IM than those who do not.

Cognitive Evaluation Theory as a sub-theory of Self-Determination Theory indicates that IM is inherent and vital to everyone. IM is like an internal force that drives the learners to pursue or perform something because they like it, they choose it, and they can relate with others while doing it. The knowledge about the CET gives us an overview of the importance of autonomy, competence, and relatedness, especially when dealing with the learners. They are innate, universal, and essential (Deci & Ryan, 2000).

Extrinsic Motivation

Intrinsic motivation (IM) is not the only kind of motivation that a person has. Deci and Ryan (2000) discussed the role of extrinsic motivation in the behavior of persons. SDT explains that a particular behavior can be imposed on a learner, but it does not necessarily mean a total change or acceptance overnight. The behavior can be observed depending on how they are *internalized and integrated* by the learners. Internalization from the word itself internalizes, the learners should internalize any imposed behavior or “taking in” as part of them. Integration, on the other hand, refers to the transformation or change of the behavior. The transformation of behavior only happens when the learner successfully synthesized the imposed behavior to his or her personal beliefs and values (Deci & Ryan, 2000).

The Five Classifications of Externally Motivated Behavior (Deci & Ryan, 2000)

Organismic Integration Theory (OIT) is another sub-theory of SDT, which was termed by Deci and Ryan (2000) as *extrinsically motivated behaviors*, which is somehow autonomous. The OIT discussed further the different classifications of these behaviors and how they are influenced

by external factors. 1. *Amotivation*. The state of having no intention to act, which result in not valuing the activity or not feeling competent to do it. 2. *Externally regulated*. The behavior that a learner demonstrates is driven by an external factor such as a reward. This kind of behavior, according to OIT, is controlled or alienated, meaning there is an external factor which controls the learner's behavior. Learners whose behavior are controlled by reward or external factor have lower interest and therefore have diminishing IM. The behavior of the learners, when regulated externally, show a lesser IM (Deci & Ryan, 2000). 3. *Introjected behavior*. This kind of behavior is performed to avoid the feeling of guilt or anxiety or to retain the ego or pride. This involves regulation or control from others, but the learner does not entirely accept it as its own. The behavior is intrapersonally controlled, which means that change or acceptance of behavior comes from the others. It shows that behavior is affected by factors such as reward or incentives. While interpersonally controlled indicates that the change in behavior comes from the learner itself. 4. *Regulation through identification or identical regulation*. The behavior shows identical regulation somewhat internal. The learner identifies a behavior and accepts it or owns it as personally meaningful. It means that a learner has accepted or valued a behavior within himself or herself, but it does not mean that it is associated with his or her values. 5. *Integrated Regulation*. This kind of behavior was considered as the "most autonomous." Deci and Ryan (2000) used the term "integrated" which means that the imposed behavior is assimilated and accepted harmoniously with the other set of values and needs of the learners. The behavior of the learners, according to OIT, resembles the intrinsically motivated learners. This happens when the basic psychological needs of autonomy, competence, and relatedness are met. However, OIT emphasized that the behaviors which are integrated are still considered EM though it is almost like IM. This kind of behavior is a higher form of EM. The self-determination continuum of Deci and Ryan shows that

behavior under integrated regulation is somehow near the IM (See Figure 1). The continuum of self-determination tells us that an individual continuously internalizes the directive of other people, its assimilation takes place; therefore, new behavior is acquired, or the transformation of behavior happens. In the classroom, learners who are externally regulated, wherein their sense of autonomy is removed from them are more likely to reject a behavior or show no interest at all. Furthermore, the kinds of extrinsically motivated behavior also demonstrate different outcomes to the learners (Deci & Ryan, 2000).

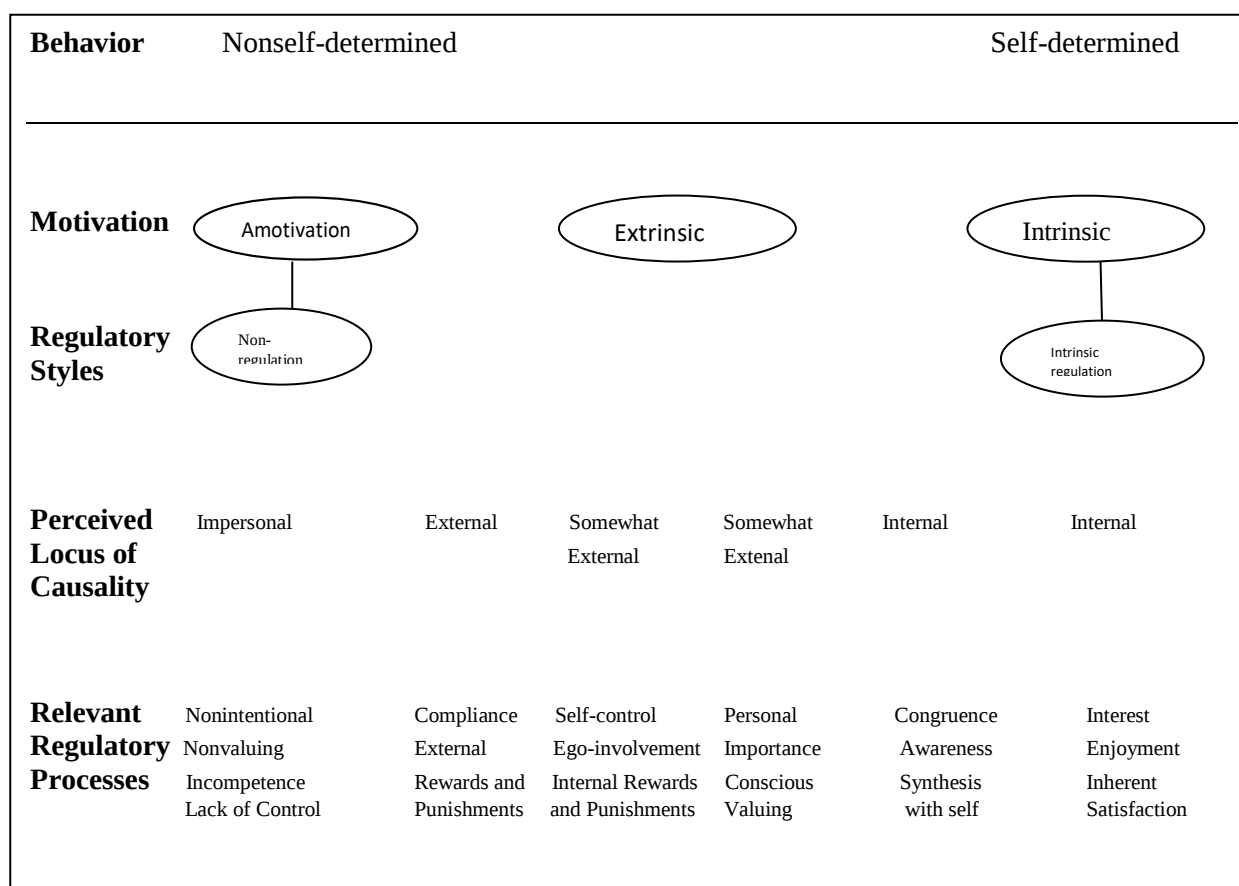


Figure 1: A Taxonomy of Human Motivation (Deci & Ryan, 2000, p. 61)

Figure 1 shows the behavior of an individual which can either be non-self-determined or self-determined; the kinds of motivation influence the behaviors that a person has. The diagram

shows that the amotivated individual has a non-self-determined behavior characterized by the lack of energy, initiative, and enthusiasm to perform a task. The regulatory styles demonstrate how the motivation is controlled or regulated by individuals, the regulation imposed can be non-regulated, regulated externally, introjected, identified, and the most autonomous of all is *integrated*. Intrinsic motivation is intrinsically regulated, meaning the control of the behavior comes from the person. Similarly, the diagram classifies the *perceived locus of causality*, it describes the influence of the behavior to a person and how it is perceived; impersonal, external, somewhat external, somewhat internal, and internal. The *perceived locus of causality* that a person may possess therefore influences his or her behavior. From the left, it shows that amotivation demonstrates non-intentional, non-valuing, incompetence, and a lack of control. The diagram shows how the behavior progresses and how it improves from lack of interest to perform a task to a lot of energy and interest to accomplish a task which is affected by the kinds of motivation that a person have.

Overall, the study of Deci and Ryan (2000) reveals that the learners' behavior in the classroom is affected by the kinds of motivation they have. Furthermore, the basic psychological needs such as autonomy, competence, and relatedness when adequately felt or experienced by the learners can significantly improve the intrinsic motivation, thus, improve their interest and performance in a subject. These basic psychological needs can be compared to our basic need, such as food. A healthy individual who prefers a well-balanced meal every day can acquire good health and well-being. Similarly, when persons acquire basic psychological needs, this can result in well-being as stated by Deci and Ryan (2000). These needs contribute a lot on how the learners in the classroom perform either they show interest or no interest at all. The teachers have a massive role in helping learners internalize and integrate behavior. When they practice supportive autonomy by letting the learners decide on their own, for instance, in doing an activity they feel

that they have the autonomy, intrinsic motivation increases. However, when a teacher-centered environment dominates the classroom, the classroom becomes dull and static. Moreover, relatedness and competence are also important factors to consider in increasing the IM of the learners. Learners' IM improve when they feel they are competent and supported by those people around them.

The study of Deci and Ryan (2000) gives us the idea that extrinsically motivated behavior ranges from non-valuing, incompetent to the highest form of Extrinsic Motivation (EM) which includes the congruence, awareness, and synthesis with one's self. The teacher has considerable responsibility in the internalization and integration of behavior, thus directly affecting the learners' motivation.

Competitive Situation increases the Intrinsic Motivation (IM)

The IM is affected by the three elements of competitive situations, namely; competitive set, competitive outcome, interpersonal context, Reeve and Deci (2000). In the study of Reeve and Deci (1996), SDT says that any event that affects one perceived competence, for instance, self-determination would affect intrinsic motivation. The external events can influence perceived competence, which depends on their informational aspect and perceived self-determination via their controlling aspect. Some studies have found that competition facilitates IM (Reeve & Deci, 1996). This takes place when a person perceived a challenging competition which flourishes IM. In other words, Deci (as cited in Reeve and Deci, 1996), for an activity to be considered as intrinsically motivating, the tasks should be optimally challenging "one simple way to find a challenge is to enter a competitive situation," (p.50). The competition itself, which is independent of the outcome might enhance IM because the perceived challenge can mediate the effect (Reeve & Deci, 1996). Competence valuation refers to placing value or importance to the task that a person

is doing or accomplishing. Doing well in a particular task can generate competition, which is an active involvement in the task that can enhance the task meaningfulness. Deci (as cited in Reeve & Deci, 1996, p.24) stated that “positive feedback enhance competence, therefore enhances IM, because it is a positive informational aspect. However, according to Fisher and Ryan (as cited in Reeve & Deci,1996), it was found out that positive feedback only enhances when the situation is non-controlling.

The study of Deci, Betley, Kahle, Abrams, and Porac (as cited in Reeve & Deci, 1996) investigated how competition vs. non-competition affects IM. The directions given to the participants in solving puzzles were, “*try to beat the other person,*” which indicated a competitive set,” while the others were instructed to “do their best,” which showed a non-competitive set. It was found out that the participants who experienced competition, found the situation, “controlling,” thus decreasing IM. A follow-up study of Vallerand, Gauvin, and Halliwell (as cited in Reeve & Deci, 1996) replicated the study in which it was found out that the competition for prizes, undermines children’s creativity which is positively related to IM.

The study of Reeve and Deci (1996) compared the elements in the competitive situation and how it affected the IM. The goal of the study was to know how the elements of a competitive situation affect IM. There were three competitive elements which were explored in the study: competitive set (competition vs. noncompetition); competitive outcome (win or lose); and interpersonal context (controlling vs. noncontrolling).

The study of Reeve and Deci (1996) shows that the elements of competition: winning (relative to losing) and interpersonal context (noncontrolling); and competence valuation (putting a value to the task a person engaged with) nourish IM. Also, it was found out that participants

found competition not challenging without any feedback about the outcome. Lastly, a challenging task increases IM.

The studies presented above support the present study in realizing the importance of motivation. Through the integration of the game-based technology Kahoot motivation flourishes. Specifically, it aimed to investigate the presence of the competition elements such as competition (noncontrolling), enjoyment, and immediate feedback and how it affected the learners in Biology class. This serves as the framework of this study, to facilitate the EM to the learners through providing a non-controlling, non-threatening, fun-filled classroom environment through the integration of game-based technology in Biology. When EM ranges from its highest form, IM also increases, thus resulting in the better, energetic, classroom.

Technology Acceptance Model (TAM)

The present study was also anchored on the Technology Acceptance Model (TAM) of Gu, Zhu, and Guo (2013). TAM aims to determine the acceptance of using technology and how it affects learning in the classroom. The model was linked to Information and Communication Technology (ICT) and more recently on the educational technology.

Outcome Expectancy

According to Gu et al. (2013), outcome expectancy or performance expectancy is the most critical predictor of using technology. The word “outcome” refers to the individual’s acceptance of technology based on its usefulness or the use of technology itself. Gu et al. (2013) asserted that ease of use, usefulness, advantage, and the implementation of technology contributes to the outcome. The expectancy may either be a positive or negative experience which depends on how simple the technology is operated and how effective it is in accomplishing a task.

Task-Technology Fit (TTF)

The second element of TAM which refers to the degree to which a technology assist an individual in performing the tasks based on the benefits the persons may receive using the technology. The TTF served as an essential component of TAM as it describes the person's preference to use the technology based on its potential advantages in task performance or completion. Moreover, it describes how user-friendly technology is in increasing a persons' productivity.

Social influence

The third element of TAM, which describes the degree to which individual views social factors such as teachers and peers or social influence, to have a significant favorable influence on individual beliefs about the usefulness of the technology. It refers to the beliefs of other persons that a person should integrate technology, and this decision depends on the social circle or kinship with other people. This indicates that social influence is a factor in incorporating technology and has an impact on the belief with the use of technology.

Personal Factors

The fourth element of TAM is personal factors. According to Gu et al. (2013), personal factors are described as computer and technology self-efficacy and personal innovativeness. *Self-efficacy* is described as the belief to one's capability in doing particular behavior while *personal innovativeness* is known as the degree to which a person is willing to strive technology.

Engagement

Motivation and engagement are both essential to the learning of the learners. Motivation is defined as the energy and the direction, and the reasons for the behavior, engagement, on the other hand, is described as energy in action, the connection between the activity and the person (Saeed & Zyngier, 2015). Engagement like the motivation consists of a continuum from authentic engagement to rebellion. According to Schlechty (2002), engagement is demonstrated by the high interest of the students despite the difficulty, the activity is personally meaningful to the students, and the activity is challenging yet accomplishing it is something worthy of doing. The students' engagement in a particular task varies depending on whether they find it interesting or not. Schlechty (2002), pointed out that any student will be engaged in different ways in different tasks at times, even concerning the same task. To better understand engagement, a rubric was developed in assessing the engagement of the students *from authentic engagement, ritual engagement, passive compliance, retreatism, and rebellion*.

Authentic Engagement

Students who are authentically engaged find meaning in performing a task, wherein the meaning is related to the ends or results of what is truly significant to the students. The students are willing to accomplish tasks despite the lack of excitement in doing it; this is because they know the association of doing and its consequences. For instance, a student who wishes to become a singer may find rehearsals repetitive, but because they know the result of practicing it he or she perseveres in doing it even there is a lack of excitement.

Ritual Engagement

A student with ritual engagement responds this way, “Tell me what to do and I will do it, no matter how meaningless it is to me.” The student works and carries out the tasks, sometimes with conscientiousness and persistence; however, there is a lack of association from the task itself.

Passive compliance

The term compliance is linked to carrying out the task for the sake of doing it, but there is no high commitment and enthusiasm to do it. Minimums and accommodations are given more emphasis than the accomplishment itself. The student is more likely to be motivated, but he or she is only trying to avoid any negative result of not doing the tasks.

Retreatism

The student is disengaged and does not incline to do work despite the negative consequences of his or her actions. Considerations such as the need for passing grades or peer approval are not compelling to this kind of engagement.

Rebellion

The student responds through rejecting the tasks, refusing to comply, and more often lack the willingness to be passive about his or her failure to comply.

Synthesis

The use of different educational technologies such as computer-assisted instructional material, web-based instruction, virtual laboratories, simulations, and game-based learning increase the academic performance, engagement, and motivation of the learners in Biology. In summary, the use of computer-assisted instructional materials (CAIM) was found to be effective

in providing authentic science classroom to the learners, thus, improved learning. The literature also recommends the development of CAIM in other subjects based on the perception of the learners. When technology is integrated into the lessons, the learners become more engaged, participative, and increase their academic performance. Also, the learners found the use of virtual laboratories or simulation interactive, fun, and helpful in understanding complex topics in Biology. Learners become more engaged in acquiring scientific knowledge and concepts; thus, improve critical-thinking and problem-solving skills Trowbridge, Bybee and Power (as cited in Guzey & Roehrig, 2009).

As our learners evolve the way they receive information, the digital-game based learning takes its role in the paradigm shift of the educational theories. The educational theories tell us that learners were once passive and only receiver of knowledge without involving themselves in the teaching and learning process; however, as time progresses, the learners' role changes also. The learners become active in the learning process, and their interest and motivation to learn change as well. The use of digital game-based learning serves as a platform in engaging, motivating, and improving the conceptual understanding of the learners. The review of the literature reveals the lack of study with the integration of game-based technology Kahoot in the Philippine setting. The Filipino students have access to the technology yet, lack the opportunity to use them in the classroom as a tool for a more exciting, fun, and engaging experience. The present study sought to explore how the incorporation of the game-based technology Kahoot affect the teaching and learning in Biology in terms of students' conceptual understanding, engagement, and motivation. Moreover, the learners' and the teacher' experiences and impressions were also investigated. Overall, a need still exist to determine the teachers' and learners' motivation as well as technology acceptance using Kahoot in Biology classroom.

Purpose of the Study:

This study investigated the use of Kahoot in teaching and learning Biology. The following questions guided this study.

1. What are the learners' conceptual understanding, engagement, and motivation after using Kahoot in Biology?
2. What are the experiences of the teachers and the learners after using Kahoot in their Biology classes?
3. What are the impressions of the teachers and the learners after using Kahoot in their Biology classes?

Conceptual Framework

The present study on the integration of Kahoot in teaching and learning Biology was anchored on the Self-Determination Theory (SDT) by Ryan and Deci (2000) and Technology Acceptance Model (TAM) modified by Gu, Zhu, and Guo (2013). The first framework, SDT, describes the origin of motivation and how it flourishes through changing the environment of the person. SDT entails the kinds of motivation which include intrinsic, extrinsic, and amotivation.

Self-determination Theory (SDT) is concerned towards definite developmental tendencies, as well as the examination of the environment of the individual. This theory focused on human motivation and personality but limited to the origin of the motivation. The study of Ryan and Deci (2000), aimed to examine factors which contribute to the enhancement or diminishment of motivation to the individuals and how the social environment affects it. The specific objective of the review was to explore intrinsic motivation as a prototype and manifestation of the human

tendency toward learning and creativity. Also, the study analyzed the self-regulation, which is concerned about how people take in social values and extrinsic factors that can change the personal values and self-motivation of a person. Lastly, it analyzed the psychological need fulfillment on health and well-being.

Motivation, as defined by Ryan and Deci (2000), deals with energy, direction, persistence, and equifinality, which are the aspects of activation and intention. Motivation in the field of psychology is the core of biological, cognitive, and social regulation. It was given much value because of the consequences it brings to the people. Motivation produces and since motivation can be produce, this becomes the concern of the teachers, religious groups, health provider, parents, and anyone involved in mobilizing others. People can be urged to take action because of the interest they have doing an activity or because of the bribe that they can get. The review highlighted that authentically motivated people are characterized by having more interest, excitement, and confidence, which can be observed both as enhanced performance, persistence, and creativity. The study reveals that humans are naturally motivated intrinsically; however, this condition is not permanent; it can either be enhanced or diminished depending on the environment of the individuals. This study focuses on how to sustain motivation and how it affects the health and the well-being of a person.

According to Ryan and Deci (2000), there are different kinds of motivation, intrinsic, extrinsic, and amotivation each differs in terms of their origin and how it raises or decreases which is affected by the persons' environment. Intrinsic motivation is inherent, meaning it comes from within the person. An intrinsically motivated individual tends to perform a task with high energy, willingness, and confidence. This kind of motivation is present to a child when born and can either flourishes or diminishes depending on the environment where the child is exposed. Cognitive

Evaluation Theory (CET) is a sub-theory of Self Determination Theory (SDT) which focuses on the intrinsic motivation of the individual. Aside from intrinsic motivation, it was theorized that extrinsic motivation exists in individuals.

Extrinsic Motivation (EM) unlike the intrinsic motivation (IM), which is inherent is based on the outcome and the visible reward that a person can get from performing a specific task. EM is based on another sub-theory of Self Determination Theory (SDT), which is the Organismic Integrative Theory (OIT). OIT describes the complex form of EM which has several classifications. Some factors, such as internalization and integration, affect the EM of the individuals. Internalization is defined as “taking in” or making a behavior imposed by other people part of you. Integration, on the other hand, deals with the transformation or change that can take place to an individual when specific behavior is combined with the set of values that a person has. The study highlighted that in order for specific behavior imposed by others to be internalized and integrated fully to a person, psychological needs have to be met, such as autonomy, relatedness, and competence.

There are three basic psychological needs of humans which influence motivation. (1) *The need for personal autonomy*. Autonomy refers not to being independent, but instead, it speaks of the free-will or the power that a person has in making a decision or a choice for himself or herself. The decision is a personal choice and not dictated by a teacher, parent, or coach. The proponents of the Cognitive Evaluation Theory imply that the person’s intrinsic motivation increases as he/she gains autonomy over his choices or decision (Ryan & Deci, 2000). (2) *The need for competence*. Competence deals with the ability of the individual to put importance in doing well. This kind of psychological need gives a person a sense of satisfaction when a task is accomplished; thus, increasing intrinsic motivation. (3) *The need for relatedness*. Relatedness refers to the feeling of

belongingness or connectedness to others. The CET suggests that when this need is met satisfactorily, an individual's intrinsic motivation increases.

The second framework of the present study was based on the modified TAM developed by Gu et al. (2013). The model is consist of four predictors of technology usage, which are related to the teachers' and learners' intention and the way they use technology in the classroom. The four sub-constructs of technology acceptance: *outcome expectancy*; *Technology Task-Fit (TTF)*; *social influence*; and *personal factors*; each sub-construct predicts and determines the person's acceptance and usage of technology.

The present study was about the integration of Kahoot, a game-based technology which has the potential to increase the learners' motivation in the study of Biology. The game elements of Kahoot and the use of technology raise the learners' excitement, interest, engagement, and motivation. Answering of Kahoot brings enjoyment and fun to the learners, which can improve their attention and motivation towards the subject. Moreover, the proposition for this study was that outcome expectancy, TTF, social influence, and personal factors which should be examined to determine the reasons why the teachers, as well as the learners, accept and use Kahoot in Biology class.

Conceptual Framework

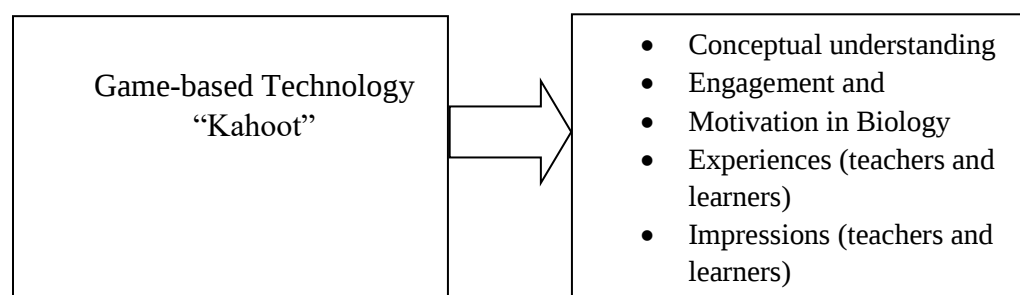


Figure 2: Conceptual framework

The figure shows the conceptual framework of the study. The use of Kahoot in teaching and learning Biology can improve the conceptual understanding, engagement, and motivation of the learners in this subject. Also, its incorporation provides a detailed description of the teachers' and the learners' experiences and impressions after using it for daily instructions in Biology classes.

The use of Kahoot is anchored on the concepts of Self-determination Theory (SDT) and Technology Acceptance Model (TAM). SDT describes how the elements of competition (noncontrolling), challenging, enjoyable, and immediate feedback in Kahoot can increase the learners' motivation, which can result in more engaging and motivated learners. Moreover, TAM describes the acceptance of teachers and learners using game-based technology in the Biology classroom. The acceptance of technology with this model is determined by the individual's beliefs, attitudes, and usage.

The incorporation of Kahoot serves as the platform in inducing higher motivation of the learners through its gamified elements such as points, ranks, levels and scoreboard, and immediate feedback. The gamified environment brings the learners to a more engaging classroom in Biology. Moreover, the teachers' and learners' acceptance of technology is described by the concepts of TAM.

Scope and Limitations

The study was conducted in a public High School in Manila during the school year 2017-2018 and involved the three classes of Grade Eight students who were taking up Biology lessons during the fourth quarter. The participants of this study were sections Daisy, Ilang-ilang, and Sampaguita (pseudonyms) and their Biology teachers Ms. C, Ms. F, Ms. G (pseudonyms). The

three Biology teachers, including the researcher, used Kahoot in the daily lessons during the fourth quarter of this school year. Furthermore, the research concentrated on the effectiveness of the game-based technology Kahoot in Biology classes. The quizzes used in Kahoot were adapted and teacher-made questionnaire.

The limitations of this study were reflected in the case study methodology. For this study, the boundaries which narrowed this study are the grade level, teachers, subject, and the location. Moreover, each class and the teacher served as the cases in this study; thus, multiple cases were analyzed in the study.

Definition of Terms

This intends to provide the readers with a better understanding of the study by defining some terms and concepts used in the implementation of the study.

Authentic Engagement- the student finds meaning in doing a task and have the willingness to carry out a particular task.

Conceptual Understanding – refers to the students’ conceptions and meaningful understanding of competencies in Science.

Digital Game-based Learning – a digital game which focuses on the content of the game

Engagement – the level of attention and commitment of the learners in performing classroom activities

Educational technology- includes the use of virtual laboratories, computer simulations, including the use of gadgets such as cell phone, iPads which fosters learning and motivation (Xiong, 2018).

Experiences – refers to the teachers’ and learners’ encounter and observations using Kahoot in the Biology classroom.

Extrinsic motivation- a kind of motivation which is based on the outcome and the visible reward that a person can get from performing a certain task in the classroom.

Game-based Technology - the use of an online game-based platform to entertain while learning concepts in the lesson.

Gamification – the use of game elements such as points, ranks, levels and leaderboards in a non-game context

Impression- refers to the views, perspectives, or the values and how the teachers and learners think about the use of Kahoot.

Intrinsic motivation – a kind of motivation which is inherent, and originates within the person. An intrinsically motivated individual tends to perform a task with high energy, willingness, and confidence.

Kahoot – a free game-based learning technology that allows teachers to create their learning games such as quizzes, survey, discussion, and jumble, or use the existing games created by other teachers (Bolkan, 2017).

Motivation- refers to the energy, confidence, persistence, willingness, and enjoyment demonstrated by the learners in the classroom.

Outcome (Performance) expectancy - the first component of the Technology Acceptance Model (TAM); it describes the acceptance of technology based on its perceived usefulness or usage (Xiong, 2018).

Perceived ease of use - a sub-construct of outcome expectancy of TAM, which refers to the individual's belief on how easy or effortless technology is to use.

Perceived usefulness - a sub-construct of outcome expectancy of TAM, which determines mostly the use of technology and its effectiveness in improving one's performance.

Passive compliance-the student completes a task to avoid any negative consequences.

Rebellion- the student refuses to do work and lacks the willingness to be passive about the failure to comply.

Retreatism- the student, is disengaged and unwilling to accomplish work despite the negative consequences such as passing grades or peer approval.

Ritual Engagement- the student, executes a task sometimes with diligence and persistence, but there is a disconnection from the task itself.

Self-determination Theory- the framework of the study which describes the origin of the motivation and how a person's motivation is flourished by changing its environment.

Social influence – the third sub-construct of TAM, which explains that a person's usage and acceptance of technology is determined by social influences such as social pressure, relationships, and external stimuli.

Technology Acceptance Model- an explanatory model which serves as a framework on how external factors affect the individual's attitude, beliefs and intention using technology and the actual use of it, moreover it elaborates the person's acceptance or rejection information technology.

Chapter 2

Procedures

Research Design and Methodology

The purpose of this research was to determine the effectiveness of using Kahoot as an instructional tool in the Biology classroom. Specifically, the study sought to determine the conceptual understanding, engagement, and motivation of the learners after using Kahoot in their Biology class. Moreover, it also explored the experiences and impressions of the teachers and the learners after using it in Biology class.

The research design of this paper is primarily observational case study consisting of multiple sources of data. An observational case study is a qualitative design; however, the data collected in addressing the research questions were both qualitative and quantitative. The primary data in this study was the qualitative data, while the quantitative data support the findings obtained from a primary source (Creswell, 2012). The quantitative data include the mean scores of the two-tier multiple choice questionnaire (MCQ) in Mitosis and Meiosis, learners' and teachers' engagement reflection and SIMS.

The rationale for using the case study

The exploration sought to provide insights regarding the experiences and impressions with the integration of Kahoot in Biology. The *particularistic, descriptive, and heuristic* features of the qualitative case study fit the aims of the study as well as the research questions raised by the researcher. The researcher thinks that the case study is the most appropriate research method to be used based on the goals of the study. The limitations found in the literature would only serve as reminders for the researcher to be careful during the implementation of the study. The researcher

was aware of the limitations of the design when it comes to validity, reliability, and generalizability. The researcher acknowledged the possible bias to consider technology access, use, and implementation in a favorable light. The questions asked to the learners and teachers were open-ended questions, and there was no sharing of perceptions with regards to the use of game-based technology Kahoot. The researcher accurately reported verbatim from the field and whatever concerns and issues raised by the participants in the study.

Observational Case Study

The present study used a case study, specifically observational case study, to gather data from the learners and teachers using the observation, interviews, and daily reflections. The instruments helped the researcher in implementing observational case study specifically in addressing the research problems raised in this study. The type of qualitative case study used in this study was the most suited type among the other kinds of a case study based on the literature (Merriam, 2009). The experiences and impressions were obtained from each case with the integration of game-based technology Kahoot were obtained through the multiple sources of data collected from the study.

The literature reveals little knowledge of the experiences and impressions of the learners and teachers using Kahoot in Biology class. The research gap in the present study investigated the learners' and the teachers' experiences and impressions with the use of Kahoot. The research would provide insights into the benefits and the difficulties or challenges encountered while using Kahoot in the classroom through observations, daily reflections, and focus group interviews. Moreover, it would also describe the predictors in accepting Kahoot as a game-based technology used in Biology class.

The researcher and the participants used Kahoot during the review and after the lessons in Biology. The teachers asked the learners to go to Kahoot.it, get the game pin, type their team names, and wait for the start of the game. Once all the groups in the class are connected, the game would immediately start. The learners were seated collaboratively with their members and used one mobile phone to participate in Kahoot. The teachers would remind the class to analyze the questions in Kahoot by brainstorming first before hitting an answer. Kahoot immediately flashed the points obtained by each group depending on their speed and correctness of their answers. Also, Kahoot provides the rank of each group by showing the names of the group and their corresponding points from rank one to five. At the end of the game, the names of the top three teams would appear on the screen. The teacher saved the scores of the learners by clicking save, and it automatically stores in the Google drive. The teachers can access the scores afterward and see which item got more correct answers and which items should receive more emphasis on the next meeting.

The research ensured the safety and protection of the participants. The use of Kahoot in the lesson was during school hours and only fifty-five minutes per session. The research was during the fourth quarter of the 2017-2018 school year. The lessons included the topics in the fourth quarter and started upon the full approval of the university. The data gathering procedures took place during class time inside the classroom. These procedures were observing, writing of daily reflection, interviewing, answering of post-test, completing of engagement reflection, and answering of SIMS. The learners were not asked to participate beyond the scheduled time for this purpose, nor were they asked to meet the researcher outside the school premises.

The learners answered the posttest using the two-tier MCQ, student engagement reflection, and SIMS. The teachers, on the other hand, were asked to answer the teacher engagement form while the learners were responding to it. Their responses mirrored each other. The learners

described their engagement in a class by choosing from the Schlechty's student engagement continuum (Schlechty, 2002), which includes authentic, ritual, passive, retreatism, and rebellion. The study used a purposive convenience selection of teachers in a public school in Manila, where the researcher was working.

The teachers were handling Grade Eight and teaching Biology during the fourth quarter. They were recruited to participate in the study, which consisted of two Biology teachers and the researcher for a total of three teacher-participants. The researcher explained to the participants that the study would ask them to use Kahoot daily during the review and evaluation of the lessons. The teachers received a briefing and consent letter before the implementation of the study. The consent letter (See Appendix M) included the description of the study, participation requirements, benefits, confidentiality, and a table of study activities with time commitment and contact information. The researcher also assured the teachers that all the collected data would be confidential and would not be a basis of their performance as a teacher. Also, they would not receive any benefit or compensation from their participation in the study. The teachers were asked to answer the engagement assessment reflection as well as write their daily reflection with the use of the Kahoot in their lessons.

The researcher provided letters of consent to the head, principal, parents, and students. The researcher visited the three classes to explain the research objectives and distributed the parent letter consent and permission slip. These were returned directly to the researcher in the following session. The present study mentioned the participants' confidentiality of information. They were informed about the use of a pseudonym instead of using their actual names.

The learners answered the pre-test and post-test, completed the engagement assessment reflection, answered the SIMS and wrote their daily reflection on the use of Kahoot in Biology and

how it affected their learning, engagement, and motivation. Also, the researcher informed the learners of selecting a focus group from their class for the interview. The interview process for each focus group was approximately 45-minutes, recorded and transcribed by the researcher. The researcher ensured that no classes were disrupted during the implementation period as well as in the data gathering procedures. The learners did not receive any benefit or compensation from their participation in the study; however, they got personal access with the result, especially in the progress report using the percentage gained after the intervention.

Overall, the researcher used multiple case study to obtain the experiences and impressions of the teachers and the learners in the incorporation of the game-based technology Kahoot in Biology class. Moreover, it provides knowledge on how teachers and learners perceived the use of technology, ease of using technology, and factors which determine their acceptance of the technology.

Research Site

The participants of the study were the students from Grade Eight Daisy, Ilang-ilang, and Sampaguita (pseudonyms) and the three Biology teachers Ms. C, Ms. F and Ms. G (pseudonyms) in a public school in Manila. The school is one of the public schools in the District Five of Manila, and it borders the cities of Pasay and Makati in the south. Also, the high school involved in this study had 2,700 population and considered as a large school in Manila. The study was conducted inside the classroom during regular school hours from February to March of the school year 2017-2018.

Selection Criteria and Participants

The population of the study included the learners and the teachers of the researcher's school in Manila. The participants of this study used a convenience sample as the researcher works at this school as a Science teacher. The availability and location were the basis for choosing the kind of sample. Also, the teachers were teaching Biology in the fourth quarter of the school year in the conduct of the study was set. The participants did not include other Biology teachers nor teachers from other schools and was limited to the school where the researcher was working.

Aside from Biology teachers, the participants in this study included Grade Eight learners of the three classes handled by the teachers selected in this study. It also utilized a convenience sample as the learners represent the class handled by the Biology teachers. The researcher gathered data from the learners who demonstrated interest, active participation, and enjoyment while using Kahoot. Moreover, in collecting data, the researcher used purposive sampling and set criteria such as active participation in class as they can provide rich information with regards to the use of Kahoot in Biology. The learners who showed interest, active participation while using Kahoot were selected as they can be a source of rich data in knowing the experiences and impressions of the learners in using Kahoot. The focus group interview in each section consisted of eight learners. According to Creswell (2014), the number of participants in a focus group interview was between six and ten. The teachers, on the other hand, were also interviewed using the same interview protocol.

Data Collection

The qualitative data collected were interview transcript, daily reflection, open-ended responses, and field notes. The researcher conducted the interviews at a frequency of one interview

per teacher in the duration of five to ten minutes. The learners' interviews, on the other hand, were conducted at a frequency of one focus group per day, which lasted for thirty minutes. The interviews were audio recorded using a Sony digital audio recording device. The researcher transcribed the interviews through replaying the audio recording at a frequency of three times for each interview. The interviews were transcribed in word verbatim on the computer.

The qualitative data obtained from the multiple cases consisted of words or text. The researcher gathered direct quotations about their experiences, feelings, knowledge, opinions, views, and ideas, including the detailed description of their behavior during and after using Kahoot in Biology lessons. The quantitative data included the mean scores in the two-tier multiple-choice questionnaire, engagement reflection slip, and the SIMS.

Two-tier multiple-choice questionnaire in Mitosis and Meiosis

Three content experts in Biology validated the researcher-made two-tier multiple-choice questionnaire (See Appendix A). The content-expert validation tool was given to three experts to evaluate the questionnaire, three as the highest and zero as the lowest. The average score in each criterion was determined, including the standard deviation. The Grade Eight learners answered the two-tier multiple in Mitosis and Meiosis, which served as the pretest and posttest.

Mitosis and Meiosis

The topic of Cell Cycle was first introduced to the Grade Eight learners before the lessons in Mitosis and Meiosis. The Cell Cycle is a regular recurrence of growth within the cell and followed by the reproduction of the cell. It consists of G₁, S, G₂, and cell division. G₁ and G refer to the growth or increase in the number of organelles and production of materials for both export and intracellular use. The cells which cease from dividing are arrested in this phase. Next, to G₁

or gap 1 is the S or synthesis, this phase doubles the DNA of the nucleus in preparation for the (later) division of the nucleus and its chromosomes; also the metabolic activity of the cell is reduced. After synthesis, G₂ or Gap 2 can take place, and cell replication are organized. In this phase, the chromosome becomes visible and move, then a set of replicated (chromatids) migrate to each pole of the cell. The cytoplasm divides, and new cells form. The cell cycle is now ready to begin again. These three phases are known as interphase (Mader, 2010).

The Grade Eight learners need to *compare Mitosis and Meiosis in their role in the cell division cycle*, as stated in the learning competencies in Biology 8. Mitosis or the nuclear division or karyokinesis, usually cell division cytokinesis. It is the division of the cytoplasm to form two cells. Mitosis has four stages which include of prophase, metaphase, anaphase, and telophase. On the other hand, Meiosis is a type of cell division which produces haploid gametes into diploid organisms. It combines the two haploids via fertilization into a diploid state in the zygote. Both Mitosis and Meiosis followed cell division, and Mitosis only have one division whereas Meiosis consists of two cell divisions, each of the four daughter cells resulting from Meiosis has a haploid set of chromosomes. Overall, Mitosis has one division of the nucleus which takes places in somatic cells while Meiosis has two nuclear and cytoplasmic division and only occurs in gametes. Mitosis produces two identical diploid cells, while Meiosis yield four haploid cells.

The teacher started this lesson in Mitosis by letting the learners analyzed diagrams showing the different phases of Mitosis; prophase, metaphase, anaphase, and telophase, after which Meiosis was discussed comparing each phase with Meiosis and pointing out some distinct phase of the division.

Development of Two-tier Multiple Choice Questionnaire (MCQ)

A two-tier MCQ questionnaire (See Appendix A) was consist of two parts: the first part of the MCQ was the first-tier and the second tier. The test was constructed after making a table of specification. A table of a specification ensures that a test covered propositional knowledge (Sesli & Kara, 2012).

Administration of the two-tier MCQ

The three classes in Biology were given a pretest before the implementation of the study during the fourth quarter of the school year. They were informed that a posttest would be given to them after their sessions in all the topics. The researcher reminded the learners that their scores in the tests would not affect their grades in Biology. The type of test was also explained to the learners; they were informed that the second tier items explain or support their answer in the first-tier. Research reveals that the administration of a two-tier multiple choice formative assessment has the potential to attain the following: increase teachers' awareness of the learners' conceptual knowledge, compose of items that can be used for group discussions, and provide useful information for curriculum revision which can be readily used in the classroom (Sesli & Kara, 2012). The learners took the pre-test from February 21-22, 2018. They took the posttest on March 13-14, 2018. The pretest was given before the lessons in Cell Cycle, Mitosis, and Meiosis, while the posttest was given after covering all the lessons.

Student and Teacher Engagement Assessment Reflection

The study adapted the student engagement reflection (See Appendix B) of Boyd (2015), and it consists of five statements aligned to Schlechty's student engagement continuum (Schlechty, 2002). In using this, the learners checked one box next to a statement. It described how they felt

about class integrating Kahoot into the lessons. On the other hand, the teacher also answered the teacher engagement reflection (See Appendix C), which mirrored the learners' reflection. The researcher obtained the average score from more than one responses. However, if the participant checked all the responses, the data became invalid and excluded in the research. The reflection instrument included an open-response which asked the teachers to reflect on the engagement of the class and provided anecdotal data that did not identify any learner. As with the engagement reflection, the responses of the teachers and the learners were scored on a scale from 1 (Rebellion) to 5 (Authentic Engagement). The researcher obtained the mean and percentage from the responses of all the cases.

The instruments were used to determine the engagement of the learners while incorporating Kahoot in Biology. The researcher adapted the instruments which were approved by the panelists. The teachers were asked to reflect on the engagement of the class by checking the box that best describes their engagement level. The teachers only selected one description of the engagement of the class and explained further their responses by elucidating in the free-response part of the form. The learners from the three classes in this study were asked to answer the said instrument by checking the box before the statement that reflects their engagement while using Kahoot. They were reminded to choose the statement that best explains their engagement as they use Kahoot. Some learners, however, chose more than three responses. The researcher omitted the data having four or five responses. However, the average scores were obtained from those responses having two and three responses. The responses of the learners reflect the engagement of their class. The Grade Eight learners completed the engagement form on March 12-16, 2018, while the teachers answered it on the same dates the learners completed the forms. Both the learners and teachers

answered the instrument on the same day, which mirrored the engagement of the class and how their teachers perceived it.

Situational Motivational Scale (SIMS)

The researcher adapted and modified a Situational Motivational Scale (SIMS) (See Appendix D) by Guay, Vallerand, and Blanchard (2000). The instrument determined how game-based technology affected learners in terms of motivation. The Self-determination Theory of Ryan and Deci (1996) served as the framework of the said instrument. The instrument identified the kind of motivation that the learners demonstrated after using Kahoot in teaching and learning Biology. The Codification key: *Intrinsic motivation*: Items 1, 5, 9, 13; *Identified regulation*: Items 2, 6, 10, 14; *External regulation*: Items 3, 7, 11, 15; *Amotivation*: Items 4, 8, 12, 16. The extrinsic motivation consisted of identified regulation and external regulation and discussed in the previous chapter.

Guay, Vallerand, and Blanchard (2000) developed and validated a situational measure of motivation, the situational motivational scale (SIMS). The instrument was designed to assess the construct of IM, identified regulation, external regulation, and amotivation in the field and other settings. There were five studies explored which help in developing and validating the SIMS. Situational Motivation, as defined by Guay, Vallerand, and Blanchard, refers to the motivation that the individuals experience while currently engaged in an activity. It refers to the here-and-now motivation Vallerand (as cited in Guay, Vallerand & Blanchard (2000). The Self-Determination Theory (SDT), specifically its constructs discussed in the previous chapter, became the theoretical basis of the development. Professors and graduate students developed the items found in the SIMS through the generation of items anchored in the constructs of SDT based on the definition of Deci and Ryan (as cited in Guay, Vallerand & Blanchard, 2000).

The results obtained in the study showed internal consistency by having Cronbach's α values. Besides, SIMS was found to have adequate construct validity, as evidenced by three correlational analyses. The results of the Cronbach's α values for the four subscales were intrinsic motivation .93; the identified regulation was .81, external regulation was .75, and amotivation was .78. The results were similar to Study 1 having acceptable values. The SIMS subscales met this criterion, which shows that the instrument was valid and reliable when used by other researchers.

Creswell (2012) stated that the criteria for choosing a good research instrument; one of the criteria mentioned was having information about the instruments' reliability and validity. Reliability refers to the consistency of the scores when the instrument is used. The scores of the participants should be nearly the same when the researcher administers the instrument several times at different times. A valid instrument, on the other hand, should match the purpose of the study or its objectives. The scores coming from an instrument are reliable and accurate if the scores of the participants are internally consistent across the items on the instrument.

Qualitative Data

Interview Protocol

In all forms of qualitative research, some and occasionally, all of the data are collected using the interview. Merriam (2009) stated that "a process in which researcher engage in a conversation focused on questions related to the research study (p.55). The most common interview form is the person-to-person encounter in which a researcher gathers information from the participants. Interviewing is conducted to elicit things we cannot directly observe or grasp, such as the feelings, thoughts, and ideas of the learners (Merriam, 2009).

The researcher conducted semi-structured interviews with the participants. A semi-structured interview is between structured and unstructured, where the interview is a mix of more and less structured questions. The study utilized a focus group for the interview process. The kind of interview has a specific topic to a group of people who know about the topic. The verbatim transcription of recorded interviews provides the best database for analysis. The research problems raised by the researcher (See Appendix E) served as the basis of the questions in the semi-structured interview. It sought to elicit ideas, insight, feelings, experiences, views, and knowledge of the learners and teachers after using Kahoot in Biology.

The content-expert validators validated the two-tier multiple-choice questionnaire and the interview questionnaire. The interview protocol underwent pilot testing by interviewing SHS students who also used Kahoot in their Science class. The pilot testing ensured the validity and reliability of the interview questionnaire by using it on other students. Aside from gauging the alignment of the questionnaire to the research questions, it also ensured that other learners could answer the questionnaire. There were no revisions made by the researcher. Moreover, the learners were able to respond from the interview questionnaire, which indicated that there was no need for rewording or altering the questions.

The researcher interviewed each teacher-participant individually, which lasted from ten to fifteen minutes using a semi-structured interview. In a semi-structured interview, specific data are collected from the participants using an interview questionnaire. Before the interview, the researcher read the researcher-made interview protocol. Also, the study informed the participants of the use of a digital audio recording device for the entire interview. They were also reminded about their rights to refuse in answering the questions. The participants agreed and approved the said interview executed by the researcher. All the teachers were comfortable and looked unhurried

during the interview. The researcher informed the participants regarding the transcribing of the interviews. Also, the researcher told them regarding the emailing of the transcripts to their accounts. The teachers were allowed to redact the responses, correct any mistake, and add other information. The focus group interview of the learners was also conducted at the Science Resource Center to avoid distraction from the other learners (Creswell, 2012). The focus group consisted of eight participants across the three classes of Biology.

The researcher used the interview protocol in reminding the focus group about the process as well as informing them of the questions. The focus group for the interview was selected based on the following characteristics: interest; active participation; and enjoyment while using the Kahoot. The kind of sampling used was considered to gather rich information from the participants or the case — the said interview was conducted during the learners' vacant time. The two focus groups: Daisy and Sampaguita, were comfortable and expressive during the interview. Some of the learners in these groups were laughing while they recalled their experiences in their Biology class using Kahoot. They appeared happy and enthusiastic during the interviews and explained their enjoyment vividly while using Kahoot. On the other hand, the focus group interview in section Ilang-ilang appeared tired during the interview. One reason for this was the time of their interview was an hour before their dismissal. Despite their exhaustion, this focus group was still able to express themselves freely with slight enthusiasm.

The interview was semi-structured interview consisting of five questions indicated in the interview protocol. The recorded interviews were reviewed three times to ensure the accuracy of the responses. Throughout the interviews, the researcher used active listening and used probes to get additional information. The focus group was also reminded by the researcher to listen attentively to their classmates and to avoid undesirable behavior and noise. The interviews were

on March 13-15, 2018. The teachers, on the other hand, were interviewed after all the school activities to avoid class disruption on March 26, 2018. The teachers' interviews were on the same day. The briefing and the interview lasted for 10 to 15 minutes only. Meanwhile, the learners' focus groups allotted a day for each interview to avoid inconvenience and class disruptions. The time duration in the focus group interviews was longer compared to the teachers because of the number of participants for each focus group and lasted for 20-30 minutes.

Daily Reflection

The reflection with regards to the use of Kahoot in Biology lessons was consolidated every day from the learners and the teachers. The learners were asked to write their reflection on the use of Kahoot in the lessons. The researcher only gave sets of questions orally to guide the learners in their reflection, but there was no questionnaire given to them. The reason for this was to avoid any restriction with the content of their reflection. The teacher also wrote their reflection daily to provide insight into the employment of Kahoot to Biology classes. Similarly, there was no provided questionnaire which could limit their responses on the use of Kahoot daily.

Observation Protocol

Observation is the process of collecting open-ended, firsthand information by observing persons and places at a research site. The information includes the opportunity to record data as it occurs in a setting and to study their actual behavior (Creswell, 2012). It consisted of the following elements: physical setting; participants; activities and interactions; conversation; subtle factors; the researcher's behavior (See Appendix F). The observer in this study served as a nonparticipant observer who visited the classroom and recorded notes without involving in the activities. Moreover, the researcher, as an instrument in collecting qualitative data acted as participant-

observer in the study. The observation took place inside the classroom for one class period, and the participants were observed while using Kahoot in their Biology class.

Analytical Methods

Quantitative Data

To analyze the collected data in the first research question, what is the conceptual understanding, engagement, and motivation of the learners after using Kahoot in Biology class? The researcher used mean, percentage, and standard deviation. (1) A percentage was used to determine the distribution of respondents and the frequency of respondents as part of the whole. (2) Mean was used in the interpretation of the content evaluation of the two-tier multiple-choice test, engagement reflection assessments for the teacher and the learners and data from the SIMS. (3) Standard Deviation was used for interpreting the deviation of the score of content-expert evaluation. The collected quantitative data from the present study were: two-tier multiple-choice questionnaire in Cell Cycle, Mitosis and Meiosis; student reflection; teacher reflection; and situational motivational scale (SIMS).

Qualitative Data

The qualitative data included the teacher' and learners' reflection and the interview transcript. The participants who knew the topic served as the focus group in the present study. The researcher interviewed each focus group using the interviews protocol. The study followed a step-by-step process of qualitative data analysis. The researcher made initial coding or open coding in organizing the vast amounts of data. The second step was coding which refers to the process of making notations next to the bit of data which struck the researcher with the potentially relevant answers based on the purpose of the study; coding allowed the researcher to categorize the focus

of the data further. The next step was axial coding, which led the researcher to define categories further.

There were two stages in analyzing the multiple case studies of the present study. The first stage was the *within-case analysis*, which involved coding and categorizing. Each case in the study involving the three Grade Eight classes: Daisy; Ilang-ilang; and Sampaguita and the three Biology teachers served as the case in this study. The researcher analyzed the data of the teachers and learners separately. The researcher examined the codes across the multiple data for each case and aggregated similar codes into a category.

Merriam (2009) referred to *within-case analysis* where each “case is treated as a comprehensive case in and of itself” (p. 204). After this stage, the researcher started with the *cross-case analysis*. The researcher looked for shared and unique categories both for the teachers and learners across the cases. The research questions and conceptual framework were the basis for interpreting the emerging themes in this study. Moreover, the researcher compared the teachers' and learners' experiences and impressions after using Kahoot in Biology lessons in terms of their shared experiences and views as well as the differences between them.

The multiple case studies in this study provide commonalities and differences which occurred among the teachers or the cases. The researcher made assertions regarding the teachers' and learners' experiences and impressions with the use of Kahoot as an instructional tool in Biology through capturing on the significant results from each case report.

Role of the Researcher

The researcher implemented the study during the fourth quarter of this school year 2017-2018. The researcher was one of the teachers who handled one of the Grade Eight class in Biology

during the conduct of the study. The roles of the researcher were: teacher; interviewer; and an observer. As the teacher, the researcher used Kahoot as supplemental activity in Biology class wrote a daily reflective journal and answered the engagement assessment. The researcher was engaged in interactions with the learners through interviews with the focus groups. The approach in this observational case study was holistic. The perceived impressions and realities of the case were recorded based on the learners' interview process, which gave them the voice in this study.

Methods of Validation

The two-tier multiple-choice questionnaire and interview questionnaire are all researcher-made instruments which were validated by the content-experts in Biology. The research questions raised in this study, the conceptual framework, and the objectives of the study served as the framework in formulating the items in the questionnaires. All of the instruments used in the study underwent validation from the experts to ensure the validity and reliability of the instruments. The content-expert validators were Master Teachers and University professor who has been teaching Biology for more than five years.

Pilot testing of Interview Questionnaire

Before the data collection, the researcher sought informed consent from all the participants (See appendices J, L & M). The interview questionnaire was pilot tested to the selected Senior High School (SHS) students of the researcher who were taking up Physical Science. The Science Department head, Senior High School Department and principal, were given a consent letter (See Appendix H) to seek permission before the pilot testing of the interview questionnaire. The researcher briefed the learners about the pilot study and reminded that their participation was optional and they could withdraw anytime. The researcher also reminded the learners that their

grades would not be affected by their participation in the study. The researcher obtained assent from the participants after the briefing during school hours.

The SHS learners used Kahoot in their Physical Science class for one week during the review of the lesson. The researcher selected students who were active, participative, and motivated while using Kahoot during class to serve as a focus group in the interview. There were five students selected in the interview process, and their responses were digitally recorded and transcribed. The researcher did not share any personal view regarding the use of Kahoot in Biology. Also, the interview was not scripted. There were some follow-up questions to the participants in some of the questions. Probes are questions or comments that follow-up what is already asked (Merriam, 2009). The entire interviews were audio recorded and transcribed by the researcher. The interview was conducted on March 9, 2018, inside their Science classroom after the examination of the learners.

Validation of two-tier MCQ

The letters along with the validation tool (See Appendix N) were given to the experts on January 24, 2018, during the Mass Training of Senior High School Teachers on Academic Track (STEM-Science) at Atrium Hotel, Pasay City. The content-experts validated the initial draft of two-tier MCQ on February 4-10, 2018. After some refinements, a final version of the test was returned to the validators. There was no feedback or comment after the final revision.

Table 1. Profile of the content-expert validators

Validator	Highest Educational attainment	Specialization	Number of years Teaching Biology
Mr. G	Master of Science in Biology	Biology	6
Mr. R	Doctor of Philosophy in Educational Management	MAT Science Education	14
Ms. S	Master of Science in Biology	Biology	14

Table 1 displays the profile of the content-expert validators, their educational attainment, specialization, and the number of years teaching Biology. It displays the names of the content-expert validators and their profile. The validators of the two-tier MCQ were experts and have enough experience in teaching Biology. It consisted of two Biology teachers in a Science High School and one professor of Science Education at a University.

Table 2. Results of the content-expert validation

Validator	Mean	SD	Remarks
Mr. G	3.00	0.000	Valid explanation
Mr. R	3.00	0.000	Valid explanation
Ms. S	3.00	0.000	Valid explanation

See Appendix O to see the full detail of the results

Table 2 shows the results of the validation, each item in the two-tier MCQ was rated by the validators using the provided rubric adapted from Cervantes (2015) (see Appendix N). The rubric consisted of the numeric scores 3, 2, 1, and 0. The score of 3 was the highest and indicated having a valid explanation in comparing similarities and differences between contexts, and apply concepts relevant to each context, 2 as a slightly valid explanation, 1 as an inconsistent explanation, and 0 as an invalid explanation.

The table above shows the summary of the scores after the final validation of the content-experts to the two-tier MCQ. The average score was also acceptable across the validators. The data above indicate that the researcher-made two-tier MCQ was a reliable measure of the conceptual understanding in Biology as validated by the three content-experts. There were some revisions of the items which were improved according to the comments of the validators.

Validation Strategies

The qualitative description provided in this study, specifically case study as the research design, is the limitation of this research. The personal reflection of the researcher on the meaning of data contributes to the interpretations of the results in this study (Creswell, 2012). Merriam (2009) stated that validity and reliability involved ethical considerations when conducting a study. The ethical considerations were tackled in the previous chapter and also addressed in this chapter to deal with the validity and reliability of the results. To establish the quality of a qualitative study, credibility, transferability dependability, and confirmability substitute the reliability, objectivity, external and internal validity.

Internal Validity or Credibility

Collecting multiple sources of data from multiple methods of data gathering (Merriam, 2009) such as field notes, daily reflection, and interviews addressed the internal validity of the present study. The participants' multiple data were compared through triangulation. For instance, the field notes obtained by the researcher was compared to the interviews of the learners to determine similarities with their impressions and experiences on the integration of Kahoot.

Reliability or Consistency

Reliability refers to the consistency of the study. It determines whether a similar study would yield the same results. The data gathering, analysis, and interpretation of data explicitly

ensured it. The researcher addressed this by triangulation and audit trail. The first method as described above while audit trail refers to the detailed descriptions on how data were collected, analyzed and interpreted by the researcher using the rich data gathered in this study (Merriam, 2009). The study had an explicit description of the data collection across the multiple cases of the study. The processes of analyzing and interpreting the data were also taken into consideration and described vividly in the previous chapter. Further, research questions, sampling procedure, participants, research instruments such as observation protocol, and interview protocols were identified and documented in the procedures.

External Validity or Transferability

Transferability refers to the extent to which the results of one's study can also be applied to other situations. The use of rich, thick description enhanced the possibility of transferability of the results in the present study. The data presented in the previous chapter portray detailed and thick responses from the participants in this study. The researcher included direct quotes from the participants gathered from the interviews and daily reflection. The researcher explored whether the findings of this study may be transferred to other setting and context.

Ethical Considerations

For the implementation of the study to the learners, several steps were taken into consideration and emphasized the potential ethical issues that this study interfere. The researcher provided the informed consent forms, interview protocols to the school principal and Science Department head before the study commencement.

The researcher communicated to the participants that their participation was voluntary, and they could withdraw from the study anytime for any reason. There were extra considerations in

the wording of the interview questions to minimize the power imbalance between the researcher and the learners.

Also, the researcher discussed the assent form showing a detailed description of the study in an age-appropriate language (See Appendix L). The learners had full and open information regarding their participation in the study and their role in it through a consent form. They read and signed the consent form before the conduct of the study. There was a question and answer session after the explanation of the consent form. The learners were informed about their rights and asked consent if they would be willing to participate in the study. The participation in the study was optional, which made the situation uncontrolled. Both the guardians of the students and the students filled out the consent form. The consent form includes approval from the guardians of the participants to bring and use their mobile phones during the implementation of the study. The reason for this was because the bringing of phones was not allowed as part of the school policies but not strictly implemented in the school. Several studies have discussed the policy about Bring Your Own Device (BYOD) in school and how it affects teaching and learning (Jones, 2014; Boyd, 2015). The researcher collected the consent forms in determining the participants' willingness to join the study.

All of the contents and competencies of the lesson, the use of Kahoot, the use of mobile phones and pedagogies were implemented similarly to all of the groups of Grade Eight learners. All of the sections received equitable and unbiased treatment during the implementation. The data from the participants were kept confidential. Also, there was no association of the data to the participants' actual names. All materials stored via password protected files. There was no sharing of identity with anyone at the school nor district level, including administrators or in the

final published of the thesis. Also, the participation of the teachers did not affect or became a part of the school evaluation.

The informed consent form states that the participants would not receive any incentive nor compensation from their participation in the study. However, they could obtain their progress in the subject from the saved scores that they got using Kahoot. Also, they could get their team's points and ranks daily. Moreover, the researcher had no personal relationship with the participants, including the teacher-participants in the study. The learners in the study were not the researcher's students. The researcher did not receive any financial gain in the conduct of this study nor promote any education application or technology. The research provided complete information regarding the study and informed the participants that their participation was voluntary and they would not receive any compensation or benefits from the study. However, they can get access to the results of the research, including their daily scores and ranking in Kahoot.

Furthermore, the researcher would send a summary of the findings to the participants and the school. The dissemination of findings could be done through a formal conference or during a Faculty meeting or school assembly. The results would be shared to all the teachers in the school during a school-level meeting, which aims to showcase teaching pedagogies. The presentation can work for all setting, audience, and ages. The report includes the core components of the study, such as title, introduction, literature review, methodology, findings, conclusion, and recommendations. The researcher would provide a copy of the final thesis to the school site level participants and the Division Office upon publication.

Also, the researcher provided an accurate, complete, and unbiased report to the participants. Since the researcher was the primary instrument for data collection, validity, and reliability of the results were taken into consideration using multiple sources of data such as daily

reflection, interview transcripts, and observation field notes. The research ensured that the results would be presented ethically and sensitively by taking into consideration the age of the participants. The researcher would present the results using plain language and would avoid using terms such as game-based technology and digital technologies. Moreover, the researcher would make emphasis on the implications of the findings by relating the use of Kahoot to their learning, engagement, motivation, and impression. Also, the researcher would share the impact of the study on the teachers by giving detailed step-by-step procedures in collecting data. The study used the term participants throughout since the sample was more involved in the study. During a conference, the researcher would convey the practical significance and implications of the use of Kahoot in teaching and learning Biology. The knowledge gained from the study would shed light on the use of game-based technology Kahoot in teaching Biology and how it affected the teaching and learning process. The results may give voice to the teachers and learners in using Kahoot and how it affected the conceptual understanding, engagement, and motivation.

Limitations of the Study

The study explored the use of Kahoot in the teaching and learning of Biology. The incorporation of this game-based technology served as supplemental activity in Biology lessons. The use of Kahoot was not considered as a formative assessment as suggested by Cheong, Cheong, and Filippou (2016). The researcher observed and interviewed the participants in this qualitative research design, specifically observational case study. The qualitative data was limited to words and texts while the quantitative data include the scores in the two-tier multiple choice test, teacher and learners' assessment of engagement and the situational motivation scale (SIMS) to support the findings of the study.

Besides, the selection of the teachers as well as students from one secondary school in Manila, may or may not represent a large population. Any finding of the study may or may not reflect the experiences and impressions of a larger population of the participants. The selection of the participants was limited to the Biology teachers and learners and did not include the parents and other subject teachers in the said school.

Potential bias may occur in the implementation of the study since the researcher served as an instrument in this qualitative research studies. The researcher was careful throughout the design of the study to consider and report any possible negative impression and experience of the teachers and the learners with the use of Kahoot in Biology class. The researcher made a conscious effort to address all potential concerns both in the literature and throughout the data collection process — the use of mobile phones, Internet connection, classroom, and behavior management and teacher concerns.

One limitation was the use of the Internet connection, which affected the use of Kahoot in the lesson. The connection was affected by the number of mobile phones connected to the Wi-Fi provided by the researcher. The signal was also a factor which impeded the use of Kahoot; the strength of the signal was dependent upon the locations. The use of Kahoot encountered some problem with the Internet connection while using inside the classroom. Furthermore, the technology and the infrastructure in place also affected the incorporation of Kahoot in Biology. To combat the issues encountered in the implementation of the study, the researcher utilized two broadband and monitored the remaining data for each day.

The researcher had less control of the events which took place to the case studied. Also, the researcher did not identify the variables and several variables ahead of time, which may either

be familiar or new. Moreover, the events that took place during the investigations were free and uncontrolled situations, which resulted in the unexpected outcomes, discovery, or variables.

Time constraints of the study may have an impact upon the data collection with the relatively short period for interview and observation. Also, the learners' attendance, including the school activities during school hours, may affect the daily use of Kahoot, thus, having an impact on the data collection process.

The researcher combated all the potential bias by not sharing any opinions nor asking leading questions of the participants, accurately transcribed and conveyed interviews, daily reflections, and results obtained using the research instruments. There was no sharing of views on the use of Kahoot during the interviews, observations, and the implementation itself. The researcher also practiced active listening.

Triangulation and member checking techniques were used in the interpretation of the findings as the results were tabulated and analyzed to assure that any form of bias on the part of the researcher was acknowledged and did not influence the methodology, collection, and analysis of data and the summary of the results. In triangulation, comparing the multiple sources of data collected from the participants was observed. For instance, the field notes obtained by the researcher was compared to the interviews of the learners to determine similarities with their experiences and impressions to the integration of Kahoot.

Chapter 3

Findings and Discussion

The purpose of this qualitative research design was to determine the conceptual understanding, engagement, motivation, experiences, and impressions of the teachers and the learners after using Kahoot in their Biology classes. This chapter presents findings and discussions to address the following research questions: (1) What are the learners' conceptual understanding, engagement, and motivation in Biology after using Kahoot? (2) What are the experiences of the teachers and the learners after using Kahoot in Biology classes? (3) What are the impressions of the teachers and the learners after using Kahoot in Biology?

The study sheds light upon the incorporation of game-based technology Kahoot in Biology, specifically Mitosis and Meiosis. The study provides both qualitative and quantitative data gathered from the researcher-made and adapted research instruments. The quantitative data were gathered using the researcher-made two-tier multiple choice questionnaire (MCQ), and the adapted student and teacher engagement reflection, and situational motivation scale (SIMS). The qualitative data were obtained using the interview protocol, observation protocol, engagement form, and the daily reflection of the teachers and the learners on the incorporation of Kahoot in Biology. The data collected were obtained from the teachers and the learners during the school year 2017-2018. The researcher used a convenience sample in selecting the participants of this study. The researcher chose this kind of sampling because the researcher is working in the said school as a science teacher, and also because of its availability and location. Moreover, the participants were Grade Eight teachers who were tackling Biology in the fourth quarter of the school year.

Three teacher-participants, including the researcher and the classes they handled, were selected for this study. Consent letters were given that included a description of the study; participation requirements, benefits, confidentiality, and a table of study activities with time commitment and contact information. All of the participants agreed to participate in the said study.

Research Problems:

What are the learners' conceptual understanding, engagement, and motivation in Biology after using Kahoot?

Conceptual Understanding

The learners' conceptual understanding was measured using the validated two-tier MCQ in Mitosis and Meiosis. Table 4 shows the results of the conceptual understanding of the Grade Eight learners after using Kahoot in Biology.

Table 3. Summary of the Post-test Scores in Mitosis and Meiosis

Learners	Post-test	Remarks
Daisy	10.02	Average
Ilang-ilang	11.45	Average
Sampaguita	10.22	Average
Overall mean	10.56	Average

Note. The maximum score is 20.

Table 3 reveals that the Grade Eight conceptual understanding was average after the incorporation of Kahoot in Biology. The results above support the findings in the literature (Licorish, Owen, Daniel & Li George 2018; Pede, 2017) wherein the integration of Kahoot in a Science class improved the learning of the students. The results may be attributed to the positive *outcome expectancy* of TAM by Gu et al. (2013) wherein the cases perceived the usefulness of

Kahoot in learning Biology concepts. Overall, all the cases had an average conceptual understanding after using Kahoot in Biology.

Several pieces of research which also employed gamified formative assessment such as Quick Quiz (Cheong, Cheong, and Filippou, 2016) found it effective in increasing the performance of the learners. Menezes and De Bortulli (2016) emphasized that immediate feedback in a gamified environment could affect the motivation as well as the learning of the students. Feedback is a vital component of a formative assessment which provides knowledge to the learners whether they have learned the objectives of the lesson or not (Menezes & De Bortulli, 2016). The literature reminds the educators that assessment comes in a variety of ways and not limited to a paper and pen form of assessment. Overall, gamification could enhance the conceptual understanding of the learners through flourishing their motivation and engagement (Plump & LaRosa, 2017).

Engagement

In the learners' engagement form, a numeric score was assigned to each response. 5= the class demonstrated high attention and high commitment to the learning tasks, 4= the class demonstrated high attention but low commitment to the learning tasks, 3=the class demonstrated low commitment and low attention to the learning tasks, 2=the class demonstrated no attention and no commitment to the learning tasks and 1=the class demonstrated diverted attention and no commitment to the learning tasks. The results of the survey were tallied and calculated into percentages. Table 5 represents the percentage of the learners that answered in each category of the engagement form.

Table 4. Percentage Scores of Learners' Engagement

Learner	Authentic (%)	Ritual (%)	Passive (%)	Retreatism (%)	Rebellion (%)
Daisy	38	41	13	8	0
Ilang-ilang	74	17	2	7	0
Sampaguita	50	39	8	3	0
Total	54	32	8	6	0

See Appendix R to see the full detail of the results

Grade Eight Daisy

Thirty-eight percent of the learners manifested authentic engagement after using Kahoot in the Biology lessons. The percentage was quite small, which indicates that the use of Kahoot to the class of Daisy fostered authentic engagement to a few numbers of learners in Biology. The study of Jones (2014) supported the use of technology in the classroom and found out its positive impact on learning.

Contrary to this, Boyd (2015) found out that bringing and using personally owned gadgets to school for instructional purposes (BYOT) was not a factor in increasing the engagement of the students. The research also shows no significant difference between the engagement level of the students with the use of technology, school-owned technology, and no technology at all. The results were corroborated in the literature in the difficulty of assessing and measuring engagement. Overall, the game-based technology Kahoot may raise learners' engagement through the incorporation of the technology itself but not applicable to all the learners. According to Schlechty (2002), it depends on the activity and the learners' interest in the activity.

Grade Eight Ilang-ilang

Seventy-four percent of the learners were authentically engaged after using Kahoot in the Biology classroom. The result reveals that the class of Ilang-ilang exhibited commitment and attention after using Kahoot. The active participation of the learners also marked an authentic engagement of the class in Biology (Schlechty, 2002). Research reveals that allowing the learners to use their gadgets in their classroom promotes students' engagement and achievement (Cutri et al., n.d.). The finding is supported by the study of Plump and LaRosa (2017), which stated that the use of Kahoot in the classroom raises the students' engagement. Moreover, the integration of educational technology, for instance, Kahoot and the use of cell phone enhanced the engagement of the learners.

Grade Eight Sampaguita

Fifty-percent of the learners were authentically engaged in the task after the incorporation of Kahoot in the Biology class. The use of Kahoot influenced the learners' engagement in Biology class. It was observed that learners' commitment and attention elevate through Kahoot. Despite the complexity of the content of the topics, the learners were still attentive during the discussion, as noted in the field notes. Their participation also increased as they tried to answer the questions in Kahoot correctly. Moreover, Schlechty (2000) Engagement Continuum described authentic engagement manifested by high commitment and attention while ritual engagement was performing the task because of grades. Some participants reported that they exerted effort to obtain high grades, while other learners reported that they became more attentive and participative in class after using Kahoot.

The findings demonstrate that the use of Kahoot can flourish the teaching and learning experience of the learners. The engagement has three classifications: behavioral, emotional, and

cognitive. The competition, points, ranks, leaderboards, and immediate feedback of the game allow the learners to be more engaged in the subject through having increase interest and participation using Kahoot. Moreover, the learners' emotional engagement involved the positive and negative reactions from using Kahoot in Biology, which also contributed to having distinct engagement across the cases.

In terms of engagement, the findings show that Grade Eight learners demonstrated authentic engagement. According to Digamon and Cinches (2018), ritual compliance was significantly correlated to the teacher's use of a work team. It also showed that the teachers' use of activities was considered as the best factor in engaging the learners and influenced authentic engagement. Furthermore, the findings indicate that the Grade Eight learners demonstrated authentic engagement after the incorporation of Kahoot which vary from each case.

Engagement

The table below shows the level of learners' engagement according to the observations of their teachers.

Table 5. Results of Learners' Engagement based on the Teachers' Observation

Participants	Rating	Interpretation
Ms. C	5	Authentic engagement
Ms. F	5	Authentic engagement
Ms. G	5	Authentic engagement
Overall mean	5	Authentic engagement
SD	0.000	

The table above indicates that the learners were authentically engaged after incorporating Kahoot in Biology from the daily observations of their teachers. The data from the learners and the teachers somehow reflect each other indicating that authentic engagement was observed among the Grade Eight Biology learners after using Kahoot.

Motivation

The quantitative instrument SIMS was used in determining the motivation of the learners after using Kahoot in their Biology class. It sought to identify the reason why they are currently engaged in the activity using the Kahoot. Table 6 shows the mean scores of the learners that responded in each category of the SIMS.

Table 6. Mean Scores of Learners' Level of Motivation

Participants	Intrinsic	Identified regulation	External regulation	Amotivation
Daisy	4.54	4.11	3.43	2.56
Ilang-ilang	4.70	4.58	3.82	2.91
Sampaguita	4.72	4.64	3.89	3.03
x	4.65	4.44	3.71	2.83

See Appendix S to see the full detail of the results

Grade Eight Daisy

The class of Daisy obtained 4.54 mean score in terms of intrinsic motivation. Their average score was high, which indicates that the learners in this class were intrinsically motivated after using Kahoot in Biology class.

Grade Eight Ilang-ilang

The learners yielded 4.70 intrinsic motivation show high IM of the learners. The results reveal that the incorporation of Kahoot was a positive experience to the learners; therefore, gained positive outcome expectancy in accepting Kahoot in the Biology class.

Grade Eight Sampaguita

Among the three cases, Grade Eight Sampaguita yielded the highest mean score in terms of intrinsic motivation. The results show that Kahoot has positive expectancy outcome flourishing their motivation in Biology.

The learners' motivation after the use of Kahoot was found to be intrinsic, which indicates that their motivation is inherent and self-determined. Ryan and Deci (2000) stated that the person's intrinsic motivation (IM) increases from performing interesting tasks which are also rewarding at the same time. The findings show that the use of Kahoot raised the learners' motivation in Biology, which was supported by the study of Plump and LaRosa (2017). The gamification elements of Kahoot contributed to the learners' increase in motivation as well as the positive outcome expectancy of Kahoot as perceived by the learners.

Grade Eight Sampaguita obtained the highest mean scores in IM; surprisingly, this class also reflected high mean scores in EM. The results show that the learners in this section are both intrinsically and extrinsically motivated, which was also supported by the literature (Ryan & Deci, 2000). Unexpectedly, Grade Eight Daisy got the lowest mean score both in IM and EM among the three sections which were parallel to the findings of their engagement level having the lowest mean scores in the authentic engagement and highest in terms of ritual engagement. Overall, the Grade Eight learners demonstrated high motivation after using Kahoot in Biology.

Teachers' Experiences Using Kahoot

The experiences of the teachers after using Kahoot in their Biology classes consist of the following: pedagogy related experiences; technology-related experiences; and class management related experiences. The responses of the teachers from the multiple data such as interview

transcript and daily reflections were analyzed through exploring the general sense of data, coding, combining similar code, and reducing into categories. The emerging categories were originated from the multiple perspectives in the study, which include the viewpoints of the teachers and the sources of data such as observation, interview, and daily reflection (Creswell, 2012).

Ms. C

Ms. C (pseudonym) expressed several experiences using Kahoot in Biology, such as pedagogy-related experiences, technology-related experiences, and class management related experiences. These experiences provided a rich and thick description supported by its subcategories.

Pedagogy-related experiences. Ms. C on her experiences using Kahoot in Biology class.

Exciting and enjoyable class. The class of Ms. C manifested enjoyment while using Kahoot despite the slow Internet connection.

Despite the long wait for the internet connection, the learners' enjoyment was still very evident. They shouted every time they got the correct answer, the teachers inside the room found it uneasy to control their reactions. The teams that got high rank were happier, and they were screaming when they saw their names flashed on the screen. The learners arranged themselves; some formed circle; others were standing while some remained seated throughout Kahoot. After using Kahoot, their attention while discussing the lesson was still high and evident.

Focused, attentive, and participative students. Ms. C observed the inclination of the learners towards the use of Kahoot and their preparation before their Biology class.

Then when you say that is necessary to use Kahoot on the second day they review to get the correct answers. It's also good because the students can visualize; their attention is focused. The questions are guaranteed to be accurate, and the students are alert. Aside from these, the students compete in answering. Even though it gets a bit noisy but it is all right because at least you see that they put effort into answering.

Moreover, Ms. C expressed the learners' excitement while answering questions in Kahoot. "During the class, they always waited and excited for the next question to flash on the screen. Answering Question using a mobile phone connected to the internet helps the students to become more active and attentive during the class." "The technology-based instruction used in teaching Mitosis made the student active during the activities. They were able to do the task without hesitating of asking the methods to follow. They perform the activity and following the instructions."

Group members collaborated. Ms. C perceived the learners' cooperation with their group members as they were brainstorming their answers.

Each group is consisting of four to five members. They were asked to read and answer the questions in the Kahoot. The learners answered by tapping the screen of their mobile phones. The members of the group collaborated by analyzing the items and coming up with one answer. They were very excited to answer; some of the groups even stood while answering; on the other hand, some groups remained seated while using Kahoot.

Easy to explain. The discussion of the lesson becomes light and smooth after the incorporation of Kahoot in Biology. Ms. C stated, "My experience in using Kahoot is that it is

effective because it is easier for me to explain the topic to the students and they become attentive to the point that they want to answer the question immediately and they easily absorb the information into their brains.”

Improved students' learning. Ms. C expressed, "Most of my students participated well, especially during the discussion. They also understand the concept clearly, and it is based on the result of their assessment.”

Prepared class. Ms. C observed that her class was prepared well for their group presentation, which was evident from the model they made showing the stages in Mitosis.

Technology related experiences. The class of Ms. C manifested the use of educational technology in the classroom. She narrated how they prepared before using Kahoot in her class.

Set up educational technology. Ms. C on her experience in setting up educational technology.

In Kahoot, what we did is to set-up the computer, then the LCD projector. Aside from this, the students should also have a cell phone and laptop to connect, of course, Wi-Fi is needed, and since Wi-Fi cannot be provided (by the students), it is necessary for the teacher to have Wi-Fi. Besides, you also have to set up everything because, in our school____, we do not have a room where everything is already set-up. Also, the teacher transfers from one class to another and does set-up in each class, which eats up time.

Poor Internet connection. Internet connection is a necessity when using Kahoot in the classroom; Ms. C reported how the slow connection affected its integration. "It was unexpected

that connecting to the internet consumed much time during the first day of using Kahoot. Some of the learners seemed dismayed but also excited, waiting for the connection. Because of the multiple connections, the teacher found it difficult to connect her laptop used in Kahoot." There was an incident when the Internet signal was slow and became a huge challenge to Ms. C. She expressed, "The difficulties that I've encountered is that sometimes, the period is almost up, but they weren't able to connect yet because I wasn't able to change the password that I've said and all student know, so the students have difficulty connecting to the Wi-Fi."

Class management related experiences. The class of Ms. C observed seating arrangement for each group.

Having a seating arrangement. "There were minimal spaces in the Science classroom, and the learners were asked to stay beside their team members. Their seating arrangement was based on the structure of the classroom having a laboratory table at the middle."

Ms. F

Ms. F (pseudonym) shared her experiences using Kahoot as an instructional tool in Biology. The experiences include pedagogy-related experiences, technology-related experiences, and class management related experiences.

Pedagogy related experiences. Ms. F, on her experiences using Kahoot in Biology reflect how the use of Kahoot improved her class.

Exciting and enjoyable class. Ms. F found the use of Kahoot fun and exciting, which improved the learners' interaction in class.

The review of the lesson was fun, exciting, and full of participation. All of the members of each team were reading the questions flashed on the screen, and trying their best to cooperate. Some learners even stood on their chair to read the questions, even if the screen was large enough to be seen by everyone.

Using Kahoot in Biology class was very exciting. Why? Because it is the first time for the student to encounter it, so they are very eager, eager to learn how to use Kahoot, and they were able to discover that it was exciting; they seem to be playing only, and they are enjoying doing it.

Students learn easily. Ms. F described how the integration of Kahoot improved the learning experiences of the learners in Biology class. She shared, "The students enjoyed doing the activity with the use of Kahoot. They were able to understand the lesson easily, and they were interested in doing the activity."

Focused, attentive, and participative students. The responses of Ms. F show the positive effects of using Kahoot in Biology class.

They were actively listening to their teacher, and some participated as well during the discussion. They quickly understood the lessons through the use of PowerPoint and the analogy used by the teacher in teaching Meiosis. They reacted when the teacher made some "hugot lines" comparing them to the processes and events in Meiosis.

Group members collaborated. The participants included the teacher and the class of Grade Eight- Ilang-ilang. The participants were divided into groups having four to five members each. The teacher assigned a particular seat for each group and shared:

The groups were engaged, active, and participative while answering the questions in the Kahoot. The class was full of energy and attention to the activity. All of the members were cooperative in answering the questions in Kahoot. All of them were reading the questions and trying to answer as correctly as possible.

Prepared class. Ms. F observed that her class was prepared for their group presentation in Mitosis the following session.

High commitment and attention of the class. Ms. F observed, “The class was interested in answering the activity. The learners were all listening while the teacher was explaining the lesson. They were committed to answering the question from the said topic.”

Improved students' learning. Ms. F observed the effectiveness of Kahoot in her class as it enhances the students' learning in Biology; she stated: "Using Kahoot, I was amazed because more students were participating in the discussion. They were attentively listening to the explanation of the teacher. The Kahoot improves the ability of the students to learn. Moreover, it was more evident based on the observation:

The class found the review engaging while the teacher did not exert too much effort in getting the attention of the learners. The teacher enjoyed the review seeing the class participating well in the review. The use of Kahoot made the review easy, fun, full of cooperation, in a short period.

Teacher enjoys teaching. Ms. F demonstrated satisfaction, and her teaching experience became delightful and fun after using Kahoot in Biology.

Technology related experiences

Ms. F reported her experiences with the integration of educational technology and Kahoot: *set-up educational technology and poor Internet connection.*

Set-up educational technology. Ms. F experienced the need to prepare and make use of educational technology with the use of Kahoot.

The classroom was situated on the second floor of the Main building. Any educational technology did not support the classroom. The teacher was the one who brought the materials and equipment needed in the implementation of the study. The materials and equipment used were a laptop, speaker, projector, white screen, and Wi-Fi. The learners, on the other hand, brought their mobile phones. Each group had one device used during Kahoot.

Poor Internet connection. Ms. F endured the slow Internet connection, which affected the experience of using Kahoot she noted:

The teacher asked the class to connect to the Internet, but the learners had difficulty connecting to the Internet. Some learners even said, “*Ma’am wala pong internet,*” (Ma’am, there is no internet.) “*Ma’am and bagal po ng internet*” (Ma’am the Internet is slow) The teacher reminded the class to use only one phone in each team and avoid browsing their social media accounts while waiting.

Class-management related experiences. Ms. F followed seating arrangement in Biology class while the learners were working as a team in Kahoot. This practiced maximized the time and reduced unnecessary behavior of the learner.

Ms. G

Ms. G (pseudonym) shared her experiences using Kahoot as an instructional tool in Biology. The following include her experiences: pedagogy-related experiences; technology-related experiences; and class-management related experiences.

Pedagogy-related views. Ms. G encountered the following after using Kahoot in teaching Biology: focused, attentive and participative, high commitment and attention, the teacher becomes motivated, prepared class, improved students' learning, group members collaborated, attentive and participative, and exciting and enjoyable

Focused, attentive, and participative. Ms. G's class displayed an engaging classroom experience through the use of Kahoot in Biology class.

The class was very high, energetic, and very excited in answering the review questions in Kahoot. During the first day, they were shouting every time they get the correct answer, and every time their team ranked first or second.

The teacher exerted less effort catching their attention during the review because all of them wanted to answer quickly and correctly. It was an exciting and fun experience to the learners; however, the teacher found it hard to control their emotion and excitement

High commitment and attention of the class. Ms. G's class demonstrated dedication in answering the questions in Kahoot, as she stated, "The class demonstrated high commitment and attention while using Kahoot during the review. They were very eager to answer the questions, and all their attention was focused on answering and cooperating with their members."

The teacher becomes motivated. Ms. G experienced increased motivation to teach Biology after the incorporation of Kahoot she shared: “The teacher becomes motivated as well to use the Kahoot in Biology class because the learners had positive comments/feedback like they would not be absent again because of Kahoot, and they pay attention during the lesson.”

Prepared class. The class of Ms. G demonstrated readiness in Biology class through the use of Kahoot in the subject. The learners presented their outputs using neat, organized, and presentable visuals. Moreover, the class was attentive and was able to provide answers to the given questions given to them in the activity.

Improved students' learning. Ms. G noticed the enhancement of learning experience in the subject after using Kahoot in the Biology classroom as stated, “...Despite the short amount of time left, the students still enjoyed answering it. It was also evident that they understood the complex topic of Meiosis by answering most of the items correctly.”

The use of their mobile phone and the game elements embedded in Kahoot, such as points, ranks, and competition enhances their focus, attention, excitement and the energy to keep doing well in the class. The use of Kahoot can gradually improve the learners' performance and interest in a hard subject like Biology.

Group Members collaborated. The use of Kahoot in team mode raised the learners' cooperation in answering the questions in Kahoot. Ms. G explained, “The learners were able to answer though some of the answers were not correct. The class participated well during Kahoot. It was evident that most of the members of the team would like to contribute to answering the questions in the Kahoot.”

Attentive and participative learners. Ms. G perceived the learners' attention and participation in Biology class where evident when Kahoot was integrated into the subject. The class was participative during the discussion, and they were listening to the teacher, and there was no misbehavior observed.

Exciting and enjoyable. Ms. G encountered stimulating and gratifying classroom experience in Biology after using Kahoot. The learners' views, reactions, and feedback with regards to the application of Kahoot in her class prompted the situations.

Technology related experiences. The class of Ms. G revealed the different circumstances in using educational technology in Kahoot these include poor Internet connection, set-up of educational technology, and teacher lent her mobile phones.

Poor Internet connection. Ms. G's employment of Kahoot was affected by the Internet connection. The slow Internet connection prolonged the entire process when starting Kahoot in class.

Set-up educational technology. Ms. G brought the materials and equipment used in the lesson. These include the laptop, projector, screen, speaker, and Wi-Fi.

Teacher lent her mobile phone. The class of Ms. G lack upgraded mobile phones, which resulted in lending her mobile phones. The circumstance happened several times to the same group in her class.

Class management related experiences. Ms. G followed collaborative seating arrangement and encountered some groups giving a hint to other groups while answering Kahoot.

Having a seating arrangement. Ms. G considered this arrangement to minimize class disruption and to maximize the time for the lesson she noted,

The learners were excited to start the class using Kahoot in their Biology class. As the learners entered the classroom, some were asking whether they would have Kahoot on this day. There was minimal space in the classroom, and the teacher asked the learners to sit with their group mates collaboratively.

Giving of a hint. Ms. G caught some group members that intentionally announced their answers to have an advantage over other groups.

Cross-case Analysis of Teachers' Experiences

The multiple case studies in this study provide commonalities and differences which occurred across the teachers or the cases. Each case contributed primarily to the significance of teachers' experiences using Kahoot in the lesson. Assertions were formed regarding the teachers' experiences with the use of Kahoot as an instructional tool in the Biology classroom through capturing on the significant results from each case report.

The cross-case analysis yielded three categories across the three cases or teachers of the present study. These categories addressed the second research question on the experiences of the teachers after using Kahoot in Biology, which yielded the following: *pedagogy related experiences; technology-related experiences; and class-management related experiences*. For each category, subcategories are included to grasp the teachers' experiences better using Kahoot in Biology. This portion emphasizes the uniqueness of the subcategories across the cases on how their experiences differ from each other.

Pedagogy-related experiences

The findings of the cross-case analysis show that all of the teachers who participated in this study used Kahoot chiefly as an instructional tool in the Biology classroom. Each case reported diverse experiences, which are then collapsed similarly in one category in this study. The study results in the following pedagogy related experiences: *easy to explain, focused, attentive, and participative students, improved students' learning, group members collaborated, exciting and enjoyable class, prepared class, and high commitment and attention of students.*

Unique Subcategories

While several categories were prominent across cases, there are few subcategories for each identified categories which are unique to each teacher. The purpose of the cross-case analysis was to attend to these distinct subcategories among the cases. The salient subcategories of the teachers' experiences after using Kahoot are: *easy to explain, the teacher becomes motivated, and students learn easily.*

Ms. C

Easy to explain. Ms. C described the benefit of using Kahoot as an instructional tool in Biology. She found that the flow of the lesson was smooth and explaining the topic became more comfortable for her. According to Ms. C, her students became more attentive while she was explaining the concepts to them.

Ms. F

Teacher enjoys teaching. All of the cases in this study reported the benefits of Kahoot in their classes, and it is worth noting how the teacher also benefited from using Kahoot in Biology. Ms. F perceived that Kahoot made her teaching experience fun and enjoyable.

Ms. G

The teacher becomes motivated. As the learners were more engaged and inclined using Kahoot in Biology, Ms. G's motivation to use it in her class also raised. The learners' feedback and comments that they would not be absent in class again because of Kahoot flourished the teacher's motivation to use Kahoot in the Biology class.

Technology-related experiences

The teachers across this study used educational technologies such as a laptop, LCD projector, screen, and Wi-Fi. They have commonalities concerning utilizing these technologies and the issues they encountered while using Kahoot in the classroom. The technology-related experiences encountered by the teachers are the following: *set up educational technology; poor Internet connection; and teachers lent her mobile phones.*

Unique Subcategories

The subcategories in the technology-related experiences of the teachers were found unique to Ms. G, which include *teachers lent her mobile phone.*

Ms. G.

Teacher lent her mobile phone. Among the three teachers, only Ms. G reported the lack of upgraded mobile phone and lack of mobile of her class. Only one group had difficulty bringing their mobile phone to the class, which was addressed by the teacher through lending her mobile phone.

Class Management Related Experiences. The cases in this study practiced collaborative seating arrangement which maximized the time in the Biology class

Unique Subcategories

Ms. G.

Giving of a hint. Ms. G noticed that while the learners enjoyed the use of Kahoot, she was also aware that some members of some groups deliberately spoke the answers. Unfortunately, the answers they expressed were wrong to gain advantage over the other teams purposely.

Discussion

Teachers' Experiences using Kahoot

The present study aimed to determine the effectiveness of Kahoot as an instructional tool in Biology. Several studies reveal the effectiveness of using Kahoot in the classroom, but little is known about the experiences of the teachers using Kahoot in Biology. The multiple case studies provide insights into the incorporation of Kahoot daily as they compare and contrast the experiences of the teachers and learners using Kahoot in Biology class. The gamification in Kahoot having points, ranks, leaderboards, friendly competition, and immediate feedback raised the learners' interest, engagement, and motivation in Biology. The constructs in SDT states that

intrinsic motivation is characterized *by having more interest, excitement, and confidence* (Ryan & Deci, 2000). Moreover, the friendly-competition of Kahoot flourished the learners' motivation. Reeve and Deci (1996) pointed out that *competition* facilitates intrinsic motivation (IM). Furthermore, the findings were interpreted concerning the modifications of the technology acceptance model TAM of Gu et al. (2013). The constructs of TAM included *outcome expectancy, TTF, social influence, and personal factors* were used to describe further and explain how technology influenced the teaching and learning process in the Biology class.

The experiences of the teachers after the incorporation of Kahoot include *pedagogy-related experiences, class-management related experiences, technology-related experiences, and content-related experiences*.

Pedagogy-related experiences

The pedagogy-related experiences described primarily how the teachers encountered Kahoot as an instructional tool in the Biology classroom. The cases or teachers in this study reported shared experiences: *focused, attentive, and participative, improved students' learning, group members collaborated, exciting and enjoyable class, prepared class, and high commitment and attention of the class*.

Focused, attentive, and participative students. Each teacher expressed how the learners' attention and participation improved after using Kahoot in Biology. They observed that when they started using Kahoot, their students became more focused on their classroom activities. All of the three teachers spoke that more learners participated actively in the discussion and during activities. Ms. C described her class as "...they do the task without hesitating." Ms. F and Ms. G observed that their classes were more attentive as they listened carefully to the explanation of the teachers.

Moreover, Ms. G pointed out that “...teacher exerted less effort, ” after using Kahoot in the Biology class.

Improved students' learning. All the teachers or cases reported that the learning experience of their classes enhanced after using Kahoot in Biology. Ms. C explicitly described that her class understood the concepts clearly. Meanwhile, Ms. G indicated that her class answered the items in the Kahoot correctly, which show that Kahoot raises their ability to learn the subject. Moreover, the classes of Ms. F and G manifested the learners' enjoyment and excitement while answering Kahoot, demonstrating a more engaging class in Biology.

Group members collaborated. The team mode option in Kahoot allowed the learners to work with their groupmates. All of the classes used Kahoot with this option consisting of five to six members while using only one mobile phone. They expressed that the members of the group participated and contributed as they analyzed the questions in Kahoot. They also reported that the members of the group cooperated which flourished their ability to work with others.

Exciting and enjoyable class. Kahoot, as a game-based technology used in the Biology classroom, transformed the classroom experience into a more exciting and enjoyable class. All of the teachers vividly described their experiences with their class as “fun,” “exciting,” and “enjoyable.”

Prepared class. The teachers noticed that the learners were more prepared for their group presentation in Biology for the next meeting. The models made by the learners in Mitosis were neat and organized while their presentation was creative as well.

High commitment and attention of the class. Ms. F and G perceived that their classes were highly committed to answering the questions embedded in Kahoot. They were more eager to

provide correct answers in the Kahoot through brainstorming among their members before coming up with their answers.

The integration of educational technology and Kahoot in Biology class is an outcome expectancy for the Biology teachers in this study. The *outcome expectancy* refers to the perceived usefulness and the actual use of technology (Gu et al., 2013). Similarly, the cases reported the usefulness and advantages of Kahoot in teaching and learning Biology. The multiple sources of data provide evidence which serve as the basis in describing the use of the technology. With regards to outcome expectancy, the teachers or cases encountered positive experiences in teaching Biology using Kahoot. The cases reported the advantages or positive outcomes of incorporating Kahoot such as *focused, attentive, and participative, improved students' learning, group members collaborated, exciting and enjoyable class, prepared class, and high commitment and attention of the class*. The advantages yielded using Kahoot as a game-based technology are parallel to other researches which also used Kahoot in the Science classroom including Pede (2017) and Licorish, Owen, Daniel and Li George (2018) specifically in terms of improved learning experiences and engagement. Thus, the results show the positive experiences of the teachers using Kahoot in Biology class. In terms of outcome expectancy, the cases' or teachers' experiences after using Kahoot in Biology were beneficial to their learners and in teaching the subject.

It is worth noting that the results yield in this study using Kahoot in Biology are unique and not yet reported in the literature, such as the enhanced cooperation, prepared class, and high commitment and attention. The team mode option of Kahoot increased the learners' collaboration and interaction with each other. The enhanced collaboration reported across the cases was supported by Higgins, Xiao, and Katsipataki (2012) in the collaborative use of technology. According to Higgins et al. (2012), the use of technology in pairs or small groups is usually more

effective than individual use. Overall, the outcome expectancy of the usefulness of Kahoot included cognitive and affective outcomes. The cognitive outcome is *improved students' learning*, while the affective outcomes are *focused, attentive, and participative, group members collaborated, exciting and enjoyable class, prepared class, and high commitment and attention of the class*. Thus, based on TAM, the acceptance of technology for the Biology teachers is due to the outcome expectancy, which is found positive.

Technology-related experiences

Set up educational technology. Ms. C expressed that the teachers need to put everything like the laptop and LCD projector, which sometimes consumed much time. Also, she pointed out her responsibility to transfer all the educational technology to her next class. Meanwhile, Ms. F and Ms. G had a similar experience of preparing and putting up the educational technology in the classroom before using Kahoot.

Poor Internet connection. All the teachers happened to have a slow Internet connection while using Kahoot in the classroom. This situation happened on the first day and occasionally due to the weak signal in the school.

The technology-related experiences of the teachers manifest the challenges encountered in the incorporation of Kahoot in the Biology class. Unlike the pedagogy-related experiences which demonstrated positive experiences, these experiences were negative and may generate unsatisfactory beliefs and attitudes towards the use of Kahoot. The cases indicated their preparation in setting up educational technology in the classroom and the poor Internet connection, which impeded the incorporation of Kahoot in the subject. Consequently, the acceptance of technology Kahoot in the Biology classes is based on the potential benefits that the teachers

perceived and was verified by Gu et al. (2013) as the most critical predictor of technology use. Moreover, the perceived usefulness and ease of use are also predictors of teachers' attitude towards the incorporation of technology. The ease of use using Kahoot was affected by the factors reported by the teachers, including setting up of educational technology and the poor Internet connection.

Furthermore, researches in Kahoot did not provide any similar findings in terms of setting up educational technology in the classroom and the poor Internet connection. The poor internet connection experienced by the teachers in this study was not reported in the literature specifically those studies which also utilized Kahoot (Licorish et al., 2018; Plump & Larosa, 2017; Pede, 2017). According to the Ookla speed test report (Barreiro Jr., 2018), the mobile broadband speed in the Philippines is below the global average. Our country ranked 176th out of 202 nations around the world with an average download speed of 3.64 Mbps. It got the slowest average broadband speed among the ten ASEAN nations (Marasigan, 2016). The unstable Internet connection experienced by the learners was due to the country's slow broadband speed.

Similarly, the problem was combated by providing two broadband to the classes. However, when the data became lower, the broadband speed also gets slower. Similarly, the set-up of educational technologies consumed much time, which resulted in negative ease of use of technology, specifically, Kahoot. This finding is contrary to the study of Xiong (2018), which yielded positive ease of use of technology when used to Hmong students in Biology course. The experiences of the Biology teachers in this study reflect the challenges of the teachers when integrating technology in their classes. The challenges of the teachers may negatively influence the technology acceptance of Kahoot in the Biology classroom. Moreover, the experiences of the teachers provide a piece of new knowledge in the literature about the negative experiences using Kahoot in the classroom. Overall, the technology acceptance of the teachers using Kahoot in

Biology has a negative influence on their perceived technology acceptance due to the poor Internet connection and teachers' preparation of educational technology.

Class-management related experiences

Having a seating arrangement. All the cases employed a collaborative seating arrangement while using Kahoot in a team mode option. The learners stayed to their assigned places from the beginning until dismissal to avoid undesirable behavior and to maximize the use of time. The collaborative seating arrangement across the three classes maximized the use of one mobile device per group. In the study of Scholz (2016), the collaborative seating arrangement encouraged the learners to seek help from one another while they were using their device during the lesson. In this study, the seating arrangement formed groups which promoted collaboration and cooperation among the learners. This knowledge gives us the idea of how the use of game-based technology nurtures collaboration among learners. Moreover, teachers may consider this practice to promote more interaction and collaboration among learners when using Kahoot. Overall, the limited spaces in the classroom made the learners interact with one another closely and allowed them to brainstorm before answering the questions in the Kahoot.

Learners' Experiences Using Kahoot

The Grade Eight learners' experiences after using Kahoot in their Biology classes consist of the following: subject-related experiences, group-related experiences, technology-related experiences, content-related, and game-related experiences.

Grade Eight Daisy

The experiences of Grade Eight Daisy after using Kahoot consist of the following categories: subject-related experiences, group-related experiences, technology-related

experiences, and game-related experiences. Furthermore, each category entails subcategories which provide rich and thick data to address the research question, what are the experiences of the learners after using Kahoot in Biology class?

Subject-related experiences

The class of Grade Eight Daisy reported various subject-related experiences which entail subcategories that speak primarily on their experiences and combined into one category.

Fun, exciting, and enjoyable. The learners vividly described their excitement, enjoyment, and fun after using Kahoot in Biology classroom as reported below.

At first, I really don't have any idea about Kahoot. I thought that it's just one boring app that's why we're asked to use a cellphone but as time passed by, I realized that it's enjoyable. Because often, Science is boring and quiet because nobody recites. But when we use Kahoot, almost everyone became active, eager to recite, and united, especially in competing points. It's enjoyable, exciting with nervousness, especially when you're not able to answer. (S7)

It is fun and exciting, especially on the part of answering because we get united about the answer, then, they/my groupmates are happy when we get high points (S8).

It was so exciting and I wish every science subject was like this (S1).

It's fun to play Kahoot; you would really learn not only about the topic of your lesson but also unity with your group mates (S20).

For me Kahoot is very interesting and enjoyable when we participate we felt happy and now my favorite subject is Science (S7).

Kahoot is also enjoyable because it tests your trust towards your friends. If you will trust in his/her answer, your friendship will grow deeper (S4).

So this is my first time using Kahoot I thought it will be going to be hard but it is really fun it gets more intense so I get more active in reciting (S4).

Fun and challenging. Aside from enjoying Kahoot the learners were challenged as well to answer the questions embedded in the application, the learner expressed, “In my experience, it sometimes gets boring, but I'm still challenged so just like the previous guys said, it was challenging...the victory and glory pumping my adrenaline, and yes I repeat, it is fun and challenging” (S8).

Learned attention and patience. The learner, in this case, improved his ability to be patient and showed undivided attention in Biology class after using Kahoot.

Learned and had fun. The learners spoke explicitly that the employment of Kahoot was enjoyable at the same time they were learning a lot in the subject well.

It's fun to play Kahoot even though it causes tension too. Despite that, I got interested because aside from learning, you will also be happy when you answer quickly (S9).

I am happy to be able to join Kahoot because I learn a lot. I am so glad because we got ^{first} place. I hope there will always be Kahoot (S13).

It's more fun for the lesson. I really learned a lot... (S22).

I enjoyed even though my group mates and I did not win. We learned and understood a lot (S29).

Challenged. While some learners were entertained with points, ranks, and competition-based environment of Kahoot, some learners felt challenged to be on top of the ranks at the end of the game. They perceived that listening attentively to the discussion would lead to higher ranks in the game.

Group-related experiences. The class of Grade Eight Daisy expressed several experiences with the use of Kahoot, specifically with their groupmates, which include the following: *fun sometimes disappointing, losing the game, and learned to cooperate.*

Fun sometimes disappointing. Some learners found Kahoot enjoyable but frustrating, sometimes due to the incorrect answers given by their groupmates. Despite their brainstorming, there were times that they answered incorrectly, which resulted in the blaming of their groupmates.

Learned to cooperate. The learners spoke on how Kahoot improved their cooperation with their groupmates as expressed below.

Ma'am, before I do not really cooperate but when Kahoot started, I got motivated to share with them (S3).

I learn now what the importance of teamwork is because even you are in top you can be down (S21).

Technology-related experiences

The class of Daisy reported several technology-related experiences concerning the employment of Kahoot. These experiences: *bring a cellphone, cellphones are not upgraded, and slow Internet connection.*

Bringing of a cellphone. The learners manifested the utilization of cellphone which was used in Kahoot as reported: "In one group, Ma'am, one person has to bring a cellphone and there should be unity in each group to get the top and highest award in Kahoot" (S8).

Cellphones are not upgraded. Some groups of Grade Eight Daisy stated their inability to provide an upgraded mobile phone which can connect to the Internet.

Sometimes, we don't have cellphones or our cellphones are not upgraded yet. We still learn a lot in Science. Sometimes we win; other times we lose because we have to compete with other groups; (participate in your group) and listen to your teacher so that you'll know the answer in Kahoot. It's fun! (S5)

Slow Internet connection. The learners' experience using Kahoot was affected by the poor Internet connection they stated,

Great idea for teaching a lesson but our connection is very low (S21).

I did not enjoy the Kahoot game because of the Internet connection (S23).

I did not enjoy today's game because of the Internet but on the second hand, I am happy that we rank first place in a short while (S24).

Game-related experiences. The experiences of the learners include not only with the use of technology but also on how they felt with the game after using it in the Biology classroom these are *losing the game, and intense and fun.*

Losing the game. The enjoyment and energy of the learners were high while they were answering Kahoot; however, some learners reported their frustration after getting low scores in the game.

I'm starting to get tired of using Kahoot our group is always on the top 8 which means we're out of the top 6 at the same time I am motivated to cooperate and give my best hope nextime where on top 6 (S29).

I am so disappointed we lost the game we are out of the top 6 and the question are on to but I know we gave our best out there we will do better next time (S30).

Every time I play Kahoot each time I lose (S26).

Kahoot is fun, but we lost (S28).

Intense and fun. Several learners expressed how extreme and fun the game was using Kahoot in Biology.

Kahoot is a very nice science game app ..it' s like expecting the things that you don't usually feel, it is intense and a lot of fun .. it helps to sharpen your minds and be aggressive. We really enjoy it I hope all of the school have this kind of game (S3).

An experience that using Kahoot is fun it's more interesting, intense, and it's perfect now in our generation the digital age (S22).

Grade Eight Ilang-ilang

The class of Ilang-ilang arrived with a broad array of experiences with regards to the employment of Kahoot in the Biology classroom. The emerging categories are reflecting their experiences using Kahoot: *subject-related experiences, group-related experiences, technology-related experiences, and game-related experiences.* These categories provide a general idea regarding the experiences of the learners, which are further supported by the subcategories analyzed by the researcher.

Subject-related experiences. These experiences of the learners demonstrate their feelings and how Kahoot improved the learning in the subject:

Fun, exciting, and enjoyable. The class of Ilang-ilang stated that using Kahoot was more exciting and they hoped to get a high score. Also, the subject became more interesting for them as they said,

I am very happy to play a Kahoot it's very fun and I appreciate that all of my classmates enjoying it (S5).

Today March 14, 2018, we played Kahoot at first we got the lowest scores but in the end, our team got top 2, and we are happy about it (S21).

I love Kahoot it was very exciting because after the game you will see your score. Kahoot is a fun game you can learn more about Kahoot you can have points (S20).

Learned and had fun. The learners of Ilang-ilang experienced the benefits of using Kahoot towards their study. They reported several times that they were learning and understood more the lessons. They stated that it was fun to play Kahoot because they had fun while learning. They also learned the Cell Cycle and DNA.

I learned a lot today and I've been so much fun learning Biology (S2).

I enjoy playing Kahoot because we were learning and having fun (S7).

Learned a lot. The learners shared how the use of Kahoot improved their learning experience in the subject.

Kahoot is really good. I learned a lot again and gained friends. I hope Kahoot becomes a subject (S29).

Easier to understand the lesson. Some learners reported the benefit of using Kahoot in Biology classroom specifically in understanding the lesson as expressed below,

It makes easier to understand the lesson. It's very exciting because at the end of the game we can see our ranking (S16).

Group-related experiences. The learners played Kahoot in a team mode option, and they were expected to work cooperatively, but some members of the groups failed to contribute to do it. They also practiced and learned the importance of teamwork, especially in doing their tasks unexpectedly, some experienced copying and fighting. They provided the following thoughts.

All the members cooperate. The learners reported how they practiced teamwork after using Kahoot in Biology class and stated:

It's fun to play Kahoot because through simple questions we're able to know what we should learn and when we use Kahoot, we have teamwork because we're all united and cooperative in each activity (S8).

When we use Kahoot, all of us get energized because we will compete with each other even though we're classmates, then all cooperate to be rank 1 (S1).

It's fun to use Kahoot because almost everyone wants to see their rank. Many cooperate; even though it makes us nervous, it is still fun (S17).

Learn to cooperate. The learners expressed too that they were beginning to learn cooperation through the employment of Kahoot as they reported,

I feel more motivated to answer when we use Kahoot unlike in other subjects. In Kahoot, we develop cooperation (S2).

Kahoot is super interesting, fun, exciting, and it builds cooperation in our group (S10).

Copying and fighting. Unexpectedly, some members of the groups copied to other groups and fought to get higher points in Kahoot as expressed,

It's fun to use Kahoot because the answers are being said, some copy from the other groups. Some even fight but it's still enjoyable because of teamwork (S6).

Its difficulties are at times, Wi-Fi connection is slow and the groupmates quarrel because we have to compete in giving the answer, and if the answer is wrong, they blame one another (S7).

Technology-related experiences. The class of Ilang-ilang experienced the employment of technology, which includes *having a slow Internet connection.*

The activity today was fun but we lost because we have some difficulties in the connections still it's interesting and fun. (S26).

Another difficulty is slow Wi-Fi. We submit our answers late which causes Kahoot's response to being delayed (S1).

Content-related experiences. The class of Ilang-ilang spoke regarding the content of the questions they encountered in Kahoot such as *difficult questions and guessing of answers.*

Difficult questions. Some learners reported the challenging questions they found in Kahoot as expressed below,

This day, we used Kahoot again for us to learn. We enjoyed using Kahoot. The questions become more difficult also (S22).

...Besides, sometimes, the questions are difficult that's why we make mistakes and blame each other (S8).

Guessing of answers. Some groups in section Ilang-ilang resulted to guessing instead of brainstorming the answers due to the difficulty of the questions as stated, "Sometimes, we do not know what to answer then we just guess, but we try to learn for our rank."

Game-related experiences. The Grade Eight Ilang-ilang spoke on their experiences with Kahoot as a game-based technology used in their Biology class these entail the following: *exciting sometimes disappointing, concentrated in the game, and intense and fun.*

Exciting sometimes disappointing. The learners recognized fun, enjoyment, and excitement using Kahoot, consequently some turned these emotions into frustration after losing the game or having lower rank at the end of the game as shared by the learner, "It is fun because all of us help each other but sometimes it is disappointing because we expected to be first but were not. It's also exciting because you get excited about the questions and whether you'll be rank 1" (S5).

Concentrated in the game. Some learners spoke on how they became focused in Kahoot as expressed by the learner, "Kahoot is so nice to use because I can concentrate in the game. Even though the Wi-Fi connection is slow, it's still good to play" (S9).

Intense and fun. The thrill brought by the Kahoot made the experiences of some learners' fun, intense, and enjoyable as reported, "My reflection on lesson today was it makes intense, excited and nervous but in the end, it's enjoyable" (S6).

Grade Eight Sampaguita

The class of Grade Eight Sampaguita encountered: *subject-related experiences, group-related experiences, and technology-related experiences*. These categories reflect their experiences using Kahoot in the Biology classroom. Each category is further described and supported by various subcategories across the multiple data collected from this case.

Subject-related experiences

The subject-related experiences reported by the class of Sampaguita revolve upon the cognitive and affective spectrum of learning such as *fun, exciting, and enjoyable, motivated and excited, learned a lot, fun and energizing, greater happiness, and gives more interest to listen*.

Fun, exciting, and enjoyable. The learners reported the effects of using Kahoot in their Biology class explicitly. They expressed their emotions as well as its impact on their learning.

At first, I feel that it will be boring, but when we used it, I got excited and as the questions near the end, I wanted to have more because we haven't won yet. Then, as time passes by, I became more interested in Kahoot because it is fun (S3).

This day I learned that topic Mitosis and what means of G1, G2, S, and others I very enjoy the lesson. It's fun and exciting to learn many lessons in science (S39).

What I can say about Kahoot is that it's beautiful and fun. The questions are exciting and you need to answer quickly to win. Even though we lost, I am still happy with Kahoot game and I hope that this can be repeated (S5).

Kahoot is very exciting and full of enjoyment. I like Kahoot and I want to use it every day in our science class (S12).

Motivated and excited. This case also spoke on how their motivation in the subject flourished as they became more excited in Kahoot as shared, "I am very motivated and excited in Biology class because of the game Kahoot. It's very entertaining and I am very happy to play it" (S30).

Learned a lot. Aside from enjoying the use of Kahoot, the learners reported the effects of Kahoot towards learning the subject.

Today was a great day because we had activities we do in science subject, also we enjoy the activities because it challenges us. I also learn more lesson from our teacher (S31).

About the lesson for today, I was happy because of the Kahoot, Kahoot is the instrument to more learning about the topic for every day (S38).

It was fun because we answered Kahoot again and we report about Mitosis and Meiosis. We recited so many questions so I learned many in Mitosis and Meiosis (S41).

I approve of Kahoot more strongly because I learn a lot and it's so enjoyable and helpful to the students (S40).

Fun and energized. The learners became enthusiastic and energetic after the incorporation of Kahoot in the Biology subject as expressed by a learner.

For me, Kahoot is exciting since the beginning. Of course, in Science, when the teacher gives lessons, I get sleepy. However, in forming groups, it gets lively because we say," Ma'am, wait, we haven't been able to connect yet. It is enjoyable, makes me energetic and not sleepy. You learn new things in Biology using it. It is exciting! (S6)

Gives more interest to listen. Through the game-based technology, the learners' attitude improved, and they became more attentive during the discussion. "I enjoy using Kahoot. It gives me more interest to listen to our Biology teacher. I found it exciting" (S42).

Group-related experiences

The collaboration among the learners was tested using Kahoot. They became more aware of the significance of cooperation and how it would affect their performance in Kahoot. The class of Sampaguita encountered the following using Kahoot in the Biology class: *learned to cooperate, teammates did not help, competing and fighting, and all members cooperate.*

Learned to cooperate. The learners realized their role in answering the questions in Kahoot and how active participation and cooperation raised their performance in Kahoot as expressed by the learner, "Besides, sometimes, when we don't do Kahoot, I really miss it because, through it, we're able to show help to one another in coming up with the answer. After Kahoot it's fun because even though you're the lowest you still did" (S1).

Aside from it being a good way to review, it develops cooperation in each group. It boosts the self-confidence of everyone, unlike before that nobody recites. When it comes to Kahoot they rush to answer because they lose shyness. They are also united unlike before that they're uncooperative; it seems that their minds become one to compete for points and answer. (S7)

Teammates did not help. Despite the positive experiences of Sampaguita in answering Kahoot with their groupmates, some learners spoke that there were instances that their teammates were uncooperative. A learner reported, "What I do not like is that my teammates do not help that

much and if they help, they give wrong answers that's why our teammates become confused. This is the only thing I do not like" (S3).

Competing and fighting. The game-based technology having a gamified environment, as well as competition, resulted to competition and small quarrel of Sampaguita as explained by the learner, "At first, because they have very high self-confidence, they compete to answer to the point that they almost drop the cellphone because they keep on pressing it. Then if the answer is wrong, they will argue, with a shout at, and fight with each other, but in the end, it is still fun" (S7).

All members cooperate. The case of Sampaguita encountered the maximum involvement of their groupmates using Kahoot in Biology class as stated,

It's fun because everyone participates and we learn a lot (S7).

What I can say about Kahoot. It is that the second day of playing with the group mates, we always lose but still fun because all of us were involved (S7).

Technology-related experiences

The case spoke on their encounter regarding the integration of technology in Kahoot. Their experiences include *connecting phones to Wi-Fi, not upgraded cellphones, and slow Internet connection.*

Connecting phones to Wi-Fi. The learners learned the routine when using Kahoot in the Biology classroom; the teacher usually gave instructions to the learners before starting Kahoot:

Of course, Ma'am, we will turn on our cellphones first, then the Wi-Fi. We will connect (our phones to the Wi-Fi), then we will search Kahoot and press it. Then, there is the game pin. Of course, we will write the game pin. Our team name, what we have talked about as

the team name, then the names of our members. Then, we will wait for a few seconds before Kahoot starts. There are questions, and we cooperate to answer the questions flashed onscreen. Then, we check if our answers are correct. (S1)

Not upgraded cellphones. One problem encountered using Kahoot was the lack of upgraded mobile phones. Unfortunately, some groups in Sampaguita lack having upgraded or mobile phones which can connect to the Internet a learner shared, "My bad experience in Kahoot is; first, there is no cellphone, the cellphone is not upgraded, and you will have arguments with your groupmates because you need grades" (S5).

Slow Internet connection. Aside from using old models of phones, the other prevailing problem related to technology was the poor Internet connection as expressed by the learner: "The difficulties in using Kahoot. In the first Kahoot, we're not able to join because the Internet connection is so slow and we're not able to enter immediately, but the second time, we got the first place" (S2).

Cross-case Analysis of Learners' Experiences

The multiple case studies or classes in this study demonstrated similarities and differences which appeared across the cases. These similarities and differences manifested the experiences of the learners using Kahoot as an instructional tool in the Biology classroom. The researcher made assertions regarding these experiences by capturing the results from each case report. The present study performed a cross-case analysis across the three cases or sections. The study yields the following categories: *subject-related experiences; group-related experiences; technology-related experiences; and game-related experiences, and content-related experiences.* Furthermore, for each category, subcategories are included to understand better the learners' experiences using

Kahoot in Biology. These emphasize the distinct categories and their subcategories across the cases on how they shared commonalities as well as their differences.

Subject-related experiences

The results of the study indicate how the learners used Kahoot in their Biology classes. Specifically, these mirror the pedagogy-related experiences of the teachers on how they used Kahoot as an instructional tool in Biology. Each case spoke on how they benefit using Kahoot in Biology class which include the following subcategories: *fun, exciting, and enjoyable, motivated and excited, learned a lot, fun and energizing, gives more interest to listen, fun and challenging, learned attention and patience, learned and had fun, challenged, fun and energizing, more motivated, and easier to understand the lesson.*

Unique subcategories

While several categories were common across cases, there are few subcategories for each identified categories which are unique to each case. The cross-case analysis aimed to address these distinct subcategories among the cases. The learners' experiences in terms of their subject-related experiences are: *fun and challenging; learned attention and patience; challenged; fun and energizing; gives more interest to listen; more motivated; learning and having fun; and easier to understand.*

Grade Eight Daisy

The class of Daisy yielded distinct subcategories such as *fun and challenging, learned attention and patience, and challenged.*

Grade Eight Ilang-ilang

The class of Ilang-ilang demonstrated different experiences such as *more motivated, learned, and had fun, and easier to understand.*

Grade Eight Sampaguita

The learners of this class exhibit the following distinct experiences: *motivated and excited; fun and energizing, and gives more interest to listen.*

Group-related experiences

The three cases encountered group-related experiences using Kahoot in the team mode option of Kahoot. The said option raised more interaction and collaboration among the members of the team for each case. The learners' group-related experiences are *fun sometimes disappointing, and all the members cooperate, learned to cooperate, copying and fighting, teammate did not help, and competing and fighting.*

Unique subcategories

While the three cases reveal parallel subcategories, the results appeared salient differences, which include *copying and fighting, teammates did not help, and competing and fighting.*

Grade Eight Daisy

Fun sometimes disappointing. The learners found the use of Kahoot thrilling yet frustrating due to the lack of cooperation of the members of their group.

Grade Eight Ilang-ilang

Copying and fighting. Some learners encountered copying and quarreling to attain higher scores after Kahoot. The said problems even resulted in blaming after giving incorrect answers in Kahoot.

Grade Eight Sampaguita

Teammates did not help. The class of Sampaguita expressed their dismay, especially to some members of their group who failed to show cooperation and for giving incorrect answers in Kahoot.

Technology-related experiences

The three sections reported their experiences with the employment of technology in Kahoot such as *bringing of a cellphone, cellphones are not upgraded, slow Internet connection, not able to join Kahoot, and connecting phones to Wi-Fi.*

Unique subcategories

While the three cases shared common experiences in terms of employing technology in Kahoot, findings reveal distinct experiences of the three sections in Biology class after the use of Kahoot which are *bringing of a cellphone and connecting phones to Wi-Fi.*

Grade Eight Daisy

Bringing of a cellphone. The class of Daisy spoke the need to bring and use a mobile phone using Kahoot in the Biology class.

Grade Eight Sampaguita

Connecting phones to Wi-Fi. While all the sections connected to Wi-Fi before using Kahoot, only the class of Sampaguita reported this experience.

Game-related experiences

The incorporation of game-based technology Kahoot in the Biology classroom became evident to the cases of Daisy and Ilang-ilang only. They stated how the gamified environment affected them after using it in Biology class, which entails *losing the game, intense and fun, exciting sometimes disappointing, and concentrated in the game.*

Unique subcategories

Grade Eight Daisy

Losing the game. The friendly competition of Kahoot resulted in either winning or losing at the end of the game. Some learners were disappointed after having low ranks consecutively but still hope to improve it the following Kahoot.

Grade Eight Sampaguita

Connecting the phones to Wi-Fi. Although all the cases connected to the Wi-Fi before the start of Kahoot, only Sampaguita reported the need to perform it.

Content-related experiences

The content-related experiences deal with how the learners perceived the questions in Kahoot. These include *difficult questions and guessing of the answers*.

Grade Eight Ilang-ilang

Difficult questions and guessing of answers. Across the three cases, only the case of Ilang-ilang reveals their experiences when it comes to the questions embedded in Kahoot. The case encountered complex questions which resulted in the guessing of answers.

Discussion

Learners' Experiences using Kahoot

The Grade Eight learners' experiences after using Kahoot in their Biology classes consist of the following: subject-related experiences; group-related experiences; technology-related experiences; content-related; and game-related experiences. The results were interpreted based on SDT by Ryan and Deci (2000) and TAM of Gu et al., (2013).

Subject-related experiences

The findings of the study demonstrate the experiences of the learners in Biology after using Kahoot which include *fun, exciting, and enjoyable, motivated and excited, learned a lot, fun and energizing, gives more interest to listen, fun and challenging, learned attention and patience, learned and had fun, challenged, fun and energizing, more motivated, and easier to understand the lesson*.

Fun, exciting, and enjoyable. Each case reported that they had fun, exciting, and enjoyable classroom experience after using Kahoot in the Biology class. The class of Daisy said that they were more participative and their quiet sessions in Science transformed into a more interactive

class after the integration of Kahoot. Moreover, the class of Ilang-ilang was captivated seeing their points and scores after the game making them delighted at the end of the game. Moreover, the class of Sampaguita became excited with each question in Kahoot and underscored their enjoyment with Kahoot.

Learned a lot. According to Grade Eight Ilang-ilang and Sampaguita, the use of Kahoot improved their learning in Biology. The class of Sampaguita expressed greater satisfaction, especially in terms of learning the subject every day through Kahoot.

The three cases have shared or similar experiences after using Kahoot in their classes. The learners reported how the integration of Kahoot enhanced their learning in Biology class. They expressed that Kahoot was not only enjoyable, but they were learning at the same time. Thus, their knowledge improved after using the game application. Their enjoyment while playing Kahoot helped the learners to appreciate more the subject despite its complexity. Also, their rich experiences using Kahoot reflect positive outcome expectancy; thus, results show that when the learners perceived the usefulness of Kahoot which support learning and encourage participation, they see the usefulness of the technology. The findings of this study were contrary to the study of Carrió, Larramona, Baños, and Pérez (2011) where the learners who were taking up Biology found the lecture-based learning more effective than game-based approach. However, several studies confirm this finding that the use of Kahoot was effective in enriching the learners' experiences and learning (Pede, 2017; Plump & LaRosa, 2017).

Moreover, the classroom experience was not only delighting for the learners because they were also learning at the same time with the integration of Kahoot. The questions embedded in Kahoot assisted the learners in processing the concepts they learned in the subjects. Thus, a

meaningful experience where fun and excitement manifest in the classroom influenced the motivation of the learners to be more self-determined (Ryan & Deci, 2000). Also, the gamified environment of Kahoot having points, ranks, leader boards, and immediate feedback amplified the fun, excitement, and enjoyment of the learners, thus, increased their motivation in the subject.

Group-related experiences

The learners' group- related experiences indicate cooperation and sometimes lack of it using Kahoot in the Biology class. Others reported copying, competing and fighting, and fun sometimes disappointing. The cooperation of the learners was evident across all the cases. They learned how to contribute to their team in responding to the questions embedded in Kahoot. These findings were similar across all the Grade Eight learners. Furthermore, they reported that the team activity of Kahoot allowed them to cooperate in answering the questions, and more importantly, they realized the importance of helping one another while doing the activities in the classroom. S5 from Grade Eight- Daisy reported the benefits of Kahoot: "A better way in socializing with your teammates."

Moreover, the learners' collaboration among their members improved after using Kahoot in Biology. It is worth noting how the learners perceived the importance of teamwork in performing a task like answering Kahoot. They started to realize that each member should contribute to the team. The use of Kahoot in a team mode facilitates teamwork in Biology, thus, improving their interaction among one another. Relatedness is one of the constructs in SDT, and it refers to the belongingness of an individual (Ryan & Deci, 2000). The use of Kahoot in a team mode option satisfied the need for relatedness or belongingness of the learners when they supported their team members in answering the questions in Kahoot. The enriching experiences of

the learners using Kahoot promote cooperation and contribute to the new knowledge in the literature, explicitly using Kahoot in Biology class.

Contrary to the result that Kahoot promotes teamwork, the learners across Grade Eight and the multiple of data also reported a lack of collaboration among their members. Unexpectedly, they reported the following disadvantages of the Kahoot such as fighting, losing the game, guessing of answer, and copying from other groups. S12 from Grade Eight- Sampaguita reported, "I feel down if we lose the game and some of my members did not cooperate, and we got the 2nd to the lowest but if fun to do Kahoot." While S14 from section Daisy said, "Every time, I play Kahoot each time I lose..." The learners tend to blame each other when they gave incorrect answers in Kahoot, which resulted in low scores and ranks in the game. According to TAM, social influence affects the learners in using or accepting the technology or not. The cases in the study exhibited positive and negative feedback, which may affect their acceptance of the technology. According to Gu et al. (2013), social influence is the ability of the person to execute or not to execute a task due to the perceived social pressure. The reported positive and negative outcomes using Kahoot may have an impact on the Grade Eight learners' intention to use the technology. Overall, the attitudes and beliefs of the learners to accept technology in their Biology class may be influenced by social influence such as fun sometimes disappointing, all the members cooperate, learned to cooperate, copying and fighting, teammates did not help, and competing and fighting.

Technology-related experiences

The cases reported their experiences with the use of Kahoot and educational technology which entail *bringing of a cellphone, cell phones are not upgraded, slow Internet connection, not able to join Kahoot, and connecting phones to Wi-Fi.*

The cases across the multiple data reported that the weak Internet connection was one of the difficulties they encountered in Kahoot. The need for Internet connection was also the disadvantage mentioned in the literature (Cutri et al., n.d.). S3 from Grade Eight - Daisy stated, “I did not enjoy the Kahoot game because of the Internet connection.” In addition to the slow Internet connection, some learners experienced a lack of mobile phones or upgraded mobile phone. Further, one group from section Sampaguita failed to work with their members due to the lack of a mobile phone. Although there were some groups with excess mobile phones, the learners did not lend nor borrow from other teams. The teachers addressed this problem by lending their mobile phones. The lack of a mobile phone or device was also encountered by other schools which integrated the bringing of a personal device (BYOD) to school. In the study of Scholz (2016) in one suburban elementary school in the US with school-wide BYOD policy, some pupils were unable to bring their mobile phones. The school's program was supported by lending the school's computers and devices to the learners. Future studies may consider grouping the class and distributing among the groups the learners who have upgraded mobile phones. This practice may lessen the negative outcome expectancy of Kahoot when used in the classroom; thus, improve the experience of the learners.

The negative experiences in terms of ease of use due to the weak Internet connection and lack of mobile phones may generate unsatisfactory beliefs and attitudes toward the use of Kahoot and educational technology. Overall, despite the negative ease of use of Kahoot, all the cases reported positive expectancy outcome, which outweighs the reported weaknesses.

Game-related experiences

The incorporation of Kahoot in Biology class also generated game-related experiences: *losing the game, intense and fun, exciting sometimes disappointing, and concentrated in the game.*

The game-based technology with its game elements such as points, ranks, leaderboards, and immediate feedback increased the achievement and engagement of the learners (Cutri et al., n.d.; Plump & LaRosa, 2017). The enjoyment and energy of the learners were high while answering Kahoot. However, some learners reported their frustration after getting low scores in the game a learner reported, “Every time I play kahoot each time I lose” (S26). The learners’ experiences of losing the game and disappointment are also considered as negative outcome expectancy and may generate negative beliefs and attitudes towards the use of Kahoot in Biology.

Consequently, the friendly-competition of Kahoot made the learners’ experiences intense and fun. The study of Xiong (2018) supported the results in the use of technology in Biology, which promoted a positive impact on the students and the positive use of technology. Overall, the game-related experiences of the cases using Kahoot in Biology generated both positive and negative outcome expectancy.

Comparisons of Teachers’ and Learners Experiences’ using Kahoot

Kahoot is an online game application which offers different forms of assessment such as survey, jumble, quizzes, and discussion (Kahoot, 2018). It has a gamified environment which includes points, ranks, leaderboards, and immediate feedback. Several studies show that Kahoot positively affects the academic motivation, engagement, and motivation of learners (Plump & LaRosa, 2017; Pede, 2017). Consequently, the literature shows little knowledge with the experiences of the teachers and learners utilizing Kahoot in Biology.

The cross-case analysis yielded three categories across the three cases or teachers of the present study. The teachers reported the following: (1) pedagogy-related experiences; (2) technology-related experiences; and (3) class-management related experiences, meanwhile, the

learners reported the following experiences: (1) subject-related experiences; (2) group-related experiences; (3) technology-related experiences; and (4) game-related experiences. Some categories mirror each other while others are found unique to each case. It exhibits both the teachers' and learners' experiences using Kahoot in Biology (See Appendix U). The pedagogy-related experiences of the teachers mirror the learners' subject-related experiences. The experiences reported by multiple cases in the study demonstrate the effectiveness of Kahoot as an instructional tool in Biology. The cases perceived the benefits or advantages of using Kahoot in Biology. Overall, both the cases of teachers and learners experienced the usefulness and effectiveness of Kahoot in teaching and learning Biology, which may influence their acceptance of the technology.

Moreover, both the teachers and learners encountered technology-related experiences which are parallel to each other in terms of the lack of mobile phone or upgraded mobile phone. Besides, they reported the poor Internet connection, which indicates negative ease of use of Kahoot in Biology. Nevertheless, only the teachers spoke of the preparation and set up of the educational technology before using Kahoot. The reported difficulties of the teacher and learners using Kahoot may generate negative beliefs or attitudes towards the acceptance of Kahoot, but its positive outcome expectancy is higher and more beneficial to the participants compared to the reported adverse experiences. The negative ease of use may be avoided in future studies through considering secure Internet connection and disseminating learners with mobile or upgraded mobile phones across the groups.

Meanwhile, the class-management related experiences and group-related experiences mirror the teachers' management with the learners' collaboration. The collaborative seating arrangement of the learners promoted more interaction and cooperation among the team members.

Unexpectedly, there were some reports of fighting, competing, and copying using Kahoot which were not reported by the teachers. Also, the gamification elements of Kahoot were evident only to the learners' game-related experiences. The friendly-competition in Kahoot ended in losing the game and disappointment, while some reports shared intense and fun, which are positive outcome expectancy of Kahoot. According to Lister and College (2015), the increasing motivation stems from the immediate feedback and acknowledgment obtained after completing a task. Also, levels in Kahoot yielded a positive impact on the learners' engagement and motivation. The elements embedded in Kahoot were found effective in motivating and engaging the learners in Biology.

Furthermore, only the learners reported content-related experiences in which they found the questions in Kahoot difficult and challenging. According to SDT, challenging tasks can increase a person's motivation. In the case of answering Kahoot, the questions should be engaging to the learners. The gamified nature of Kahoot positively impacts the learners' motivation towards the subject. According to Bjørner and Hansen (2011), games are essential in motivating learners.

Moreover, the levels or elements of the game and the learning content should coalesce. Thus, the logic of the game was essential for learners' motivation. Further, it was emphasized that the game should not compromise the learning of the students (Bjoerner, 2011).

Overall, the experiences of the teachers and the learners reflect each other in some of the emerging categories in the study, while others are found unique. Their experiences are anchored on the SDT of Ryan and Deci (2000), which explain how the teachers' and learners' motivation enhanced through the use of Kahoot. Moreover, the modified technology acceptance model (TAM) of Gu et al., (2013) described the positive expectancy of Kahoot which fosters learning, engagement, motivation, cooperation, teaching and learning experiences, and cooperation. Thus,

the acceptance of technology is associated with the reported benefits and challenges of the teachers and learners after using Kahoot in Biology.

Teachers' Impressions using Kahoot

The teachers' impression towards the use of Kahoot are the following: pedagogy related views; content related views; and technology-related views. The teachers shared different views, but commonalities are evident across several subcategories.

Ms. C

Pedagogy-related views. Ms. C shared her impressions with the use of Kahoot in Biology class specifically how she thinks about its use in teaching the subject. These views include: *use Kahoot in the entire process, enhances learning outcome, made teaching more interesting, and Kahoot reinforces learning.*

Use Kahoot in the entire process. Ms. C believed that Kahoot should be used in all parts of the lesson and should not be limited to review and evaluation.

Maybe it would be better if we do not apply Kahoot only to the review. Aside from the review, maybe it would be better if we apply it during the entire process of teaching – not only in the evaluation but also in the discussion. It would be better to use Kahoot every time we discuss so that there will be interactive games and the attention of the students will be there in a fun way, and they will not be sleepy. They will be able to understand (the topic). It's good to include Kahoot not only in the review but also in discussion and motivation, in all parts (of teaching).

Enhances the learning outcome. Ms. C stated that "The use of Kahoot as strategies in teaching, especially in a part of the review, enhances the learning outcome of the students."

Made teaching more interesting. While the use of Kahoot fosters the learning outcome of the learners, Ms. C thinks that it also flourishes her teaching in the Biology subject as she stated, "The students enjoyed learning, and they participated the class discussion actively. Kahoot caught the students' attention and made teaching more interesting."

Kahoot reinforces learning. The class of Ms. C displayed engaging and cooperative learners while participating in Kahoot.

The use of Kahoot reinforces the learning of the students through cooperation and active participation. It is a capable platform in developing collaboration among learners demonstrated while they were brainstorming their answers before answering. It was not an individual game but a team game.

Technology-related views. Ms. C also expressed her views with the employment of educational technology in the classroom. She found it advantageous to her class at the same time challenging and time-consuming.

A fast connection is a necessity. Ms. C shared her personal views regarding the need for a fast Internet connection with the use of Kahoot in her class.

One Wi-Fi is not enough for connection; two or three Wi-Fi is needed so that the students will be able to quickly access; if it's only one, they cannot access easily because they compete for the signal. After that, the children will connect and form groups. It's not needed for each student to have a cell phone; they can be in groups to optimize the signal of internet connection. After that, the students will be able to connect, and the activity will start. They

will use Kahoot. It's a necessity to have a fast connection so that they will be able to easily access.

Kahoot is suited to the learners' age. Ms. C considered Kahoot appropriate to the kind of learners we have today. She thinks that Kahoot engages and motivates the learners to study Biology while providing their learning outcomes in the subject.

Content related views. Ms. C shared her ideas in connection to the topics covered in the Fourth quarter while using Kahoot in Biology class.

Students learn easily. Ms. C explicitly stated the benefits to her class after using Kahoot in Biology. "Through Kahoot the lesson of Meiosis becomes effective, because Meiosis is one of the boring lessons but using this Kahoot, it allows the students to learn easily."

The benefit of Kahoot is that when you teach Biology and you find it difficult to describe the topic, it helps a lot. Because Biology is actual using Kahoot, you have questions and you can even insert diagrams and videos so that the students will be able to visualize it clearly, unlike when you teach without Kahoot. When you teach (with Kahoot), you show the video, and then after the video, there will be a discussion. At the beginning of class, in the review session, you can put everything at once including Kahoot so it will be easier for the students to understand and remember.

Concepts become more interesting. Ms. C perceived that the use of Kahoot made learning more appealing as it enriched the quality of student learning in the subject. "For the students learning was boring but with the use of Kahoot studying Cell Cycle becomes more interesting. The students feel that learning can be also enjoyable with the use of Kahoot as a strategy." "Mitosis was not easy to teach, there are a lot of concepts in each event. For me, it is very complicated but

with the help of technology like videos or even Internet connection the concepts become more interesting.”

Ms. F

Pedagogy-related views. Ms. F viewed the integration of Kahoot in teaching Biology as: *challenging and impressive, lessons become easier, motivates students, effective activities, enjoyable to the teachers, and Kahoot reinforces learning.*

Challenging and impressive. The utilization of Kahoot was challenging yet impactful to the class of Ms. F because according to her, it stimulates learning in Biology class.

Lessons become easier. Ms. F stated, “The benefits that I see in Kahoot is that the lessons become easier for the teacher to teach and the students can easily learn it.”

Motivates students. Kahoot involves the learners’ participation which can enhance the motivation of the learners in Biology class as Ms. F indicated, “Using the Kahoot in the lesson about Mitosis was interesting because it can motivate the students’ behavior towards the lesson. The students became more attentive and interested to answer the activity in Mitosis using the Kahoot.”

Effective activities. Ms. F perceived the incorporation of Kahoot compelling to the learners as they cooperate in Kahoot.

My reflection about Meiosis by using Kahoot.it is the effective activities for the student. The students become active through Kahoot. Because every student can participate by using multimedia can be seen in reality. The feedback from the student says that it cannot

feel lazy for the entire discussion. Every student has a chance to share to their respective groupmates of what they learned through discussion.

Enjoyable to the teachers. Ms. F admired the use of Kahoot in Biology class as observed in her class, “The teacher found the use of Kahoot enjoyable, engaging to the learners, and automatically catches the attention of the learners. The teacher felt good using Kahoot in Biology because the learners became motivated to participate without any threat or punishment.”

Kahoot reinforces learning. Ms. F viewed Kahoot as a useful instructional tool in the subject as reported, “The use of Kahoot could reinforce their mastery in the subject especially to a content subject like Biology. Both the teacher and the students benefit in using Kahoot, the learners understand the content of the lesson well, while the teacher becomes creative in reinforcing the subject content.”

Technology related views. Ms. F perceived Kahoot as an ICT integration in her Biology class, which spoke primarily on the way she viewed the technology.

Kahoot is more advanced. Ms. F perceived Kahoot as an advanced tool in teaching the subject.

Using Kahoot is more advanced compared to ordinary teaching that we do. Besides, the children are able to explore the use of technology with the help of the lesson, they understand it more clearly and it is enjoyable even for the teacher. The benefits of using Kahoot (pause) it’s good for the advancement of the lesson and since it uses technology the lesson becomes smooth and enjoyable.

Content-related views. For Ms. F, students learn, and the teacher's mastery of the lesson is essential after incorporating Kahoot in Biology class.

Students learn easily. Ms. F conceived that the learners understand the lesson well through Kahoot. "The students enjoyed doing the activity with the use of Kahoot. They were able to understand the lesson easily, and they were interested to do the activity."

Teacher's mastery is important. Aside from the effect of Kahoot in raising the learners' interest and motivation, Ms. F viewed mastery as an important factor in teaching Biology after using Kahoot in class.

Ms. G

Pedagogy-related views. Ms. G perceived the integration of Kahoot in teaching Biology as *Kahoot as an effective platform, reinforces learning, and motivates learners.*

Kahoot as an effective platform. Ms. G viewed Kahoot as an effective online platform in Biology class of today's learners as she noted, "The Kahoot was an effective platform in a student-centered environment where the learners became motivated and engaged while recalling the concept they learned."

Reinforces learning. Ms. G observed Kahoot as an instructional tool which can fortify the learning experience in Biology class. Despite the compound concepts in Mitosis, the learners' interest and enjoyment in class became apparent after the use of Kahoot as she indicated,

The use of Kahoot reinforced the learning of the learners in a complex topic like Mitosis. Understanding the stages, processes, and the different terms used in this topic became easier for learners through the use of Kahoot. The teacher enjoyed Kahoot and helped the learners in their studies.

Motivates students. Ms. G regarded Kahoot as an instructional tool which raises motivation and engagement of the learners in Biology class as stated,

Using Kahoot in Biology class flourishes the learners' interest in the subject. The excitement, enjoyment, points, and ranks they get from using Kahoot significantly affect their attitude and performance in the subject. The complexity of the topic lessens using their mobile phones, the Internet, and the game-based technology Kahoot. It was an effective platform in elevating the performance of the learners as they become more interested in the subject; learning becomes easier and more delighting. Their experience in using Kahoot drives them to work harder in the subject while enjoying at the same time.

Content-related views

The integration of Kahoot yielded content-related view which describes how the subject or a particular topic in Biology was viewed after using Kahoot.

Mitosis becomes an easy topic. Ms. G recognized that Mitosis becomes easy after using Kahoot in Biology class daily as stated, "It was evident that the class was engaged and motivated to participate in the lesson, although the topic is complex and comprehensive. Mitosis becomes an easy topic to understand because of the learners' sustained attention."

Cross-case Analysis of Teachers' Impressions

The cross-case analysis of the teachers' impressions with the use of Kahoot suggested three categories across the three cases of the present study. These categories are *pedagogy-related views*, *technology-related views*, and *content-related views*. For each category, subcategories are included to understand the teachers' views better regarding the use of Kahoot in Biology. This

portion underscored the unique impressions, specifically its subcategories across the cases. The unique subcategories are pointed out to see how the teachers' impression vary across the cases. Moreover, the teachers have shared experiences, but there are more unique subcategories found in the multiple data in this study.

Pedagogy-related views

The teachers in the present study reported their impressions on how Kahoot was used in their Biology classroom as an instructional tool. The cases have some similar views with Kahoot as used in teaching the subject, which includes the following: *Kahoot reinforces learning, and Kahoot motivates the learners*. Meanwhile, each case results in distinct impressions such *Kahoot is challenging and impressive, the lessons become easier, effective activities, and enjoyable to the teachers*

Unique subcategories

Ms. C

Use Kahoot in the entire process, enhances the learning outcome, made teaching more interesting, and interactive activities. Ms. C viewed Kahoot uniquely such integrating it in all the phases of the lesson and enriching the learning outcomes of the learners. Her experience using Kahoot in Biology made her realized that teaching the subject became more impressive by the incorporation of interactive activities in Kahoot.

Ms. F

Challenging and impressive, lessons become easier, effective activities, and enjoyable to the teachers. For Ms. F, answering of Kahoot was challenging yet impressive to her class. The

lessons in Biology became light through the practical activities embedded in the application. Overall, she found Kahoot fun and exhilarating in teaching the subject.

Ms. G

Effective platform. Ms. G grasped Kahoot as an effective platform for teaching Biology. For her, Kahoot offers a student-centered environment which fosters learners' engagement and motivation in the subject.

Technology-related views

The views of the teachers with regards to the technology are all unique across the cases which include: *fast connection is a necessity, Kahoot is suited to the learner's age, and Kahoot is more advanced.*

Unique subcategories

Ms. C

Fast connection as a necessity. For her, two Wi-Fi are necessary so that the learners can easily access Kahoot

Kahoot is suited to the learners' age. Ms. C thinks Kahoot age-appropriate to the kind of learners she has in Biology, and since she found it relevant, for her Kahoot engages and motivates her class.

Ms. F

Kahoot is more advanced. Ms. F perceived Kahoot as a modern way to teach while comparing it to the traditional teaching pedagogy. She thinks that Kahoot as an advancement of technology which assisted the teaching and learning process more efficient.

Content-related views

Biology as a content subject requires understanding the terms and concepts correctly. The teachers stated diverse views concerning the employment of Kahoot such as *concepts become more interesting, teachers' mastery is important, and Mitosis becomes easy*. Consequently, two cases in the study have shared view regarding the use of Kahoot, which is *student learn easily*.

Unique subcategories

Ms. C

Concepts become more interesting. Ms. C distinguished that the concepts in Biology were more compelling to the learners after using Kahoot. According to her, using Kahoot in the Cell Cycle enlivened the classroom experiences of her learners. Moreover, the educational technologies used cultivated the interest of the learners towards the subject.

Ms. F

Teachers' mastery is important. Ms. F recognized that in teaching Biology, the teacher's proficiency in teaching the subject was significant. For her, without mastery, the teaching and learning experience would be ineffective.

Ms. G

Mitosis becomes an easy topic. Ms. G perceived the topic as simple through the employment of Kahoot in the Biology classroom. According to her, the close attention of her class was evident, which made the teaching and learning process more effective.

Discussion

Teachers' Impressions using Kahoot

The teachers' impressions refer to their views on how they think about the use of Kahoot. These primarily speak on the cognitive aspect of Kahoot as used in teaching Biology. The results of the analysis exhibit the following impressions: *pedagogy-related experience, technology-related views, and content-related views*. These impressions are interpreted according to the framework of the study, the SDT of Ryan and Deci (2000) and TAM by Gu et al., (2013).

Pedagogy-related views

The shared views of the teachers regarding the use of Kahoot: *Kahoot reinforces learning, and Kahoot motivates the learners*. Meanwhile, each case yielded distinct impressions such *Kahoot is challenging and impressive; the lessons become easier, effective activities, and enjoyable to the teachers*.

The teachers' broad array of impressions with the use of Kahoot as an instructional tool reflect the positive outcome expectancy of Kahoot when used in teaching Biology. The teachers reported the perceived advantages and benefits of using Kahoot such as challenging and impressive; the lessons become easier, effective activities, and enjoyable to the teachers. These impressions or views suggest that the cases perceived the usefulness of Kahoot in teaching the subject, therefore have a significant impact in accepting Kahoot as an instructional tool. According to Gu et al., (2013), the outcome expectancy is the highest predictor of accepting or rejecting the technology depending on the perceived usefulness and ease of use. In the case of the teachers, all of them reported positive expectancy outcome.

Technology-related views

The views of the teachers with regards to the game-based technology are all unique across the cases which include: *fast connection is a necessity, Kahoot is suited to the learner's age, Kahoot is more advanced, and Kahoot is an effective platform*. The different views of the teachers reflect that the acceptance of Kahoot is based on personal factors which are beliefs and their willingness to try the new technology (Gu et al.,2013). The teachers reported positive expectancy outcome, and there was no report regarding their resistance to using the technology in the subject. Moreover, they perceived Kahoot as an effective tool with the kind of learners they have today. The results suggest the willingness and the acceptance of the teachers to utilize Kahoot in Biology despite the challenges they reported.

According to Prensky (2001), the teachers should use a variety of pedagogy, which is more appropriate and attractive to the kind of learners we have today. The use of computer games was highly recommended, even in the most complicated subject. Kahoot, as a game-based technology, can be integrated into the lessons and serve as an educational application for the 21st-century learners of today. Moreover, digital immigrant teachers should adapt the language and style of the digital native learners in teaching the content of their subject. The use of Kahoot may serve as a bridge between the digital immigrant teachers and the digital native learners, specifically in teaching and learning Biology.

Content-related views

The cases had diverse views concerning the employment of Kahoot: *concepts become more interesting, teachers' mastery is essential, and Mitosis becomes easy*. Consequently, two cases in

the study have shared view regarding the use of Kahoot, which is *students learn quickly*. The discussion of the findings is as follows.

The content-related views of the teachers indicate the positive outcome expectancy of using Kahoot in teaching Biology. They shared commonalities that the students learn quickly with the use of Kahoot in the subject. Their views suggest the benefits of Kahoot when used daily in teaching Biology. Moreover, Ms. F reported that the mastery of the teachers in teaching the subject was essential to effective and efficient learning experiences. Also, Ms. G viewed the topic Mitosis easy, and the concepts became more interesting to teach. Their views speak of the positive outcome expectancy of Kahoot based on its perceived usefulness, such as effective teaching and learning process and have interesting concepts. According to Higgins, Xiao, and Katsipataki (2012), digital technology has an impact on learning and supports the notion that technology, when used effectively in the classroom, may yield positive impact in the teaching and learning process. It underscored the significant idea that the "how" is more important than the "what." How refers to the way teachers integrate the technology in the classroom is essential than determining whether technology has an impact or not. The teachers, especially their views with the use of technology like Kahoot, may influence their technology acceptance based on the construct of TAM by Gu et al. (2013). Overall, the teachers' views imply that they perceived the use of Kahoot positively based on their responses.

Learners' Impressions using Kahoot

Grade Eight Daisy

The class of Daisy described different impressions with the use of Kahoot, which entail the following categories: *subject-related views, group-related views, and game-related views*. Each

impression was supported with subcategories, which vividly served as the foundation in each category.

Subject-related views

The class of Daisy reported how they viewed the integration of Kahoot in Biology class. Their views entail what they think about its daily use in the subject which include: *fun and learning interaction, measures learning, Kahoot is motivating, makes the students energetic, and Science becomes more fun.*

Fun and learning interaction. The class stated that the employment of Kahoot was interactivity between them and their teacher the learner spoke, “Typical use of Kahoot is to have fun interaction between students and teachers” (S7).

Measures learning. The learners think Kahoot as an instrument in assessing their learning, “Kahoot measures (pause) how much you have learned, and it is fun, especially when everyone helps one another” (S4).

Kahoot is motivating. The class found the employment of Kahoot as well as the technology flourishing: “In my opinion, it’s only necessary that we do not use the Internet connection in all things, but this way is great in motivating the youth because we use technology. Also, the use of a projector. During elementary days, we did not have it so it's amazing. I hope that they widen the use of Kahoot” (S1).

Makes the students energetic. While some learners became motivated, the other members of the class pointed out the effect of Kahoot in learning the subject: “I hope that Kahoot will be used in other subjects too because Kahoot is like that - it makes the students energetic to learn” (S14).

Science becomes more fun. The class of Daisy found the subject more amusing after using Kahoot in the subject: “I hope that Kahoot will be used in other subjects too because Kahoot is like that - it makes the students energetic to learn” (S24).

Group-related view. The class of Daisy conveyed their view on how Kahoot nurtured their interaction with their members.

Socializing with teammates. The interaction among the learners through Kahoot was also evident as reported, "A better way in socializing with your teammates" (S4).

Game-related views. The game-based technology with its gamified environment was highlighted through their personal views with the game itself, which include: *a nice game, best educational app, and cooperation is needed.*

Nice game. The class of Daisy shared their views with Kahoot as a tool in assisting them in learning the subject more effectively. Moreover, some learners viewed Kahoot as a fun game: "Kahoot is a nice game that when you learn to play it, it makes you nervous yet excited and challenged” (S11).

Best educational app. While the class perceived Kahoot as a game, other learners consider it as a useful and practical application for learning Biology as shared, "Kahoot is the best educational app game that teaches me about sister chromatids, chromosomes, etc.” (S17).

Cooperation is needed. The learners perceived the value of cooperating while using Kahoot: “You really will not get a high score if there is no cooperation in the group” (S19).

Grade Eight Ilang-ilang

The class of Ilang-ilang reported their views with the employment of Kahoot. Their views include *subject-related views, game-related views, school-related views, and technology-related views.*

Subject-related views

The case of Ilang-ilang shared several impressions using Kahoot in Biology classroom which covers how they think as it was incorporated in the subject such as *Kahoot is motivating, fun, intense, and motivating, exciting answering the questions, and a new way of teaching Biology.*

Kahoot is motivating. The class Ilang-ilang described Kahoot, "It's motivating to study because of Kahoot. Everyone competes using a cell phone and everyone is happy" (S15).

Fun, intense, and motivating. The class reported, "It's fun to use Kahoot even though it causes tension since it's a race in giving answers. It's motivating, intense to play, and you will surely learn something" (S19).

Exciting answering the questions. The class described answering Kahoot as exhilarating as reported, "Because of Kahoot answering question just got more exciting and I hope in the near future other subjects would to this kind of method to make the student learned a little bit in the subject" (S30).

A new way of teaching Biology. The class perceived Kahoot as an advanced method to teach the subject as expressed by the learner,

What I can share as additional thoughts about Kahoot is that it is good because it is a new way of teaching Biology. Because it's already the 21st century, gadgets are the trend now. It's beautiful so that all classmates will be together and help each other because seldom do they help each other, only when there are groupings, that's why it's mostly solo when Kahoot is not used. (S1)

Game-related view

The section Ilang-ilang reported their impression using Kahoot, specifically as a *confusing but exciting game*. The class shared their view with Kahoot as: “Kahoot is a little confusing game but it getting excited by playing” (S3).

School-related view

While the class perceived Kahoot as a useful tool in learning the subject, they also shared their school-related view, which was to *use Kahoot in all the schools*. The class expressed their satisfaction with Kahoot and expressed: “I could only say that hopefully all schools use Kahoot because it is great” (S1).

Technology-related view

The Grade Eight Ilang-ilang shared that each learner should have their device while using Kahoot. *Have individual gadgets*. The class viewed Kahoot more effectively using 1:1 ratio of the device: “It’s better to use Kahoot if we all have individual gadgets because if the answer of one is wrong, there is blaming” (S7).

Grade Eight Sampaguita

Grade Eight Sampaguita spoke of only one category in terms of their view using Kahoot in the subject. The class only reported subject-related views, which indicate how Kahoot enhanced their learning experiences and made learning easy, exciting, fun, and motivating.

Subject-related views

The case of Sampaguita primarily shared subject-related views using Kahoot in Biology class: *Kahoot is like a drill, helped in the study of Biology, learn the topic easily, use Kahoot in all the subjects, exciting part of the discussion, Science becomes more fun, and Kahoot is more motivating.*

Kahoot is like a drill. S1 reported view with Kahoot:

The benefits I got there, first, Kahoot is useful so that those topics you've discussed with us will be in Kahoot. It looks like a drill that we can repeat and remember, "This is the definition of mitosis, two daughter cells." Like that, Ma'am, and additional knowledge that as Kahoot continues, our knowledge in Biology continuously increases. (S1)

Helped in the study of Biology. The class of Sampaguita perceived the use of Kahoot as useful or helpful in their study of the subject as added by S3:

For me, Kahoot has greatly helped in our study of Biology. Because before we use Kahoot, we need lessons first so that Kahoot will get questions to check whether what you have learned is correct, whether it is already enough, whether what you have learned is right. This is why it helps a lot. (S3)

Learn the topic easily. S4 shared that Kahoot helped them to understand the topic easily, “For me, I don’t want to add anything to Kahoot because it’s really the best. We’re able to create good knowledge about our topic-deeper than our topic so that we can easily learn” (S4).

Use Kahoot in all the subjects. S6 expressed that Kahoot is used in all the subjects, “For me, all subjects should have Kahoot because many students are inactive. In using Kahoot in each subject, they will cooperate and listen” (S6).

Exciting part of the discussion. The learners perceived Kahoot exhilarating, "Playing Kahoot is a very exciting part of the discussion. Kahoot is so fun and playing Kahoot is useful to continue increasing our learning" (S32).

Science becomes more fun. For Sampaguita, their Biology class was more engaging and fun, “Science class become more fun because of Kahoot game, and we learn more because of it” (S36).

Kahoot is more motivating. The class reported Kahoot as motivating: "Another knowledge that I learn in this game, this subject motivated me to learn more about in Meiosis and Mitosis” (S33).

Overall, the cases of Grade Eight learners shared similar and unique categories regarding their views with the use of Kahoot in Biology class. The commonalities of their impressions include *subject-related views and game-related view*. Moreover, several categories were found distinct in each case and were explicitly described by its subcategories.

Cross-case Analysis of Learners’ Impressions

The learners' impressions after integrating Kahoot in Biology class suggested five categories: *subject-related views*; *group-related views*; *game-related views*; *content-related views*; *technology-related views*; and *school-related views*. The cross-case analysis made by the researcher provided shared and unique views across the cases in the multiple data of the study. This portion intends to highlight the unique categories across the cases or Grade Eight learners after the integration of Kahoot in Biology.

Subject-related views

The three cases reported subject-related views, which described how they think with the use of Kahoot as an instructional tool in the Biology classroom. Most of the subcategories for each case are found unique, while the only common subcategory was *Kahoot is motivating*. The distinct subcategories: *fun and learning interaction*, *measures learning*, *makes the students energetic*, and *Science becomes more fun*, *fun*, *interesting*, and *motivating*, and *exciting answering the questions*, *Kahoot is like a drill*, *helped in the study of Biology*, *learned the topic easily*, *use Kahoot in all the subjects*, *exciting part of the discussion*, and *science become fun or more fun*.

Unique subcategories

Grade Eight Daisy

The learners reported Kahoot as *fun and learning interaction*, *measures learning*, *makes the students energetic*, and *Science becomes more fun*.

Grade Eight Ilang-ilang

The case of Ilang-ilang perceived the use of Kahoot as *fun*, *interesting*, and *motivating*, and *exciting answering the questions*.

Grade Eight Sampaguita

The case of Sampaguita had several unique views in terms of how they perceived Kahoot when integrated in the Biology lesson such as *Kahoot is like a drill, helped in the study of Biology, learned the topic easily, use Kahoot in all the subjects, exciting part of the discussion, and science become fun or more fun.*

Game-related views

The cases of Daisy and Ilang-ilang shared views regarding the use of Kahoot as a game-based technology and reported different subcategories such as *nice game, best educational app, cooperation is needed, socializing with teammate and confusing but exciting game.* They also expressed their opinions using Kahoot in their Biology classes.

Unique subcategories

Grade Eight Daisy

The case of Daisy reported their views using Kahoot as *a nice game, best educational app, and cooperation is needed.*

Grade Eight Ilang-ilang

Ilang-ilang spoke of their view using Kahoot as *confusing but exciting game.*

Group-related view

The case of Daisy was the only section which reported their view when it comes to their interaction with their teammates through the use of Kahoot in Biology. This case stated that Kahoot is *a way of socializing with their teammates.*

School-related view

The class of Ilang-ilang spoke to utilize Kahoot to other schools. The learners suggested integrating Kahoot not only in their school but also to others.

Technology-related view

While the learners became inclined using Kahoot in Biology, the class of Sampaguita suggested of having own gadget for each student in the class.

Discussion

The learners' impressions using Kahoot in Biology class suggested two shared categories across the cases: *subject-related views and game-related view*. This part intends to interpret the shared and distinct views of the learners using Kahoot in Biology. These views are related to how the learners perceived Kahoot as integrated with their Biology class. They are interpreted based on the constructs of SDT by Ryan and Deci (2000) and TAM of Gu et al. (2013) which described in ways the findings confirm, disconfirm or extend knowledge in the discipline by comparing the results to the peer-reviewed literature.

Subject-related views

The learners across the multiple data in this study described their Biology class after the integration of Kahoot as "fun," "interesting," "energizing," "exciting," and "motivating." These terms are associated with the constructs of SDT by Ryan and Deci (2000). According to SDT, interesting activities foster the learners' motivation and the use of Kahoot with corresponding points, ranks, leader boards, and immediate feedback flourish the motivation of the learners. The

literature supports the result of how the gamification in Kahoot enriched the learners' engagement, motivation, and the teaching and learning process (Licorish et al., 2018; Pede, 2017).

The learners believed that the integration of game-based technology Kahoot enhanced their learning experience in the subject, which yield positive impressions with the use of technology. The use of Kahoot flourished behavioral, emotional, and cognitive engagement. Behavioral engagement is the involvement in learning, academic tasks, and demonstrated behavior while using Kahoot such as showing effort, concentrating, paying attention, and contributing to class discussion. Also, the emotional engagement was demonstrated through the learners' reactions inside the classroom, such as "fun" and "exciting." Similarly, the cognitive engagement was executed through having the preference for a challenge (Fredricks, Blumenfeld & Paris, 2002). The cases in this study reported that they learned the subject quickly and helped them in their study of Biology. The use of Kahoot raised the learners' engagement, thus improved the learning experience. According to Fredricks, Blumenfeld, and Paris (2002), teachers, school, peers, autonomy, relatedness, and need for competence cultivate the learners' level of engagement. The learners became more engaged in terms of cognitive, emotions, and behavior after using Kahoot as described in this chapter. These also suggest the positive outcome expectancy of the cases after using Kahoot in Biology. The learners reported several times the perceived advantages of using Kahoot in the subject such as fun and learning interaction, measures their learning, motivating, energizing, Science becomes more fun, exciting, and helped in the study of Biology. These show that Kahoot as a game-based technology is accepted by the learners as supported by the multiple benefits reported across the cases in the study.

Overall, the learners' engagement, motivation, interest, learning experiences, and views in Biology subject improved as well as their perceived learning experiences, which may influence to accept and use Kahoot in Biology class.

Game-related views

The case of Daisy and Ilang-ilang reported their game-related views regarding the use of Kahoot in Biology. Grade Eight Daisy considered Kahoot as: *a nice game, best educational app, and cooperation is needed*, while the class of Ilang-ilang viewed Kahoot as *confusing but exciting game*. The learners viewed Kahoot as an effective tool in learning the subject. The construct of SDT by Ryan and Deci (2000) stated that challenging activities raise the learners' motivation. Playing Kahoot with its friendly-competition and embedded gamification elements challenged the learners and made the subject more interesting. The study of Lister and College (2015) confirms that points, badges, leader boards, and levels were the common elements of gamification. After analyzing 19 peer-reviewed journals and conference, they discovered that these game elements increased the motivation, attendance, participation, and academic performance of the learners. Mekler et al. (as cited in Lister & College, 2015) found out that giving of points was effective in flourishing intrinsic motivation. The increased motivation of Grade Eight in Biology stems from the immediate feedback, and the gamification elements found in Kahoot. Also, levels were found to have a positive impact on the learners' engagement and motivation, which was supported by the literature (Lister & College, 2015).

Group-related views

The class of Daisy reported their unique view with Kahoot as a way of socializing with teammates. The view indicates that the usefulness of Kahoot as game-based technology is positive

as it nurtures their social interaction with their teammates in the game. Also, they are not only learning the subject but also enjoying the relation they have with others through the use of Kahoot. The result demonstrates the advantage of using Kahoot in a team mode option instead of individual users. In terms of outcome expectancy, the class of Daisy perceived Kahoot as beneficial or positive for their learning.

School-related view

After integrating Kahoot in Biology, the class of Ilang-ilang uniquely recommended to use it in other schools. The case perceived the advantages of using Kahoot and suggested to use it as well by other schools. The finding exhibits the usefulness of Kahoot in Biology class, which indicates positive outcome expectancy.

Technology-related view

The Grade Eight Ilang-ilang viewed the use of one device per student to avoid blaming one another for giving incorrect answers in Kahoot. However, this was not possible during the implementation of the study due to several factors such as lack of mobile phone, lack of upgraded mobile phones, and the poor Internet connection. The use of one mobile phone for each learner is contrary to the study of Higgins et al. (2012) that one-to-one provision of technology was challenging and may impede collaboration and interaction. This indicates that using one mobile phone for each group using Kahoot is recommended instead of one-to-one provision.

Comparisons of Teachers' and Learners' Impressions

The cross-case analysis of teachers' impression included three categories: (1) pedagogy-related views, (2) technology-related views, and (3) content-related views. Meanwhile, five categories are exhibiting the learners' impressions these include (1) subject-related views, (2)

technology-related views, (3) game-related views, (4) group-related views, and (5) school-related views. It exhibits both the teachers' and learners' impressions after using Kahoot in Biology (See Appendix V). The pedagogy-related views of the teachers mirror the subject-related views of the learners. These views correspond to how they perceived Kahoot as used in their Biology class. The teachers' views reported the perceived advantages and benefits of Kahoot in their teaching as well as to the learning of their classes. They also spoke on how it enriched the teaching of the content as it made their execution more attractive to the learners. Meanwhile, the learners shared positive views using Kahoot in their class. Their views reflect the cognitive and affective engagement, which also indicate positive outcome expectancy of using Kahoot in the subject. Overall, the usefulness of Kahoot in teaching and learning Biology was effective both to the teachers and learners.

Concerning technology-related views, the teachers' and learners' views are found unique from each other. The teachers' views speak both of the advantages and disadvantages of Kahoot as a game-based technology. The perceived advantages include the view in Kahoot as an appropriate application to the learners' age of today and an advanced method of teaching the subject. The digital immigrant teachers view Kahoot as an effective and age-appropriate application for their digital native learners. According to Gu et al. (2013), the teachers' experiences, attitudes, and competence are essential in integrating ICT in the classrooms. The acceptance of the technology was based on their internal beliefs and attitudes which indicate that the Grade Eight Biology teachers perceived Kahoot as effective to the teaching and learning process especially to the kind of learners they have today.

On the other hand, one case reported a disadvantage of Kahoot, which speaks to the need for a secure Internet connection. The negative impression of the teacher may affect the belief and

attitude towards the use of Kahoot in Biology class. The said problem may be addressed in the future, especially to the Philippine setting by considering the signal of the school and by providing fast-connection to the schools. The learners' view, on the other hand, suggested of having one-to-one gadget provision to avoid blaming after giving incorrect answers. The view was not recommended by the teachers and contrary to Higgins et al.'s (2012) recommendation.

Moreover, learners' game-related views are also distinct. These impressions correspond to the usefulness of Kahoot in learning the subject. They also reported the importance of cooperation, which was not mentioned by the teachers in this study. The game-based technology Kahoot is useful and effective in Biology class; however, one case reported it as a confusing but exciting game which shows both the positive and negative views with Kahoot.

With content-related views, only the teachers reported their impressions specifically on how Kahoot enhanced the teaching of the subject. The teachers were satisfied with the use of Kahoot in the Biology class. This finding confirms the literature of Xiong (2018) in that the technologies are found useful in teaching Biology course for high school students, and the technologies positively impacted the students' learning.

Furthermore, the learners uniquely reported of their group-related views after using Kahoot in Biology class. The learners perceived positive use of Kahoot not only with their learning but also to their social interaction with others. In this study, the use of Kahoot in Biology class had a social influence among the learners in accepting the use of technology. According to Gu et al. (2013), social influence is the perceived social pressure to perform or not to perform a task and have a significant positive influence on the individual beliefs about the usefulness of the technology. Overall, the Grade Eight learners' use and acceptance of Kahoot maybe associated with the social influence of their teammates.

In terms of school-related view, only the learners reported using Kahoot in all the schools. The finding indicates a positive view and usefulness of Kahoot in Biology class, which show that the learners' acceptance of technology is also positive.

Overall, the views of the teachers and the learners influenced their acceptance of Kahoot in Biology class due to the benefits and disadvantages reported after using Kahoot. The advantages of using Kahoot enhanced the teaching and learning processes as the technology fosters collaboration, motivation, fun, excitement, and speak the language of today's learners. On the other hand, the perceived challenge is associated with the weak Internet connection, which may also influence the teachers to accept or not the technology.

Implications of the Study

This study has a significant impact on science education, specifically in teaching and learning Biology. The results of this study provide knowledge to the integration of Kahoot in Biology through the rich and thick description mentioned in this chapter. The advantages of Kahoot provide relevant information to the Science teachers, Science Department Heads, and coordinators to consider the incorporation of Kahoot in their schools. Moreover, teachers can also regard the potential of this game-based technology in their classroom settings in reaching their digital native learners. Prensky (2001) underscored that one way of speaking the language of our digital native learners is through the use of computer games.

The rich and thick descriptions provided in the study convey the advantages and difficulties encountered by the teachers and learners while using Kahoot in Biology. These results can be used to inform the administrators to consider the use of personal mobile phones for classroom purposes like Kahoot. This may enlighten the administrators and teachers that technology is not an enemy

in catching the attention of their learners, but it can be a tool to raise the learners' engagement, motivation, cooperation and learning experiences in Science subject like Biology. Meanwhile, the learners' experiences and impressions not only stated the advantages and challenges of Kahoot, but it also conveyed their perception towards the subject. Some learners mentioned several times that they found Science subject boring and Kahoot turns their boredom into excitement and enjoyment at least in Biology. Teachers may consider this critical insight from the teachers and learners after the successful use of Kahoot. The increased engagement, motivation, teamwork and teaching and learning experiences across the Grade Eight participants in Biology may serve as a reminder that Biology class should be engaging and interesting and should manifest excitement, energy, and enthusiasm without compromising the content of the subject.

Chapter 4

Summary, Conclusions, and Recommendations

Summary of the Study

The purpose of the present study was to determine the conceptual understanding, motivation, and engagement of the learners after integrating Kahoot in Biology. It also explored the experiences and impressions of the teachers and learners with the incorporation of the game daily in Biology class. The study was anchored on Self Determination Theory SDT of Ryan and Deci (2000). This theory states that the motivation of an individual is inherent and can either flourish or diminish depending on its environment (Ryan & Deci, 2000). Also, it indicates that there are three psychological needs that when satisfied, can raise a person's motivation. Moreover, the study was also anchored on TAM of Gu et al.(2013), which describes the technology acceptance of an individual in terms of outcome expectancy, social influence, and personal factors. The gamification elements in Kahoot were found to be motivating, engaging, and improved the teaching and learning experience in Science. The participants in the study consisted of multiple cases of Grade Eight teachers and learners. The collected qualitative data from interview transcripts, daily reflection, and field notes were analyzed in two levels. In the first level of within-case analysis, the researcher read the general sense of data, coded and categorized, once finished, cross-case analysis was performed to determine shared and unique categories across the multiple cases.

Summary of the Findings

From the analysis of the multiple sources of data, the following results are obtained:

1. The learners' conceptual understanding was average across the three sections of Grade Eight. Regarding engagement, the results of this study reveal that the Grade Eight learners were authentically engaged after using Kahoot. While the findings on motivation show that they are intrinsically motivated.

2. The experiences of the teachers after the incorporation of Kahoot include: (a) pedagogy-related experiences, (b) class management-related experiences, (c) technology-related experiences, and (d) content-related experiences. The Grade Eight learners' experiences after using Kahoot in their Biology classes are (a) subject-related experiences, (b) group-related experiences, (c) technology-related experiences, (d) content-related, and (e) game-related experiences. The experiences demonstrate both positive and negative experiences, which may influence motivation and the acceptance of technology in the Biology classroom.

3. The cross-case analysis of the teachers' impressions with the use of Kahoot suggested three categories across the cases of the present study. These categories are: (a) pedagogy-related views, (b) technology-related views, and (c) content-related views. The multiple cases of learners yielded the following categories: (a) subject-related views; (b) group-related views; (c) technology-related views; (d) school-related views; and (e) game-related views. The impressions are both positive and negative, which may affect the acceptance of technology in Biology class.

Conclusions

Based on the results presented in the previous chapter, the following conclusions are deduced:

- (1) the use of game-based technology like Kahoot is an effective instructional tool in teaching Biology topics like Mitosis and Meiosis;

- (2) The gamification elements in Kahoot and the use of educational technology enhanced the motivation, engagement, cooperation, and the teaching and learning experiences in Biology;
- (3) The incorporation of Kahoot demonstrated benefits, challenges as well as positive and negative impressions both to the teachers and the learners. The teachers and the learners have commonalities in terms of their experiences and impressions, but there are more unique experiences and impressions obtained from the study. The outcome expectancy, social influence, and ease of use may influence the teachers' and learners' acceptance of the technology.

Recommendations

Based on the results of the study, the following recommendations are made:

- (1) provide school Internet infrastructure for Kahoot. The initial step to assure the integration of game-based technology like Kahoot is through increasing broadband trunk line and the installation of a proxy server. The learners may also use their mobile phones with data without connecting to the school's internet to lessen the dramatic increase in traffic due to multiple internet users;
- (2) adopt behavior and classroom management. Behavioral concern that may arise while integrating Kahoot in the classroom will be avoided by using an agreement form before its implementation and employing behavioral techniques;
- (3) use Kahoot in all the learning phases. The formative assessment may be given before, during or after the lesson and may be incorporated in the lesson to boost the

energy and enthusiasm of the learners in Science class instead of a long lecture in Science;

- (4) include Kahoot in the learning action plan and develop professional development for teachers through learning action plan or peer-to-peer mentoring, and classroom observations of peers; and
- (5) further research into the effectiveness of Kahoot across all the subjects areas may also be explored by the future researchers and compare their differences. Future studies may be designed to include the responses from a larger population of teachers, learners, parents, and administrators will provide additional information and may be a potential subject in future research with regards to the use of Kahoot. Student-teachers who will use Kahoot in their practice-teaching may be investigated through a longitudinal study to determine the extent to which they integrate Kahoot on their teaching practices.

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Appendix A
Two-Tier Multiple-Choice Questionnaire

Name: _____ Section: _____

Gender: _____ Age: _____ Score: _____

Cellular Reproduction and Genetics Two-tier Multiple-Choice Questionnaire

Directions: This questionnaire consists of 10 items that test your knowledge on the applications of cellular reproduction and genetics. Each item has two parts:

- first-tier
- second-tier

Read and analyze the diagrams and items below. Choose the best answer from the choices below by writing the letter of the correct answer on the spaces provided.

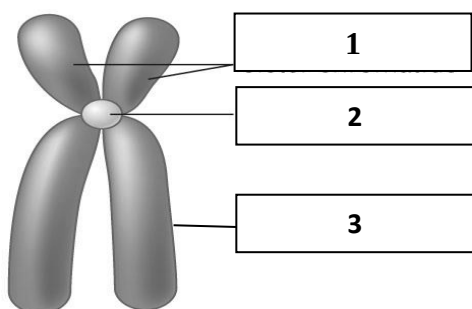
_____ 1A. Which process is referring to the exchange of genetic material between homologous chromosomes?

- | | |
|-------------------|---------------|
| A. cell division | C. interphase |
| B. crossing-over* | D. synapsis |

_____ 1B. Which statement BEST explains your answer?

- A. Cell division contributes to the exchanges of genetic information between two parent cells during fertilization.
- B. Crossing-over takes place during synapsis which exchanges the genetic material between the non-sister chromatids.*
- C. Interphase contributes to the genetic variability resulting from sexual reproduction.
- D. Synapsis allows the exchange of chromosomes where chromatids of homologous chromosomes exchange segments.

For numbers 2A-2B, refer to the diagram below.



___2A. Which part of the chromosome is responsible for joining the two sister chromatids?

- | | |
|-------|-----------------------------|
| A. 1 | C. 3 |
| B. 2* | D. Both 1 and 2 are correct |

___2B. Which statement BEST explains your answer?

- A. The short arms of the chromosome connect the two sister chromatids at the center.
- B. The long arms of the chromosomes found in the middle join them together.
- C. The centromere found in the central region of the chromosome combines them.*
- D. The short and long arms are responsible for associating the sister chromatids.

___3A. Which stage of the cell cycle allows the duplication of the DNA and accounts for the 90% of the time during each cycle?

- | | |
|----------------|--------------|
| A. anaphase | C. prophase |
| B. interphase* | D. telophase |

___3B. Which statement BEST explains your answer?

- A. Anaphase allows the cell to increase in size which takes a longer time.
- B. Interphase is consist of G1, S, and G2 phases which allow the cell to increase in size and duplicates the DNA and become larger again for division.*
- C. Prophase allows the chromatin fibers to become more tightly coiled and become condensed chromosomes resulting in DNA replication.
- D. Telophase allows the cell to grow more with the presence of the nonkinetochore microtubules forming two daughter nuclei.

___4A. Which statement is TRUE about fertilization?

- A. The haploid sperm cell from the father fuses with the haploid egg cell of the mother resulting to a zygote. *
- B. The diploid sperm cell from the father joins with the haploid egg cell from the mother resulting to a zygote.
- C. The diploid sperm cell from the father and the diploid egg cell from the mother fuse together forming haploid cells.
- D. The haploid sperm cell from the father combines with the diploid egg cell from the mother resulting to a zygote.

___4B. Which statement BEST explains your answer?

- A. The gametes or sex cells are both diploid cells which allow genetic recombination.
- B. The gametes or sex cells are both haploid cells which underwent meiosis allowing the genetic recombination thus, genetic variability of offspring*
- C. The sperm cell of the male is a haploid cell while the egg cell of the female is a diploid cell which produces four genetically identical haploid cells.

D. The sperm cell from the father is diploid while the egg cell from the mother is haploid which produces two genetically diploid cells.

____ 5A. Which is **NOT** a function of mitosis in humans?

- A. Humans can produce gametes or sex cells from diploid cells. *
- B. Jose's knees recovered after getting severe wounds from an accident.
- C. Mang Ador's damaged cells in his liver were replaced by healthy ones.
- D. Maria's height increase to one inch after several months

____ 5B. Which statement **BEST** explains your answer?

- A. Meiosis is a kind of cell division responsible for the growth in humans.
- B. Meiosis is the kind of cell division which produces gametes or sex cells. *
- C. Mitosis is responsible for the healing of wounds through cell division.
- D. Mitosis replaces the damaged cells in our body through cell division.

____ 6A. Which statement shows the difference between a diploid cell and haploid cell?

- A. A haploid cell in humans is 46 or $2n$ while the diploid cell is 23 or n coming from each parent.
- B. A diploid cell in humans and other animals have a single set of chromosome while the haploid cell has half number of chromosome.
- C. Diploid cell in humans and other animals have a pair of homologous chromosome while the haploid cell has a single set of chromosome.*
- D. Haploid cell allows the doubling of chromosome number in each generation while the diploid cell maintains the number of chromosomes.

____ 6B. Which statement **BEST** explains your answer?

- A. diploid cells are responsible for the genetic recombination that results to genetic variability.
- B. diploid cells are a pair of chromosomes which allow the doubling of chromosome number in each generation.
- C. haploid cells in humans are consist of a pair of homologous chromosomes while the diploid cells are consist of a single chromosome.
- D. haploid cell in humans results from meiosis having single chromosome while the diploid cells results from mitosis having homologous chromosomes.*

____ 7A. Which phase in the cell division allows the quantity of DNA in cells growing in the laboratory doubled?

- A. between anaphase and telophase of mitosis
- B. between prophase and anaphase of mitosis
- C. between G1 and G2 phases of the cell cycle*

D. during the prophase I and prophase II of meiosis

___7B. Which statement BEST explains your answer?

- A. During the anaphase and telophase of mitosis the cell grows before cytokinesis.
- B. During prophase and anaphase of mitosis the cell accumulates materials from the outside.
- C. During the prophase I and prophase II all the proteins and cell parts are synthesized making it bigger.
- D. During the S phase, DNA replication occurs which doubles the quantity of DNA.*

___8A. What is the difference between the cytokinesis in animal cells and plant cells?

- A. Cleavage furrow is the first sign of cleavage both in animal and plant cells which leads to the separation of cells.
- B. Cleavage furrow deepens until the parent cell is squeezed in animal cells while the plant cell fuses vesicles together.
- C. Cleavage furrow is the initial sign of cleavage in an animal cell while the plant cell formed cell plate instead of the cleavage furrow. *
- D. The cell plate is formed both in plant and animal cell through the collection of vesicles at the middle of the parent cell.

___8B. Which statement BEST explains your answer?

- A. Cleavage furrows are formed in plants only before the cell divides.
- B. Cleavage furrows form in animal cells but not in plant cells.*
- C. The cell plate is formed both in animals and plant cells during telophase.
- D. The cell plate is only formed in animal cells during telophase.

___9A. Which statement shows the difference between a normal cell and cancer cell?

- A. The cancer cell is always formed in the M phase of the cycle while the normal cell is formed through meiosis.
- B. The cell cycle of the normal cell is arrested at the interphase while the cancer cell in the S phase.
- C. The normal cell synthesizes DNA while the cancer cell synthesizes RNA.
- D. The normal cell functions properly and stops from dividing while the cancer cell divides continuously.*

___9B. Which statement BEST explains your answer?

- A. The normal cell divides continuously while the cancer cell stops dividing due to the phenomenon called density-dependent inhibition
- B. The normal cell stops dividing when it reaches the density-dependent inhibition while the cancer cell divides continuously *

- C. The normal cell divides when needed by the body while the cancer cell divides all the time
- D. The normal cell grows on the surface or with contact with the solid surface while the cancer cell continues dividing at high density.

___10A. Which statement is TRUE about meiosis?

- A. Meiosis is a type of cell division which produces diploid cell into haploid organisms.*
- B. Meiosis is a type of cell division which increases chromosome number from diploid to haploid.
- C. Meiosis requires two cell division producing two genetically identical daughter cells.
- D. Meiosis is a type of cell division that produces haploid gametes into diploid organisms.

___10B. Which statement BEST explains your answer?

- A. Each chromosome in the nucleus is duplicated and undergoes meiosis I which separate the two chromosomes of the homologous pair.
- B. Meiosis I divides the sister chromatids into two identical diploid cells while meiosis II yield four haploid cell.
- C. Meiosis I forms haploid cells after separating the two chromosomes of homologous pair while meiosis II separates the sister chromatids into four daughter cells as haploid.*
- D. The sister chromatid replicate forming a pair of homologous chromosomes in a diploid parent cell then divides to two genetically identical chromosomes.

Appendix B
Student Engagement Reflection

Participant's Profile

Name: _____

Gender: _____ Age: _____

Directions: Read the following statements below and check the box that describes best how you felt about class with the integration of Kahoot.

____ I wish every class was like this every day at school (*Authentic engagement*).

____ I worked hard just to get the best grade possible (*Ritual engagement*).

____ I did what I had to do to finish my work and stay out of trouble (*Passive engagement*).

____ I was so ready for class to be over and I wish we could learn in other ways (*Retreatism*).

____ I am not going to do any work if we have a class like this again (*Rebellion*).

Appendix C
Teacher Engagement Reflection

Name: _____ **Date:** _____

Topic: _____

While observing my class during instructional time today and after reflecting on the class's engagement, I believe the class as a whole was at a level of:

_____ ***Authentic engagement.*** The class demonstrated high attention and high commitment to the learning tasks.

_____ ***Ritual engagement.*** The class demonstrated high attention but low commitment to the learning tasks.

_____ ***Passive engagement.*** The class demonstrated low commitment and low attention to the learning tasks.

_____ ***Retreatism.*** The class demonstrated no attention and no commitment to the learning tasks.

_____ ***Rebellion.*** The class demonstrated diverted attention and no commitment to the learning tasks.

Please explain the reason for your ranking with as much anecdotal evidence as you can recall without identifying individual students.

Appendix D
The Situational Motivation Scale (SIMS)

Name: _____

Section: _____

Gender: _____ Age: _____

Directions: Read each item carefully. Using the scale below, circle the number that best describes the reason why you are currently engaged in the activity using the Kahoot. Answer each item according to the following scale:

- 5- corresponds enough
 4- corresponds moderately;
 3- corresponds a little;
 2- corresponds a very little;
 1- corresponds not all;

Why are you currently engaged in this activity?

- | | | | | | |
|---|---|---|---|---|---|
| 1. Because I think that this activity is interesting | 5 | 4 | 3 | 2 | 1 |
| 2. Because I am doing it for my own good | 5 | 4 | 3 | 2 | 1 |
| 3. Because I am supposed to do it | 5 | 4 | 3 | 2 | 1 |
| 4. There may be good reasons to do this activity,
but personally I don't see any | 5 | 4 | 3 | 2 | 1 |
| 5. Because I think that this activity is pleasant | 5 | 4 | 3 | 2 | 1 |
| 6. Because I think that this activity is good for me | 5 | 4 | 3 | 2 | 1 |
| 7. Because it is something that I have to do | 5 | 4 | 3 | 2 | 1 |
| 8. I do this activity but I am not sure if it is worth it | 5 | 4 | 3 | 2 | 1 |
| 9. Because this activity is fun | 5 | 4 | 3 | 2 | 1 |
| 10. By personal decision | 5 | 4 | 3 | 2 | 1 |
| 11. Because I don't have any choice | 5 | 4 | 3 | 2 | 1 |

12. I don't know; I don't see what this activity brings me	5	4	3	2	1
13. Because I feel good when doing this activity	5	4	3	2	1
14. Because I believe that this activity is important for me	5	4	3	2	1
15. Because I feel that I have to do it	5	4	3	2	1
16. I do this activity, but I am not sure it is a good thing to pursue it	5	4	3	2	1

Appendix E
Interview Protocol

Date:

Time:

Place:

Interviewer:

Initial Information for the participants:

I am Jonalyn G. Poserio, and I am doing this research to earn my Master's degree in education.

Thank you for taking the time to share your thoughts on the use of Kahoot with me. Your answers to the questions that will be asked here are very important to me and the study I am conducting.

I am using your answers, the teachers' observation, and my observations to analyze the use of Kahoot in our Biology class. I want to assure you that no one, except for me, will have access to the information you share with me today.

With your permission, I would like to make an audio recording of this interview as well as take notes while you speak. This will help me to collect your thoughts and ideas completely.

(Check the recording device and begin interview)

I would like to ask you a few questions regarding your experiences as a student with the use of Kahoot. If, at any time you feel uncomfortable about a question, just let me know, and we will move on to the next question. Remember that you may stop the interview at any time.

Impression

1. Describe a typical use of Kahoot in your Biology class.
2. Tell me about your experience of using Kahoot in your Biology class.
3. Describe the benefits of using Kahoot in your Biology class
4. Describe the difficulties/challenges you have encountered using Kahoot in your Biology class
5. What else would you like to share about the use of Kahoot in our Biology class?

Appendix F Observation Protocol

Subject:	Date:
Topic:	Time:
Observer:	Place:
Physical Setting <i>What is the physical environment like?</i> <i>What kinds of behavior is the setting designed for?</i> <i>How is space allocated?</i> <i>What objects, resources, technologies are in the setting?</i>	
The Participants <i>Who and how many people are in the scene?</i> <i>What are their roles?</i> <i>Who is not here who would be expected to be here?</i> <i>What are the relevant characteristics of the participants?</i> <i>What are the ways in which the people in this setting organize themselves?</i>	
Activities and Interactions <i>What is going on?</i> <i>Is there a definable sequence of activities?</i> <i>How do the people interact with the activity and with one another?</i> <i>How are people and activities connected?</i> <i>What norms or rules structure the activities and interactions?</i> <i>When did the activity begin? How long does it last?</i> <i>Is it a typical activity, or unusual?</i>	

Conversation

What is the content of conversations in this setting?

Who speaks to whom?

Who listens?

Subtle Factors

Informal and unplanned activities

Symbolic and connotative meanings of words

Nonverbal communication such as dress and physical space

Unobtrusive measures such as physical clues

What does not happen that ought to have happened?

Researcher Behavior

How does my role affect the scene I'm observing?

What do I say and do?

What thoughts do I have about what is going on?

Appendix G
Letter to the Validator

February 20, 2018

Dear _____:

The undersigned is writing her thesis titled *“Using Kahoot as an instructional tool in Biology”* as a requirement leading to the Degree of Master of Arts in Science Education with specialization in Biology in Philippine Normal University.

In the said thesis, a 10-item two-tier multiple-choice questionnaire instrument on Cellular Reproduction and Genetics as well as a semi-structured interview questions with regards to the use of Kahoot have been developed. In addition, an adapted and modified Situational Motivational Scale (SIMS) will also be used in the study. Vouching on your expertise, your valuable professional assistance is being sought to kindly evaluate the attached research instruments. Your feedback on the validity of these instruments will aid the researcher to gather the much needed data that will help shed light on the questions raised.

Your time and effort in extending your expertise to the undersigned is greatly appreciated.

Respectfully yours,

Jonalyn G. Poserio
MA Science Education
Student

Noted:


Dr. Arlyne Marasigan
Thesis Adviser

Appendix H
Letter to the Department Head

February 15, 2018

Mrs. Mary Grace Awkit
I.Villamor High School
Science Department
Head

Dear Ma'am Awkit:

The undersigned is writing her thesis titled *“Using Kahoot as an Instructional Tool in Biology”* as a requirement leading to the Degree of Master of Arts in Science Education with specialization in Biology in Philippine Normal University.

In relation to this, your permission is being sought to allow the undersigned to administer the testing of the interview questionnaire among the selected Grade eleven ABM and HUMSS strands. The test of the instrument will help the undersigned to gather the data from the said respondents necessary towards the completion of the thesis being undertaken.

Your usual support on this academic endeavor is deeply appreciated.

Respectfully yours,

Jonalyn G. Poserio
MA Science Education
Student

Noted:


Dr.Arlyne Marasigan

Thesis Adviser

Appendix I
Consent Letter for the conduct of the study

February 15, 2018

Mrs. Ma. Teresa A. Custodio
I. Villamor High School
Principal III

Dear Ma'am Custodio:

The undersigned is writing her thesis titled ***"Using Kahoot as an Instructional Tool in Biology"*** as a requirement leading to the Degree of Master of Arts in Science Education with specialization in Biology in Philippine Normal University.

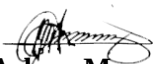
In relation to this, your permission is being sought to allow the undersigned to conduct a study at your respected school during the fourth quarter of this school year. The study will involve three classes of Grade eight students in Biology handle by three different teachers. The participants in the said study will be briefed prior to the implementation of the study. The learners will be asked to take a pre-test and post-test exam, write a daily reflection, complete a reflection slip and answer the situational motivation scale (SIMS). Also, the research will also conduct a focus group interview with the selected participants. Moreover, the teachers in the study will also be asked to complete a reflection slip, write a daily reflection regarding the use of Kahoot.

Rest assured that any information or data gathered will be treated with utmost confidentiality.

Respectfully yours,

Jonalyn G. Poserio
MA Science Education
Student

Noted:


Dr. Arlyne Marasigan
Thesis Adviser

Appendix J

Parents' Consent

Dear Parent/Guardian,

This is to ask your consent to allow your child/ren to be a participant in the research that I am conducting entitled, ***“Using Kahoot as an Instructional Tool in Biology.”*** This research study is a component of my thesis writing as I work towards my master's degree. There are no costs or obligation associated with participation in the study.

My study seeks to answer the following question: ***1. What are the learners' academic performance, engagement, and motivation in Biology after using Kahoot? 2. What is the overall impression of the learners after using Kahoot in Biology class?*** Wu (1998) stated that “the purpose of using technology in education should focus on meeting students where they are in their development; therefore digital games might be a place to start ” (p.1).

For these compelling reasons, I am conducting a research on students' academic performance, motivation, and engagement as well as their overall impression with the use of digital game-based learning Kahoot in the classroom. In this study, the respondents will undergo a Pre-test, Intervention and Post-test about Cellular Reproduction and Genetics to determine the use of Kahoot in improving the academic performance of the learners. At the end of the classes, the students will be asked to write a daily reflection on the use of Kahoot in Biology. They will also be asked to complete a reflection slip and The Situational Motivation Scale (SIMS) after using Kahoot for several weeks. The reflection slip will ask the students to check one of five boxes rating their engagement level. The SIMS, on the other hand, will be asked the students to circle the number that corresponds to their motivation level. The research will also conduct a focus group interview wherein selected students will be asked regarding their impression on the use of Kahoot in Biology class. The said interview is approximately 45 minutes and will be held in the Science Resource Center during their vacant time.

The class will be divided into ten groups consisting of five members for each group. Each group will need a mobile phone to be used in answering the questions given by the teacher. The researcher/teacher will provide access to the internet during the study. However, the teacher/researcher will not be liable/responsible for any theft, damage or loss of any device or the information on any such device. It will be the responsibility of the owner of the device to ensure that it is safe and secure. Attached to this letter is the permission slip to bring their mobile phones to school.

The said study will be conducted during the fourth quarter of the school year 2017-2018. Any information or data gathered will be treated with utmost confidentiality. I am hoping for your kind consideration

Jonalyn G. Poserio
Science Teacher/ Researcher

_____ I allow my child/ren to participate in the study on the use of Kahoot in teaching-learning
Biology

_____ No, I refuse my child/ren to participate in the study on the use of Kahoot in teaching-learning
Biology

Parent's/ Guardian' Signature over printer name

Appendix K
Permission Slip

Bringing of Mobile Phone

I have read and reviewed the School policy for students bringing their own devices to school.

____ I give my child/ren permission to participate in this study and bring their mobile phone/s to school.

____ I would like to opt out of this study at this time.

Student Name: _____

Parent Signature: _____

Appendix L
Students' Assent for the Participation in the study

To the students:

This is to ask your consent to be a participant in the research that I am conducting entitled, “***Using Kahoot as an Instructional Tool in Biology.***” This research study is a component of my thesis writing as I work towards my master’s degree. There are no costs or obligation associated with participation in the study.

The following information is provided to help you decide whether you wish to participate in the present study. You should be aware that you are free to decide not to participate or to withdraw at any time without affecting your grades in your Biology class. The purpose of this study is to determine the academic performance, engagement, motivation and impression of the learners using Kahoot.

Data will be collected using a pre-test in Mitosis and Meiosis at the beginning of the class. Then, a post-test, engagement reflection slip, situational motivation scale (SIMS) will be given during conduct of the study and your scores will be recorded. You will also be observed and asked to write a daily reflection with regards to the use of Kahoot. The teacher will select eight participants in your class to know their impressions regarding the use of Kahoot. The selected students will be interviewed during vacant time at the Science Resource Center for approximately thirty minutes.

Do not hesitate to ask questions about the study before participating or during the study. I would be happy to share the findings with you after the research is completed. Your name will not be associated with the research findings in any way, and only the researchers will know your identity.

There are no known risks and/or discomforts associated with this study. The expected benefits associated with your participation are the knowledge about the use of Kahoot in teaching-learning Biology. If this study is later submitted for publication, a by-line will indicate the participation of all students in the class.

Please sign this consent form. You are signing it with full knowledge of the nature and purpose of the procedures. A copy of this form will be given to you to keep.

Signature over printed name

Date

Jonalyn G. Poserio
Researcher

Student's Assent for the pilot testing of the interview questionnaire

To the students:

This is to ask your consent to be a participant in the pilot testing of the interview questionnaire I made in my study, "***Using Kahoot as an Instructional Tool in Biology.***" This research study is a component of my thesis writing as I work towards my master's degree. There are no costs or obligation associated with participation in the study.

The following information is provided to help you decide whether you wish to participate in the present study. You should be aware that you are free to decide not to participate or to withdraw at any time without affecting your grades in your Physical Science class. The purpose of this study is to determine the academic performance, engagement, motivation and impression of the learners using Kahoot.

The teacher will select five participants in your class to know their impressions regarding the use of Kahoot. The selected students will be interviewed during vacant time inside the classroom for approximately thirty minutes.

Do not hesitate to ask questions about the study before participating or during the study. I would be happy to share the findings with you after the research is completed. Your name will not be associated with the research findings in any way, and only the researchers will know your identity.

There are no known risks and/or discomforts associated with this study. The expected benefits associated with your participation are the knowledge about the use of Kahoot in teaching-learning Biology. If this study is later submitted for publication, a by-line will indicate the participation of all students in the class.

Please sign this consent form. You are signing it with full knowledge of the nature and purpose of the procedures. A copy of this form will be given to you to keep.

Signature over printed name

Date

Jonalyn G. Poserio
Researcher

Appendix M
Invitation to Participate Consent Letter to the Teachers

February 19, 2018

Mr. _____
I. Villamor High School
Science Department
Teacher

Dear Mr. Salonga:

The undersigned is writing her thesis entitled ***“Using Kahoot as an Instructional Tool in Biology”*** as a requirement leading to the Degree of Master of Arts in Science Education with specialization in Biology in Philippine Normal University. This study will investigate the use of Kahoot in teaching-learning Biology and will address the following research questions: ***1. What are the learners’ academic performance, engagement, and motivation in Biology after using Kahoot? 2. What is the overall impression of the learners after using Kahoot in their Biology class? 3. What is the overall impression of the teachers after using Kahoot in their Biology class?*** The said study will be implemented during the fourth quarter of this school year, with your participation as well as the participation of one class you handle.

This is an invitation for you to participate, as you have been identified as a Biology educator teaching in the public school in Manila.

Participation - Participation will use the digital game-based learning Kahoot in teaching Biology before or after the lesson. The internet access will be provided by the researcher throughout the implementation of the study. It will also consist of completing a reflection slip, writing a daily reflection regarding the use of Kahoot.

Benefit – The participants in the study will not receive any form of incentive or compensation.
Confidentiality –The Grade eight Biology teachers are invited to participate as potential respondents in the present study. The identity of the participants will be kept confidential and known only to the researcher, as you will not be identified by your name you but by an assigned name throughout the research process and in the proposal itself. Your daily reflection and reflection slip will also be kept confidential in the sense that they will not be associated with your name and all materials will be stored via password protected files. Your identity will not be shared with anyone at the school or district level including administrators or in the final published of the thesis. Your participation will not affect or be a part of your school evaluation. You may choose to exit the study at any time should you change your mind about participation.

The table below presents an overview of the activities. You will see that the time commitment is not overwhelming and the study is designed to accommodate your participation.

Study Activities and Time Commitment

Activities	Time Commitment	Place
1. Read and respond to this invitation to participate in the study.	10 minutes	School
2. Using of Kahoot in teaching Biology	5-10 minutes	Classroom
3. Writing a daily reflection – after using Kahoot in Biology lesson (scheduled as your convenience)	5 minutes	Classroom
4. Completing the reflection slip- after using Kahoot during the fourth quarter	5 minutes	Classroom

Please Check and return this form to me.

___ **Yes** I would like to participate in this study.

___ **No** I would prefer not to participate in this study.

I am looking forward to meeting with you and working with you on this important study. Please feel free to call me at 0906 769 8283 or e-mail me at poseriojonalyn0011@gmail.com if you have any questions or would like to discuss participation.

Respectfully yours,

Jonalyn G. Poserio
MA Science Education
Student

Appendix N
Validation Tool in the Interview Protocol

To the Validator:

Name of the Validator	
Field of Specialization	
Affiliation	

Attached herewith is a researcher-made **interview question** for my research study entitled ***Using Kahoot as an instructional tool in Biology***. Kindly validate this instrument to determine its relevance/applicability with regards to the main concern of this study. Please rate each interview question by checking the column of the number that represents the scale with their numeric equivalent as follows:

Kindly indicate your assessment in each of the following questions by following the rubric below.

Numerical Equivalent	Code	Verbal Interpretation	Description
3	R	Relevant	The interview questions are well written and relevant.
2	FR	Fairly Relevant	The interview questions are relevant to some extent.
1	IR	Irrelevant	The interview questions show no relevance.
0	NR	Needs Revision	Have incorrect/irrelevant ideas.

Your time and effort in extending your expertise to the undersigned will be greatly appreciated.

Respectfully yours,

Jonalyn G. Poserio
MA Science Education
Student

INTERVIEW QUESTIONS		3	2	1	0	REMARKS
Impression	1. Describe a typical use of Kahoot in your Biology class.					
	2. Tell me about your experience of using Kahoot in your Biology class.					
	3. Describe the benefits of using Kahoot in your Biology class					
	4. Describe the difficulties/challenges you have encountered using Kahoot in your Biology class.					
	5. What else would you like to share about the use of Kahoot in our Biology class?					

ADDITIONAL COMMENTS:

Evaluator's Signature over Printed Name and Date Signed

Validation Tool in the Two-tier MC

To the Validator:

Name of the Validator	
Field of Specialization	
Affiliation	

Attached herewith is a researcher-made **two-tier multiple-choice questionnaire** for my research study entitled *Using of Kahoot in Teaching-Learning Biology*. Kindly validate this instrument to determine its relevance/applicability with regards to the main concern of this by checking the column of the number that represents the scale with their numeric equivalent as follows:

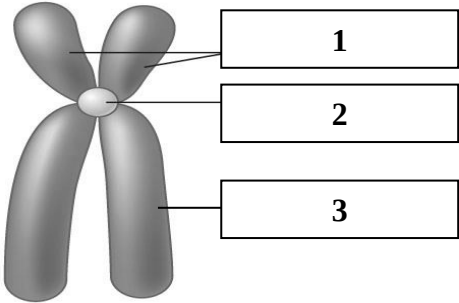
Kindly indicate your assessment in each of the following questions by following the rubric below.

Numerical Equivalent	Code	Verbal Interpretation	Definition
3	VE	Valid Explanation	Compare similarities and differences between contexts, and apply concepts relevant to each context.
2	SE	Slightly Valid Explanation	Have relevant ideas but do not fully elaborate links between them in a given context.
1	InE	Inconsistent Explanation	Have relevant ideas but fail to recognize links between them. Make links between relevant and irrelevant ideas.
0	IE	Invalid Explanation	Have incorrect/irrelevant ideas.

Your time and effort in extending your expertise to the undersigned will be greatly appreciated.

Respectfully yours,

Jonalyn G. Poserio
MA Science Education
Student

QUESTIONS		3	2	1	0	REMARKS
1 A	Which process is referring to the exchange of genetic material between homologous chromosomes? A. cell division B. crossing-over* C. interphase D. synapsis					
1 B.	Which statement BEST explains your answer? A. Cell division contributes to the exchanges of genetic information between two parent cells during fertilization. B. Crossing-over takes place during synapsis which exchanges the genetic material between the non-sister chromatids.* C. Interphase contributes to the genetic variability resulting from sexual reproduction. D. Synapsis allows the exchange of chromosomes where chromatids of homologous chromosomes exchange segments.					
2 A	For numbers 2A-2B, refer to the diagram below.  Which part of the chromosome is responsible for joining the two sister chromatids? A. 1 B. 2* C. 3 D. Both 1 and 2 are correct					
2 B	Which statement BEST explains your answer? A. The short arms of the chromosome connect the two sister chromatids at the center. B. The long arms of the chromosomes found in the middle join them together. C. The centromere found in the central region of the chromosome combines them.* D. The short and long arms are responsible for associating the sister chromatids.					

3 A	Which stage of the cell cycle allows the duplication of the DNA and accounts for the 90% of the time during each cycle? A. anaphase B. interphase* C. prophase D. telophase				
3 B	Which statement BEST explains your answer? A. Anaphase allows the cell to increase in size which takes a longer time. B. Interphase is consist of G1, S, and G2 phases which allow the cell to increase in size and duplicates the DNA and become larger again for division.* C. Prophase allows the chromatin fibers to become more tightly coiled and become condensed chromosomes resulting in DNA replication. D. Telophase allows the cell to grow more with the presence of the nonkinetochore microtubules forming two daughter nuclei.				
4 A	Which statement is TRUE about fertilization? A. The haploid sperm cell from the father fuses with the haploid egg cell of the mother resulting to a zygote. * B. The diploid sperm cell from the father joins with the haploid egg cell from the mother resulting to a zygote. C. The diploid sperm cell from the father and the diploid egg cell from the mother fuse together forming haploid cells. D. The haploid sperm cell from the father combines with the diploid egg cell from the mother resulting to a zygote.				
4 B	Which statement BEST explains your answer? A. The gametes or sex cells are both diploid cells which allow genetic recombination. B. The gametes or sex cells are both haploid cells which underwent meiosis allowing the genetic recombination thus, genetic variability of offspring* C. The sperm cell of the male is a haploid cell while the egg cell of the female is a diploid cell which produces four genetically identical haploid cells. D. The sperm cell from the father is diploid while the egg cell from the mother is haploid which produces two genetically diploid cells.				

5 A	Which is NOT a function of mitosis in humans? A. Humans can produce gametes or sex cells from diploid cells. * B. Jose's knees recovered after getting severe wounds from an accident. C. Mang Ador's damaged cells in his liver were replaced by healthy ones. D. Maria's height increase to one inch after several months.				
5 B	Which statement BEST explains your answer? A. Meiosis is a kind of cell division responsible for the growth in humans. B. Meiosis is the kind of cell division which produces gametes or sex cells. * C. Mitosis is responsible for the healing of wounds through cell division. D. Mitosis replaces the damaged cells in our body through cell division.				
6 A	Which statement shows the difference between a diploid cell and haploid cell? A. A haploid cell in humans is 46 or $2n$ while the diploid cell is 23 or n coming from each parent. B. A diploid cell in humans and other animals have a single set of chromosome while the haploid cell has half number of chromosome. C. Diploid cell in humans and other animals have a pair of homologous chromosome while the haploid cell has a single set of chromosome.* D. Haploid cell allows the doubling of chromosome number in each generation while the diploid cell maintains the number of chromosomes.				
6 B	Which statement BEST explains your answer? A. diploid cells are responsible for the genetic recombination that results to genetic variability. B. diploid cells are a pair of chromosomes which allow the doubling of chromosome number in each generation. C. haploid cells in humans are consist of a pair of homologous chromosomes while the diploid cells are consist of a single chromosome. D. haploid cell in humans results from meiosis having single chromosome while the diploid cells results from mitosis having homologous chromosomes.*				
7 A	Which phase in the cell division allows the quantity of DNA in cells growing in the laboratory doubled?				

	A. between anaphase and telophase of mitosis B. between prophase and anaphase of mitosis C. between G1 and G2 phases of the cell cycle* D. during the prophase I and prophase II of meiosis				
7	Which statement BEST explains your answer?				
B	A. During the anaphase and telophase of mitosis the cell grows before cytokinesis. B. During prophase and anaphase of mitosis the cell accumulates materials from the outside. C. During the prophase I and prophase II all the proteins and cell parts are synthesized making it bigger. D. During G1 and G2 phases the cell increase in size by absorbing materials that give energy before cell division.*				
8	What is the difference between the cytokinesis in animal cells and plant cells?				
A	A. Cleavage furrow is the first sign of cleavage both in animal and plant cells which leads to the separation of cells. B. Cleavage furrow deepens until the parent cell is squeezed in animal cells while the plant cell fuses vesicles together. C. Cleavage furrow is the initial sign of cleavage in an animal cell while the plant cell formed cell plate instead of the cleavage furrow. * D. The cell plate is formed both in plant and animal cell through the collection of vesicles at the middle of the parent cell.				
8	Which statement BEST explains your answer?				
B	A. Cleavage furrows are formed in plants only before the cell divides. B. Cleavage furrows form in animal cells but not in plant cells.* C. The cell plate is formed both in animals and plant cells during telophase. D. The cell plate is only formed in animal cells during telophase.				
9	Which statement shows the difference between a normal cell and cancer cell?				
A	A. The cancer cell is always formed in the M phase of the cycle while the normal cell is formed through meiosis. B. The cell cycle of the normal cell is arrested at the interphase while the cancer cell in the S phase.				

	C. The normal cell synthesizes DNA while the cancer cell synthesizes RNA. D. The normal cell functions properly and stops from dividing while the cancer cell divides continuously.*				
9 B	Which statement BEST explains your answer? A. The normal cell divides continuously while the cancer cell stops dividing due to the phenomenon called density-dependent inhibition B. The normal cell stops dividing when it reaches the density-dependent inhibition while the cancer cell divides continuously * C. The normal cell divides when needed by the body while the cancer cell divides all the time D. The normal cell grows on the surface or with contact with the solid surface while the cancer cell continues dividing at high density.				
10 A	Which statement is TRUE about meiosis? A. Meiosis is a type of cell division which produces diploid cell into haploid organisms.* B. Meiosis is a type of cell division which increases chromosome number from diploid to haploid. C. Meiosis requires two cell division producing two genetically identical daughter cells. D. Meiosis is a type of cell division that produces haploid gametes into diploid organisms.				
10 B	Which statement BEST explains your answer? A. Each chromosome in the nucleus is duplicated and undergoes meiosis I which separate the two chromosomes of the homologous pair. B. Meiosis I divides the sister chromatids into two identical diploid cells while meiosis II yield four haploid cell. C. Meiosis I forms haploid cells after separating the two chromosomes of homologous pair while meiosis II separates the sister chromatids into four daughter cells as haploid.* D. The sister chromatid replicate forming a pair of homologous chromosomes in a diploid parent cell then divides to two genetically identical chromosomes.				

ADDITIONAL COMMENTS:

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

Evaluator's Signature over Printed Name and Date Signed

Appendix O
Results of Expert Validation in Two-tier MCQ in Mitosis and Meiosis

Question	EXP1	EXP2	EXP3	MEAN	SD	REMARKS
1A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
1B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
2A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
2B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
3A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
3B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
4A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
4B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
5A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
5B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
6A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
6B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
7A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
7B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
8A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
8B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
9A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
9B	3.00	3.00	3.00	3.00	0.000	Valid Explanation
10A	3.00	3.00	3.00	3.00	0.000	Valid Explanation
10B	3.00	3.00	3.00	3.00	0.000	Valid Explanation

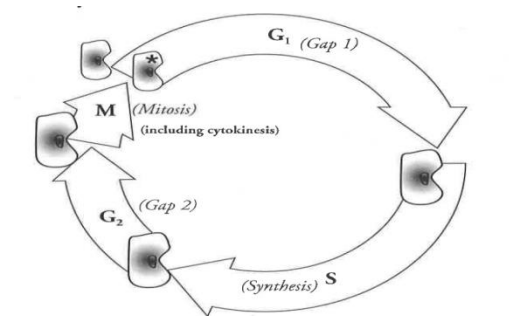
Results of Expert Validation in Interview Protocol

Question	EXP1	EXP2	EXP3	MEAN	SD	REMARKS
1	3.00	3.00	3.00	3.00	0.000	Relevant
2	3.00	3.00	3.00	3.00	0.000	Relevant
3	3.00	3.00	3.00	3.00	0.000	Relevant
4	3.00	3.00	3.00	3.00	0.000	Relevant
5	3.00	3.00	3.00	3.00	0.000	Relevant

	Appendix P Daily Lesson Log in Cell Cycle
I. OBJECTIVES	
A. Content Standards	The learners demonstrate an understanding of: 1. how cells divide to produce new cells
B. Performance Standards	The learners should be able to: 1. report on the importance of variation in plant and animal breeding
C. Learning Competencies/ Objectives Write the LC code for each	Compare mitosis and meiosis, and their role in the cell-division cycle S8LT-IVd-16 1. Identify the different stages of cell cycle 2. Summarize the events in the cell cycle 3. Cooperates with the groups in performing the activity
II. CONTENT	Heredity: Inheritance and Variation of Traits Stages of mitosis
III. LEARNING RESOURCES	
A. References	K to 12 Science Curriculum Guide August 2016 p.149
1. Teacher's Guide pages	N/A
2. Learner's Materials pages	
3. Textbook pages	
4. Additional Materials from Learning Resource (LR) portal	
B. Other Learning Resources	www.biology.arizona.edu
IV. PROCEDURES	
A. Reviewing previous lesson or presenting the new lesson	The teacher will ask the learners to do the procedures below to review the previous lesson. Procedures: 1. Go to kahoot.it 2. Enter the game pin found on the screen 3. Choose your Team Name 4. Type your members name
B. Establishing a purpose for the lesson	The teacher will show diagrams of the following. a. growing child b. healing wound c. damaged cells in the body Questions: 1. What causes a child to grow? 2. How does an open-wound heal? 3. Which is responsible for the cell repair in the body?

	The teacher will ask the learners to identify the topic by arranging the letters below: L L E C Y L C E C 5 minutes
C. Presenting examples/instances of the new lesson	- The teacher will ask the learners to read the objectives of the lesson. - The teacher will ask the learners to give the meaning of the following words by matching the term with its correct definition. The learner will get points based from the score they get from the wheel of fortune. A - process of dividing - a series of events or operations that recur regularly - a particular appearance or state - to make denser or more compact B - phase - cycle - division - condense - The teacher will discuss first the following concepts to the learners by showing diagram to the learners. - gene - chromosome - chromatin - chromatid - sister chromatid - The teacher will ask the class to raise their hands, 5 fingers – all concepts are clear - The teacher will introduce the topic “Cell Division” to the class. Cell Cycle <i>What controls the life and development of a cell?</i>

An old piece of poetry say, “for everything there is a season... a time to be born, a time to die.” This topic will help you understand the different season in the life of a cell.



Questions:

1. How many phases are there in the cell cycle as shown in the diagram? (four)
2. Which of the stages in the cell cycle allow the cell to grow? (G₁ and G₂)
3. Which of the following stages allow the number of cell to increase?
6. The teacher will ask the class to work by group by performing the “Cell Cycle Station.”
7. The class will be divided into 4 groups. Each group will be assigned to the following stations and will be asked to analyze the diagram, read and answer the questions by reading the concepts stated in their station.

20 minutes

D. Discussing new concepts and practicing new skills #1

The teacher will ask each group to perform the task given to them and go to the next station once they hear the bell. This indicates that they have consumed 3 minutes. already. The class will be asked to draw the diagram of cell cycle before processing to the activity. (See Activity Sheet 1 The Cell Cycle Wheel)

Group 1- G₁

Group 2- S

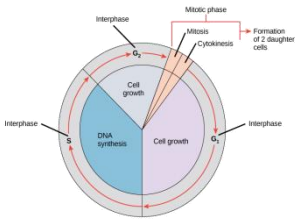
Group 3- G₂

Group 4 – Mitosis

15 minutes

E. Discussing new concepts and practicing new skills #2

F. Developing mastery (leads to

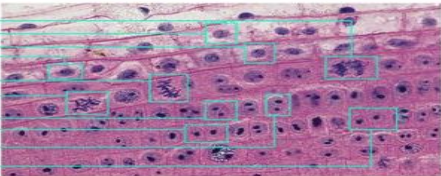
Formative Assessment 3)	
G. Finding practical applications of concepts and skills in daily living	
H. Making generalizations and abstractions about the lesson	
I. Evaluating learning	The learners will be asked to go to their small group. Each group having 5 members. The teacher will ask the learners to connect to the internet provided by the teacher. The teacher will ask the class to go to Kahoot.com and enter the game code provided. The group will answer the questions using their mobile phones, the scores and percentage of the answers for the distractors and correct answer will be flashed on the screen. 1. Which of the following phases of the cell cycle refers to the initial growth of the cell? A. G1* B. G2 C. Interphase D. M Phase 2. Which of the following statements is TRUE about the G2 phase? A. G2 phase allows the cell to grow bigger again by synthesizing the available materials* B. G2 phase allows the cell to grow smaller by breaking down its nuclear membrane. C. G2 phase prepares the cell for cell division by replicating the DNA D. G2 phase prepare the cell by dividing the cell into 4 daughter cells. 3. Which of the following phases of the cell cycle replicates the DNA?  A. G1 B. G2 C. Interphase D. S Phase* 4. Which of the following phases is consist of the G1, S, G2? A. G1 B. G2 C. Interphase* D. S Phase 5. Why does the cell need to undergo interphase before cell division?

	A. The interphase allows the cell to break and grow smaller in preparation for cell division. B. The interphase allows the cell to grow bigger and duplicate its chromosomes in preparation for the cell division* C. The interphase is the resting phase of the cell to stop from growing before it undergo cell division D. The interphase is consist of four stages such as prophase, metaphase, anaphase and telophase important in the cell division.
J. Additional activities for application or remediation	
V. REMARKS	
VI. REFLECTION	
A. No. of learners who earned 80% in the evaluation	
B. No. of learners who require additional activities for remediation	
C. Did the remedial lessons work? No. of learners who have caught up with the lesson	
D. No. of learners who continue to require remediation	
E. Which of my teaching strategies worked well? Why did these work?	
F. What difficulties did I encounter which my principal or supervisor can help me solve?	
G. What innovation or localized materials did I use/discover which I wish to share with other teachers?	

Appendix P Daily Lesson Log in Cell Cycle	
I. OBJECTIVES	1. Describe the stages of mitosis. 2. Perform activities showing the stages of mitosis 3. Appreciate the importance of mitosis to us
A. Content Standards	<i>The learners demonstrate an understanding of:</i> 1. how cells divide to produce new cells
B. Performance Standards	
C. Learning Competencies / Objectives Write the LC code for each	<i>At the end of the module, the learners are expected to compare mitosis and meiosis in their role in the cell division cycle.</i> S8LT-IVd-16
II. CONTENT	Stages of Mitosis
III. LEARNING RESOURCES	
A. References	
1. Teacher's Guide pages	
2. Learner's Materials pages	
3. Textbook pages	
4. Additional Materials from Learning Resource (LR) portal	
B. Other Learning Resources	Mitosis in Onion Root Tip Cells retrieved from: http://w3.marietta.edu/~biol/introlab/Onion%20root%20mitosis.p df What is Mitosis? Retrieved from: https://www.yourgenome.org/facts/what-is-mitosis Mitosis-Made Super Easy Animation Retrieved from: Mitosis in Onion Root Tip Cells retrieved from: http://w3.marietta.edu/~biol/introlab/Onion%20root%20mitosis.p df What is Mitosis? Retrieved from: https://www.yourgenome.org/facts/what-is-mitosis <i>Mitosis 3D animation: Phases of Mitosis/Cell Division</i> <i>Retrieved from: Mitosis 3D animation: Phases of Mitosis/Cell Division</i>
IV. PROCEDURES	

A. Reviewing yesterday's lesson or Presenting the new lesson Connect the lesson with learners' prior knowledge. Explicitly teach to the learners how the new lesson connects to previous lessons.	Kahoot! <i>Students will analyze the multiple-choice questions in the Kahoot by selecting the correct answer using their mobile phone.</i> 1. Enter the game pin 2. Type the name of your team and nicknames 3. Read and analyze the question 3. Select your answers using your phone.
B. Establishing a purpose for the lesson Motivate them to learn the new lesson. Encourage them to ask questions about the new topic. This will help establish a reason for learning the new lessons.	Picture Formula <i>Students will identify the terms related to the topic by analyzing the pictures and solving the letters following the given mathematical operations.</i> <i>Example:</i>  - tractor +  - one + a  + - PROPHASE
C. Presenting examples/ instances of the new lesson Provide examples of the new lesson. Show what the instances of the content and competencies. This is where the concepts are clarified.	<i>Tell the students that "Mitosis" occur everyday. To strengthen the concept and terms presented to the students on the previous activity (Picture Formula), the students will watch a video presentation regarding the stages of mitosis. Title: Mitosis 3D animation: Phases of Mitosis/Cell Division.</i> Questions: 1. How many stages are there in mitosis? 2. What happens to the cell after the G2 phase?
D. Discussing new concepts and practicing new skills #1 (Leads to Formative Assessment 1) Discuss the concepts. Prepare good questions for this. Listen to the answers of learners to gauge if they understood your presentation lesson. If not, then reteach. If they have understood, then proceed to deepening the lesson.	<i>The class will be divided into 4 groups. Each group will receive an activity card that they have to do or perform. The teacher will explain the activities to the class.</i> Group 1: Observation of Onion root tip squash Group 2: The Voice: Biology Edition Group 3: Mitosis Visual Diagram Group 4: Virtual Tour of Mitosis <i>The learners will be asked to present their work to the class.</i>
E. Discussing new concepts and practicing new skills #2 (Lead to Formative Assessment 2) Deepen the lesson with new ways to apply the learning. Pair, group and teamwork might be a good way to help	<i>The teacher will discuss the "Stages of Mitosis" with the use of pictures.</i>

learners discuss the lesson among themselves. They can present their work to the class and this serves as the teachers' way of assessing if the concepts are solidifying and if their skills are developing.	
F. Developing mastery (Leads to Formative Assessment 3) Develop mastery through more individual work activities such as writing, creative ways of representing learning, dramatizing, etc. Let children demonstrate their learning through assessable activities such as quizzes, worksheets, seat work, and games.	
G. Finding practical applications of concepts and skills in daily living Develop appreciation and valuing for their learning by bridging the lesson to daily living. This will establish relevance in the lesson.	<i>The teacher will present a picture with quotation (in gif format), the students will observe and will react to it. Afterwards, the teacher will be asking questions.</i>  <i>Guide question:</i> <i>1. In your own perception, what was the quotation all about? (In this question, the students could have varied ideas and interpretation on the picture. With that, the teacher could ask different questions regarding their answers.)</i> <i>2. How will you relate the quotation to mitosis?</i> <i>3. Why is mitosis important to our everyday life?</i>

	Each group will answer the worksheet by following the general instructions. Mitotic cell division Analyse the photomicrograph of cells in the onion root tip by identifying the stages and phases for mitotic cell division by adding "✓" in the table. A B C D E F G H I J  Onion root tip (L.S.) <table><tr><th rowspan="2">Cell</th><th rowspan="2">Cell growth (Interphase)</th><th colspan="4">Mitosis (Nuclear division)</th><th rowspan="2">Cytoplasmic division</th></tr><tr><th>Stage 1 (Prophase)</th><th>Stage 2 (Metaphase)</th><th>Stage 3 (Anaphase)</th><th>Stage 4 (Telophase)</th></tr><tr><td>A</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>B</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>C</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>D</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>E</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>F</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>G</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>H</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>I</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>J</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	Cell	Cell growth (Interphase)	Mitosis (Nuclear division)				Cytoplasmic division	Stage 1 (Prophase)	Stage 2 (Metaphase)	Stage 3 (Anaphase)	Stage 4 (Telophase)	A							B							C							D							E							F							G							H							I							J						
Cell	Cell growth (Interphase)			Mitosis (Nuclear division)					Cytoplasmic division																																																																									
		Stage 1 (Prophase)	Stage 2 (Metaphase)	Stage 3 (Anaphase)	Stage 4 (Telophase)																																																																													
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H. Making generalizations and abstractions about the lesson Conclude the lesson by asking children good questions that will help them crystallize their learnings so they can declare the knowledge and demonstrate their skills.																																																																																		
I. Evaluating learning Assess whether the learning objectives have been met. Evaluations should tap into the three types of objectives.	Paper and Pen Test The teacher will conduct a 5- item quiz about the stages of mitosis.																																																																																	
J. Additional activities for application or remediation	Agreement On your Biology notebook, write your answers on the following questions. 1. What is meiosis? 2. Why is meiosis important? 3. How does meiosis differ from mitosis?																																																																																	
V. Remarks																																																																																		
VI. Reflection																																																																																		
H. No. of learners who earned 80% in the evaluation																																																																																		
I. No. of learners who require additional activities for remediation																																																																																		
J. Did the remedial lessons work? No. of learners who have caught up with the lesson																																																																																		
K. No. of learners who continue to require remediation																																																																																		
L. Which of my teaching strategies worked well? Why did these work?																																																																																		
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N. What innovation or localized materials did I use/discover which I wish to share with other teachers?																																																																																		

Appendix Q

Results of Pre-test and Posttest in Two-tier MCQ in Mitosis and Meiosis

	Daisy			Ilang-Ilang			Sampaguita		
	Pretest	Posttest	Gained Score	Pretest	Posttest	Gained Score	Pretest	Posttest	Gained Score
1	9	11	2	2	12	10	5	7	2
2	4	8	4	10	11	1	5	7	2
3	5	6	1	11	11	0	6	10	4
4	7	13	6	5	13	8	0	9	9
5	6	9	3	4	9	5	6	9	3
6	7	7	0	4	12	8	5	6	1
7	2	9	7	4	15	11	3	8	5
8	6	6	0	7	15	8	5	5	0
9	6	11	5	6	7	1	0	5	5
10	9	14	5	6	11	5	0	6	6
11	7	14	7	6	12	6	7	11	4
12	0	13	13	0	10	10	7	7	0
13	9	11	2	4	10	6	7	12	5
14	3	8	5	11	13	2	6	12	6
15	13	13	0	7	13	6	7	13	6
16	8	10	2	9	10	1	9	13	4
17	5	7	2	7	14	7	2	16	14
18	5	7	2	7	9	2	4	9	5
19	2	11	9	7	12	5	1	8	7
20	7	12	5	7	11	4	8	8	0
21	6	12	6	6	13	7	4	9	5
22	7	10	3	11	12	1	2	10	8
23	2	10	8	7	10	3	8	12	4
24	4	11	7	7	16	9	6	9	3
25	4	8	4	7	10	3	0	7	7
26	5	8	3	6	11	5	7	12	5
27	6	14	8	7	10	3	4	14	10
28	5	10	5	3	13	10	6	15	9
29	0	11	11	6	9	3	2	12	10
30	9	12	3	2	16	14	7	15	8
31	7	9	2	7	10	3	3	9	6
32	1	6	5	1	8	7	5	13	8
33	6	10	4	7	10	3	8	16	8
34	3	5	2				5	11	6
35	9	9	0				5	14	9
36	10	15	5				5	9	4
37	6	10	4						
38	5	9	4						
39	4	14	10						
40	7	10	3						
41	2	8	6						
×	5.56	10.02	4.46	6.09	11.45	5.36	4.72	10.22	5.50
SD	2.8022	2.5445		2.6852	2.1950		2.5254	3.1086	

