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SCITOCIN: DEVELOPMENT OF SCIENCE MOBILE LEARNING APP FOR LEAST LEARNED COMPETENCIES IN SCIENCE 9

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ABSTRACT

This designed research aimed to develop science mobile learning application for least learned competencies in science 9 particularly in Living Things and their Environment topics. The respondents of this study were grade 9 students and teachers, for the researcher-made test and acceptability of the mobile app, and five experts for the evaluation of the acceptability of the app. The data-gathering instruments were a researcher-made test, teachers' evaluation sheet, students', and experts' evaluation questionnaires. Data analysis techniques employed were frequency count, percentage, mean, and standard deviation. This study employed design research because it aims to develop and validate the science mobile learning application utilizing Input-Process-Output (IPO) model. The data gathering instruments were the validated and reliability-tested researcher-made performance test in Living Things and their Environments topics and adopted questionnaire from state university for acceptability of the mobile application. The 50-item performance test was based on topics in Quarter One in Living Things and their Environment. Based on the findings there were 3 identified least learned competencies based on students' performance test. The result based on students' performance test was also corroborated with the result based on teachers' perception. In this study, a Scitocin mobile application was developed and yielded a rating of "Very acceptable" which further suggested that the mobile learning application has excellently met the standards in terms of content, instructional quality, technical quality, presentation and organization, accuracy and up-to-datedness of information, and assessment among the end-users and experts. Furthermore, this Scitocin mobile learning application composed of different distinct features such as e-module, video lesson, and educational games. Thus, the mobile app indeed served its purpose to cater to the needs of the 21st-century learners of a technology-enhanced instructional material that is flexible, innovative, interesting, and acceptable which would facilitate their construction of knowledge through videos and coming to class prepared. It is recommended that further research be conducted to ascertain the effect of the developed mobile app on students' academic performance and develop more mobile learning applications for relevant subjects.

Keywords: Science Mobile Application, Mobile Learning, Least Learned Competencies, Innovation, Developmental Studies

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INTRODUCTION

In today's setting, various levels of education are compromised with the need to supply the same quality of education as in traditional methods. The inclusion of technological advances in education has become imperative and inevitable due to its noted positive effects on the teaching and learning process (Ja'ashan, 2015). Technology has long been an integral part in the daily life of individuals. It has reached the specific level of being introduced to various areas of teaching and learning, especially in higher education. Starting from films and television, computers and the other variations of applications are slowly becoming a normal part of the educational scene today (Malonisio, 2018).

The results of the country's National Achievement Test (NAT) offers a basic idea of how well students are doing and perform in school. The low mean percentage scores (MPS) indicate that some of the students who are being evaluated have a low level of understanding of the ideas.

Moreover, after the Philippines' low ranking in the Programme for International Student Assessment (PISA), the Department of Education (DepEd) underlined the need of resolving the difficulties and gaps in obtaining a high-quality education. The new normal educational system had led to students' hesitation on how to perform activities and other distinguishable challenges particularly in the field of science and mathematics.

In line with this, the researcher aimed to develop Scitocin- a science mobile learning application as the intervening activity to address learning challenges in the field of science under this new normal setting. This mobile application contains different features that captured the attention of the students while exploring and studying science at home. These features are e-module, educational games, and video lectures. E-module or Electronic Viewer materials that allows the students to read and gain understanding on the topic in a digital way. On the other hand, Educational Games is also considered as one of the features that refers to the playful and creative mode of assessing students' knowledge about the specific topics. Lastly, the video lectures that will serve as the additional mode of relaying topics and lessons to the students for in-depth comprehension. This mobile application was named as "SCITOCIN" which means a combination of the two terms: Science and Oxytocin. Science as the general subject to focus on and the goal of the app that inspired by oxytocin "love hormone". Thus, the mobile app was developed to increase the love hormone of students towards science.

Research Questions

1. What are the least learned competencies of students in the topic in Living Things and their Environment for Science 9?
2. What Science mobile learning app can be developed to address the least learned competencies in Living Things and Their Environment?
3. What is the experts' evaluation and students' level of acceptability on Scitocin as a tool for mobile learning in terms of: (a) Content; (b) Instructional Quality; (c) Technical Quality; (d) Presentation and Organization; (e) Accuracy and up-to-datedness of information; and (f) Assessment?

REVIEW OF RELATED LITERATURE

Mobile Technology in Education

All students and instructors have had to change as a result of the introduction of mobile learning tools into the classroom. Mobile learning is a pervasive, wireless, extremely portable, and multimedia-enabled technology that adds a new dimension to the delivery of education (Melhuis and Falloon, 2010). The usage of mobile learning devices in schools has skyrocketed in recent years, and despite being designed for non-educational purposes, it has rapidly worked its way into the classroom. The educational sector has been drawn to these gadgets mostly because of the ability to play a variety of games (Litchfield, et al. 2007). The current edition of these gadgets introduces new features that makes it handy and inexpensive, thus, new apps that make our lives convenient are always being developed. As a result of these advancements, educators and researchers have begun to use these gadgets to aid in the teaching and learning process. By altering the traditional classroom into one that is more dynamic and engaging, mobile devices have a lot of potential to change how people learn. It also allows teachers



to teach at their own pace and in their own environment, allowing students to continue studying after class or in locations where they naturally learn. This further allows instructors to interact with students on an individual basis through the use of gadgets that they use on a constant schedule, while sensing technologies allow learning to be tailored to the particular learner's needs (Chu, et al. 2010).

Least Learned Competencies

The k-12 basic curriculum, which seeks to improve learner's fundamental abilities, develop more competent citizens, and prepare graduates for lifetime study and employment, is one of the most recent initiatives designed by the Department of Education. The letters "K" and "12" refer to the 12 years of basic education that follow kindergarten (Bigcas, 2016).

The goal of the K-12 Science Curriculum is for students to become empirically, technologically, and ecologically literate and productive members of society, with skills such as critical problem solvers, environmental stewards, citizens who are innovative and creative, informed decision-makers, and effective communicators, among other things. The goal of science education is to help students acquire scientific literacy so that they may become well-educated and active citizens who can make informed and responsible decisions about how to use scientific knowledge in ways that are beneficial to society, health, and the environment (K to 12 Curriculum Guide in Science 2018). Higher order thinking abilities must be cultivated among the learners in order to reach these goals.

As a result, biology education has a huge influence on society since it defines each individual's knowledge of scientific concepts, ideas, and principles in a given community. Teachers have struggled for years to raise the expectations of all students, particularly in biological sciences, in order to equip them with the skills they need to become more internationally competitive and functionally literate. In terms of academic quality, the Philippines trails behind other countries in the world, especially when it comes to science (Millanes et al., 2017; Rogayan Jr & Dollete, 2019).

The results of the country's National Achievement Test (NAT) offer a basic idea of how well students are doing in school. The low mean percentage scores (MPS) indicate that some of the students who are being evaluated have a low level of understanding of the ideas. Learners who take standardized tests tend to underperform and do not realize their full potential.

As per the SEI-DOST (2011), Filipino students exhibit a lack of analytical and communication skills, as well as a low level of reasoning, a low level of concept recall, and a lack of ability to explain and articulate their thoughts in their own words. According to biology in-service teachers in the National Capital Region, Mendelian and non-Mendelian genetics, mitosis and meiosis, and other topics in the field are the highest ranked topics where students have low metacognitive awareness and mastered competencies, according to a local study by Lawsin and Garcia (2017).

Development of Mobile Learning App

Mobile learning is a classification of an application designed for education and expressly, to meet the demands of students, with the purpose of providing additional learning opportunities using more efficient mobile devices (Sagirani et al., 2018). To meet this problem, an m-learning application that was previously established with internet-based and android must be created. The m-learning application was created utilizing the concept of game to fit the habits of the students, in this case high school learners. Gamification is a method of teaching that use game components to motivate students, increase their comfort level, and increase their interest in learning process.

Students of all levels can benefit from a new generation of learning that is not limited by distance or time (Alzaza and Yaakub, 2016). Within formal schooling, mobile learning (mLearning) is growing more prominent due to its cost-effectiveness, flexibility, fast connection, and awareness for the context. Mobile learning encourages students to interact socially; it encourages cooperative learning, engagement, and quick feedback, as well as social cooperation; it strengthens their knowledge structure; and it motivates them to learn. Students are more motivated to participate while studying using mobile devices, according to Domingo and Garganté (2016). Their motivation to complete academic requirements also improves with the use of mobile device, and it helps students become more self-directed in their studying. Mobile communication in education is a method that comes with a variety of benefits and drawbacks. In terms of development, the mobile application must include the following.



Mobile Learning Application and its features

As Lex (2018) points out that there are numerous benefits inclined with mobile learning, however, one of the most important benefit is that it can be accomplished anywhere. Mobile devices and applications, according to Alden (2017), are predicted to have a substantial effect on teaching and learning in the coming years. Teachers can use the widespread accessibility of phones to create a more participatory and engaging learning environment. The teacher may create a novel learning experience and involve learners in the classroom and outside of it by exploiting the specific capabilities of the phones, increasing academic motivation among students (Jones et al. 2018). Smartphones can help students study more effectively by delivering authentic and contextual learning opportunities (Sharples et al., 2016). Learning using mobile devices can be unstructured and tailored to meet specific needs. It opens new channels for learning, such as studying outside of the classroom and learning on flexible time and place (Liu et al, 2016).

E-module

An e-book, also known as an e-module, is a mobile tool that allows students to learn from home, or whenever and wherever they choose, using their phone, tablets, or computer. Educators could also construct their own activities based on the topics covered in the e-module. To address the issues of internet limit and connection, students might save the e-book/e-module to their device and utilize it offline after downloading it. If the learners still do not comprehend the lesson, they can go through the materials again. E-modules should be built dynamically by teachers and simply run by students so that they do not become confused about how to utilize them. Remarks, pen tools, page zooming, search tool, and read aloud feature are included in the e-book/e-module to assist students in taking notes or highlighting significant information. The photos, audio, animations, audio explanations, and video clips could all be added to the eBook/e-module by the teachers. The materials in the e-module could also be conveniently replayed and reminded by students (Trilestari, 2020).

Furthermore, Trilestari (2020) stated that when instructors develop their own e-module, they will plan and arrange their teaching resources based on their students' level of understanding, demands, and the most recent/newest contents. The construction of the e-module was determined to be extremely realistic to use not only at higher or secondary educational level, but also at the level of younger students. Trilestari also demonstrates that the usage of e-modules as a learning and teaching medium has yielded reliable results, as it offers both students and teachers with learning activities and processes.

Games

Students nowadays spend a massive portion of their free time online. They frequently use mobile devices, such as tablets and smartphones, to play games. Playing generates learning as well as the use of mobile technology in education have transformed the way students think and absorb information because of these advances. Frequently, technology, such as games, provide an immersive, voluntary, and entertaining activity in which challenging goals are sought in accordance with predetermined rules. Simultaneously, as schools attempt to provide a compelling learning environment for their learners, these advances are progressively serving the basic objectives of their educational programs. Ubiquitous innovations can be used for purposes other than entertainment, and they should be viewed as part of a deliberate move toward discovery-based learning. Serious games, for example, are designed with the objective of being used in education and training rather than for sheer amusement. These games have well defined learning objectives that aim to strike a balance between subject content and gameplay. According to Camilleri & Camilleri (2019), such innovations in education might promote students' learning interests and motivate them to learn more. Digital games and other instructional applications are also becoming an essential element to student's intellectual development as they assist them in their learning journey, according to their research. As a result, mobile learning technologies have a lot of promise since students can use them to increase their knowledge, abilities, and learning efficiency in an informal setting.

Benefits of Mobile Application Development

Based on the similar study of Tavares, Vieira, & Pedro (2021), potential impacts of conceptualized mobile map have been exhibited and revealed. First, the potential influence of mobile app to the teachers that gave them privileged provide digital educational resources significantly interrelated on the probability of implementing orientation and engage phase. Some of the teachers' responses were: 1) mobile app as the main tool to obtain students' interest and to simulate their learning; 2) it enhances students' interaction with scientific concepts, steers them to be proactive, and aids comprehensive



learning process; 3) basic tool of presenting and exploring scientific concepts; 4) enrich scientific concepts and encourage students to apply new knowledge acquired; 5) simplified comprehensive, systematic, hands-on scientific concepts and activities approach; and 6) boost students' motivation to learn more. Second, conceptualized mobile app influence the implementing of conceptualization and explore phase and promoting engagement, expression, and interaction. Some of the responses were: 1) students' gain active and playful learning participation; 2) helpful in the development, consolidation and deepening of scientific concepts and knowledge; 3) provide various approaches to integrate scientific competencies. Third, mobile app affected the implementation of investigative and explain phase and recognize multiple ways of expressing scientific competencies and interactions with the concepts. Some responses include: 1) manipulate scientific accuracy; 2) materialize experiments with scientific occurrences; 3) compare scientific data and occurrences; 4) organize scientific knowledge and skills; and 5) active learning. Fourth, mobile app influenced conclusion and elaborate phase. It helps the students to: apply scientific knowledge, consolidate concepts, and gain in-depth scientific knowledge, new learning opportunities.

Significantly, those were some of the benefits of integrating and developing mobile application in Science Learning. These facts justified that need to develop mobile application as learning tool in the field of Science since amidst COVID-19 pandemic, students are most exposed to various online activities. By doing so, students might be encouraged, motivated, and excited to learn new things and acquired additional knowledge under this new normal pedagogical set-up.

By utilizing mobile learning to promote students' learning outcomes, the digital revolution is redefining education (Criollo-C, 2021). In many e-learning study areas, mobile device is seen as an excellent tool to develop students' skills such as positive thinking, collaboration, and interaction. It is also seen as a key component of big innovation. As a result of the demands of the twenty-first century, skills have been established to meet the growing needs in education, resulting in a paradigm transition from traditional teaching methods to mobile learning (El-Sofany, 2020).

Synthesis

Teaching science at any level has always been a challenging endeavor especially in the high school level. With the advent of technologies brought about by the 21st century, it has revolutionized and transmogrified many facets of the society and that includes education. More and more applications of technology are becoming evident and prevalent in the classroom and even outside of it. Access to learning materials were increased together with enhanced interaction between the teacher and the students.

Technology provides dynamic opportunities for instruction in science education. With this, they can enhance the learning process and make concepts come alive through engaging and interactive media. One of these media is the use of mobile learning application in delivering content that will increase students' engagement and assist their construction of knowledge. The power of technology had indeed changed the way teaching and learning process is done in the classroom. With this demand in education, educators are making innovations in their classrooms to cope with the demands of the 21st century learners and allow learners to explore and construct knowledge. The integration of mobile learning application in teaching-learning process may brought so many changes in the educational system nowadays. These changes may be beneficial to both students and teachers for which they are the first to utilize and integrate to their teaching and learning processes.

In the line with the PISA result, the government must prioritize the implementation of the use of technology-based teaching and learning by simply integrating and adapting the different platforms brought by technological advancements. Through this, they can be able to address the low mastery of students in terms of biology and other subject areas. In addition, the recently concluded International Assessment showing low mastery of lesson in Science and Mathematics in the Philippines will serve as the baseline to all curriculum implementers and makers to find alternative solution in this low performance of students in the Philippines.

In terms of developing the mobile application, with the purpose of providing additional learning opportunities to the students, this will help boost our educational to adapt the fast-changing opportunities brought by technological advancements. Furthermore, students and teachers at all levels can benefit in the development of this mobile learning application for which the teaching and learning will not be limited



inside the classroom, distance, and time. Aside from learning, the motivation of students to complete their academic requirements also improves with the use of mobile devices and it helps them to become more self-directed in their study.

The development of mobile learning application is well-suited to be utilized in this new normal. By providing students with the material to gain a basic level of knowledge and understanding before class, classroom time can be used to deepen learning and develop higher-level cognitive skills. One of the core objectives of development of mobile application is to move students away from passive learning and towards active learning where students engage in collaborative activity, peer learning and problem-based learning. Within this context, the role of the teacher shifts towards that of facilitator and coach by empowering students to take control of their own learning. The use of technology like mobile application developed by the teacher enriches the learning process and promotes skills that are essential for 21st-century learning.

For teachers who would want to create their own instructional materials like mobile application which includes e-modules, simulation activities, games and video lesson, various formats and models are available. The ADDIE model or the generic term for the five-phase instructional design model consisting of Analysis, Design, Development, Implementation, and Evaluation. Lastly, the ASSURE model defined as an instructional design model that has the goal of producing more effective teaching and learning. "ASSURE" is an acronym that stands for the various steps in the model.

In the terms of benefits, the development of mobile learning application will be beneficial to all educators because they can supervise their students online and handle learning activities more effectively with the help of technology like mobile application. Because learners are no longer constrained by the traditional classroom, mobile technology in education has an influence on learning. Students can customize existing mobile capabilities to match their demands, expand their interests, and create their own learning via mobile learning application. Mobile learning opens new learning possibilities that go beyond traditional activities, allowing individuals to participate, challenge, compete, and interact with their peers and teacher. Moreover, teachers who are competent to use technology such as mobile application will be helpful for them to engage and utilize the available materials or they can develop based on their subject in order to address their gaps in teaching. Technology enhanced mobile learning was both effective and scalable; it better facilitated learning than the simulation-based training and students found this approach to be more motivating in that it allowed for greater differentiation of instruction. An added value of the mobile application was being able to rewatch the lecture videos, re-try the games and other simulated activities. Students could pause and rewind the videos, take notes, and solve example problems while watching the lecture videos. Having access to course materials for 24/7 provided flexibility for students with different learning preferences and personal commitments. Several researchers found that students came to class better prepared, and they devoted more time and formed better study habits compared to traditional classroom approaches.

In the case of Living Things and their Environment, one of the disciplines of the new K-12 curriculum under Republic Act 1033 or the Enhanced Basic Education Act of 2013 is the spiral progression approach wherein various discipline had been incorporated every grade level. Hence, the output of this study, the mobile learning application composed of e-modules, video lessons, games, and simulated activities, are indeed timely as a response because of the low mastery and retention of students in this spiral approach. Since most of the teachers find the topics difficult to them because of spiral approach, development of more instructional materials such as mobile application can be one of the ways to supplement the scarcity of resources in this new curriculum. Though some printed materials and modules were already produced, limited resources are available that utilizes technology like videos, game-based learning, and simulated activities. Knowing the fact that students in the 21st century prefer to learn with the aid of technology, mobile applications are helpful in making students' learning worthwhile and meaningful even in this new normal.

With this, they cannot deny the fact that great teachers using digital technology with certified technological skills will be the most powerful educators in the 21st century.



RESEARCH METHODOLOGY

Research Design

This research utilized Design-based research (DBR) as Plomp (2013) defines design research as to design and develop an intervention (like programs, teaching-learning strategies and materials, products, and systems) as a solution to a complex educational problem, or alternatively to design and develop educational interventions (like learning processes, learning environments and the like) with the purpose of developing or validating theories. Furthermore, design research envisions a tighter, more rigorous connection between learning principles and features of the educational innovation. In design research a theorist or researcher's rigorous analysis of a learning problem leads to quite specific ideas for interventions. This study employed design research because it aims to develop and validate the Scitocin- a science mobile learning application.

Research Respondents

The development and evaluation of the Scitocin- a science mobile learning app was based on the data that collected from twenty (20) selected Grade 9 students from Public Secondary School in second district of Capiz, (6) experts comprised of IT experts, division personnel, and Master teachers, and (10) selected Grade 9 Science teachers from Public Secondary School in the School Division of Capiz.

The twenty (20) selected Grade 9 Science, Technology and Engineering (STE) students enrolled in Public Secondary School in the School Division of Capiz for the school year 2021 – 2022. Were selected through purposive sampling to obtain the desired number of participants of the study. Likewise, the research has an inclusion criteria that serve as a guide to identify the participants in the study. The list of inclusion criteria was the following: (1) Enrolled under Science, Technology, and Engineering Curriculum Program for the school year 2021-2022. (2) participants must have gadget / cp/ tablet/ (at least android version 4.4 up to latest). (3) have internet connection (at least 5-10 mbps). (4) have consent signed by them and their parents for confidentiality.

Research Instrument

For the purpose of this study, the researcher used the researcher-made test and teachers' evaluation form to assess the least learned competencies of the students in Public Secondary School in the Division of Capiz and evaluation form for the acceptability of the developed Scitocin- a science mobile learning app by the students and the experts which was adapted and modified from the questionnaires of the State University. These research instruments were subjected to content validation by the different experts based on the nature of the research instrument and was pilot tested for reliability purposes. Furthermore, the researcher-made performance test had a Cronbach's alpha of .82 which suggested that the items had relatively high internal consistency.

Students' and experts' evaluation form. The evaluation form for the science mobile learning app is an adapted checklist from the State University. This instrument was used to determine the acceptability of the mobile learning app in terms of Content, Instructional Quality, Technical Quality (Presentation, Navigation/User interface, Audio/Music, Technical Requirements, and Interactivity and Feedback), Presentation and Organization, and Accuracy and Up-to-Datedness of Information in which every category has different number of statements. The instruments were accomplished by both the experts and the students. The instrument was subjected to face and content validity by the experts related to the topics in Science 9, educational technology expert, instructional development expert, education program supervisor in science, and IT expert. These items were based on the evaluation forms from State University but modified by the researcher for the purpose of the study. Each participant was asked to check the appropriate column for his/her response.

To score the responses of the respondents, the following five-point scale was used.

Numerical Value	Description
5	Very Acceptable (VA)
4	Acceptable (A)
3	Moderately Acceptable (MA)
2	Fairly acceptable (FA)
1	Not Acceptable (NA)



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Data Analysis

To analyze the data collected in the study, the researcher employed appropriate analysis methods. The statistical tools used in this study were mean, and standard deviations.

Frequency count and Percentage. These two were utilized to determine the frequency or number respondents as to their response to each item to determine the least learned competencies in Living Things and their Environment topics.

Rank. The rank was used to determine the order or rank of the different competencies based on the frequency and percentage.

Mean. The mean was used to determine the overall acceptability of the Scitocin- science mobile learning app in terms of Content, Instructional Quality, Technical Quality (Presentation, Navigation/User interface, Audio/Music, Technical Requirements, and Interactivity and Feedback), Presentation and Organization, and Accuracy and Up-to-Datedness of Information evaluated by experts and students.

Standard deviation. The standard deviation was used to determine the homogeneity and heterogeneity of the obtained responses in the experts' and students' evaluation of the Scitocin- science mobile learning app.

Statistical Package for the Social Sciences (SPSS). The software was used to analyze and interpret the statistical data needed in the study.

RESEARCH FINDINGS AND DISCUSSION

Least Learned Competencies based on Students' performance test

In this study, a researcher-made test was administered to 20 selected grade 9 students from Public Secondary School under Science, Technology, and Engineering (STE) class.

Table 1. Least Learned Competencies in Living Things and Their Environment

Competency	Frequency of correct responses	Percentage	Rank
1. Explain how the respiratory and circulatory systems work together to transport nutrients, gases, and other molecules to and from the different parts of the body	159	79.50	5
2. Infer how one's lifestyle can affect the functioning of respiratory and circulatory systems	152	76.00	4
3. Explain the different patterns of non-Mendelian inheritance	102	51.00	1
4. Relate species extinction to the failure of populations of organisms to adapt	117	58.50	2



to abrupt changes in the environment

5. Differentiate basic features and importance of photosynthesis and respiration	140	70.00	3
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In this study, a researcher-made test was administered to 20 selected grade 9 students from Public Secondary School under Science, Technology, and Engineering (STE) class. Furthermore, the researcher also administered evaluation to 10 selected teachers particularly from Public Secondary School in the Division of Capiz to identify the least learned competencies based on teachers' perception. The least learned competencies in Living Things and their Environment lesson were then determined based on the topics with the least number of students who answered the items correctly, then it was corroborated with the teachers' perception on what learning competencies they think most of the students have difficulty.

The three least learned competencies identified were "Explain the different patterns of non-Mendelian inheritance" and "Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment" and lastly "Differentiate basic features and importance of photosynthesis and respiration". The result is supported by Santos, et.al (2021) "Least mastered competencies in biology: Basis for instructional intervention" as revealed by the student responses, in the open-ended question, the lowest mastery they have in grade 9 biology obtained in the following indicators: Explain the different patterns of non-Mendelian inheritance, relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment, differentiate basic features and importance of photosynthesis and respiration. The students' reasons for low mastery include the lack of interest in the topics, poor retention, poor conceptual understanding, and poor prior knowledge about the topic and not thoroughly discussed by the teacher.

Least Learned Competencies based on Teachers' perception

Table 2 shows the least learned competencies based on teachers' perception on the difficult topics where most of the student have low mastery.

Table 2. Least Learned Competencies based on Teachers' perception

Competency	Mean	SD	Rank
1. Explain how the respiratory and circulatory systems work together to transport nutrients, gases, and other molecules to and from the different parts of the body	3.90	0.74	5
2. Infer how one's lifestyle can affect the functioning of respiratory and circulatory systems	3.70	0.82	4
3. Explain the different patterns of non-Mendelian inheritance	1.50	0.53	3



4. Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment	1.40	0.52	2
5. Differentiate basic features and importance of photosynthesis and respiration	1.20	0.42	1

The result shows the least learned competencies based on teachers' perception on the difficult topics where most of the student have low mastery. The three least learned competencies were "Differentiate basic features and importance of photosynthesis and respiration" with an average of 1.20 and ranked 1 based on teachers' responses, and "Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment" with an average of 1.40 or ranked 2 based on teachers' responses, and lastly "Explain the different patterns of non-Mendelian inheritance" with an average of 1.50 or ranked 3 based on teachers' responses. These three identified least learned competencies were both agreed by the teachers' perception and students' performances in the given researcher-made questionnaire.

Based on the findings, it can be observed that the students' performance in a researcher made performance test was corroborated with that of teachers' perception on the least learned competencies in the Living Things and their Environment topics.

As a result, it merely signifies that the existing Science 9 curriculum has failed to address the learners' least taught skills. To find a solution to this challenge, the Department of Education must develop alternative programs or pedagogical methodologies. All educators, curriculum designers, and implementers should use the PISA results as a starting point for finding new ways to improve students' science performance. This is where the development of mobile learning application is very timely and relevant in today's setup. It has a lot of benefits because of the freedom it provides students in ways, time, and spaces that were formerly unavailable (Schuck et al., 2017), as well as the growing number of application programs available. Despite its disadvantages, mobile learning has developed as a significant sub-domain and pattern in technology adoption, attracting a lot of attention in the field of education (Felisoni & Godoi, 2018).

Development of Science Mobile Learning Application for the Least Learned Competencies

An android-based mobile learning application was developed to address the least learned competencies in Living Things and their Environment for grade 9 students with the following competencies: a) "Explain the different patterns of non-Mendelian inheritance," b) "Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment," and lastly c) "Differentiate basic features and importance of photosynthesis and respiration." An outline of the topics, necessary parts, and distinct features of Scitocin-science mobile learning application.

Table 3. Outline of the topics / competencies, parts, and distinct features of Scitocin

Content
I. List of Competencies in the Mobile App
Competency 1: Explain the different patterns of non-Mendelian inheritance
Competency 2: Relate species extinction to the failure of populations of



organisms to adapt to abrupt changes in the environment

**Competency 3: Differentiate basic features and importance of photosynthesis
and respiration**

II. Parts/ Distinct Features of Scitocin

1. Read

1.1 Modules and Quizzes

2. Watch

2.1 Embedded video lessons with video links and download links

3. Play

3.1 Educational Games

This Scitocin- a mobile learning application has different features such as e-module, educational games, and video lesson. In e-module, learners can be able to read the localized learning materials with different activities and practice quiz. This is where the students can be able to answer the different quizzes aligned in the least learned competencies so that they can be able to understand the topic very well. In educational games, learners can play different games anchored on the least learned competencies. Each competency has their own game which can help the learner to understand the lesson by playing and enjoying the games. And lastly, the video lesson serves as the additional mode of relaying topics and lesson to learners for in-depth comprehension and to have a better understanding in the topics. These video lessons serve as the discussion part wherein students can understand the lesson by simply watching the video with comprehensive explanation about the topic. The topics or competencies found in Scitocin were the identified least learned competencies based on students' performance test and teachers' perception. In order to navigate the app, the students should download the app first and it requires at least 200 mb mobile data to install the application on their mobile phone. Then after they install the Scitocin app, they can navigate the app by clicking the getting started button to select the different features in which they can learn by reading the modules and answering the quiz, watch the video lessons, and or by playing the educational games. Furthermore, the application has also distinct features where they can download the video lesson and save on their mobile phone.

The results of the development show how the mobile application works with the following components:

Splash Screen. This part of the app (see Figure 1) serves as the opening interface of the Scitocin Application. It has no function but only an introductory or landing page of the application.

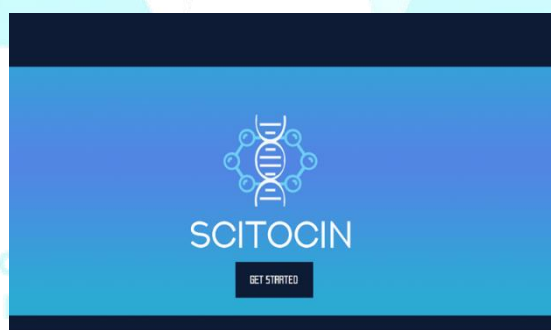


Figure 1. The Splash Screen of the Scitocin mobile app

Main Dashboard. This part of the app (see Figure 2) serves as selection medium for interaction: The User has three options: (1) Learn – for reading the contents of the module, (2) Watch – for watching of videos and (3) for Playing of interactive games.





Figure 2. The Main Dashboard of the Scitocin mobile app

Read Module Dashboard. This part of the app (see Figure 3) serves as the selection of the User to interact with the lessons and quizzes. Each lesson has a quiz for assessment. The Read Module Dashboard has 3 topics to choose from and they are namely: (1) Heredity: Inheritance and Variation, (2) Biodiversity and Extinction and (3) Ecosystem: Life Energy.

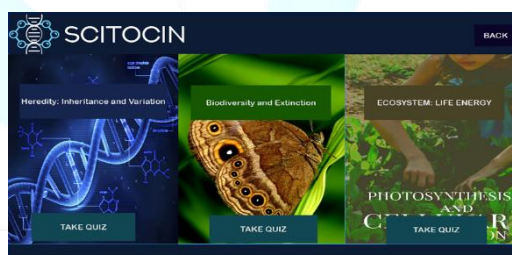


Figure 3. Read Module Dashboard of the Scitocin mobile app

Read Module (Heredity: Inheritance and Variation). This feature (see Figure 4) displays and presents the lesson contents and discussion of the Heredity: Inheritance and Variation. The interface has three buttons: (1) Next Button – proceeds to the next content, (2) Back Button – proceeds back with the past interface and (3) Home Button – Returns to the Learn Module Dashboard

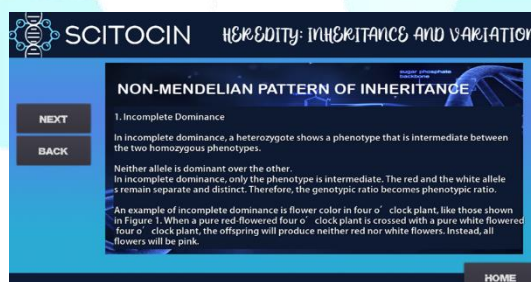


Figure 4. Read Module (Heredity: Inheritance and Variation) of the Scitocin mobile app

Read Module (Biodiversity and Extinction). This feature (see Figure 5) displays and presents the lesson contents and discussion of the Biodiversity and Extinction. The interface has three buttons: (1) Next Button – proceeds to the next content, (2) Back Button – proceeds back with the past interface and (3) Home Button – Returns to the Learn Module Dashboard





Figure 5. Read Module (Biodiversity and Extinction)

Read Module (Photosynthesis and Cellular Respiration). This feature (see Figure 6) displays and presents the lesson contents and discussion of the Photosynthesis and Cellular Respiration. The interface has three buttons: (1) Next Button – proceeds to the next content, (2) Back Button – proceeds back with the past interface and (3) Home Button – Returns to the Learn Module Dashboard.



Figure 6. Read Module (Photosynthesis and Cellular Respiration)

Quiz Game Splash Screen. This part of the app (see Figure 7) serves as the opening interface of the Quiz Game of Scitocin Application. It has no function but only and introductory or landing page of the application.



Figure 7. Quiz Game Splash Screen of the Scitocin mobile app

Quiz Game Proper. This section of the app (see Figure 8) assesses the student's performance and understanding of the topics in the Learn Module. Each module has a quiz assessment.



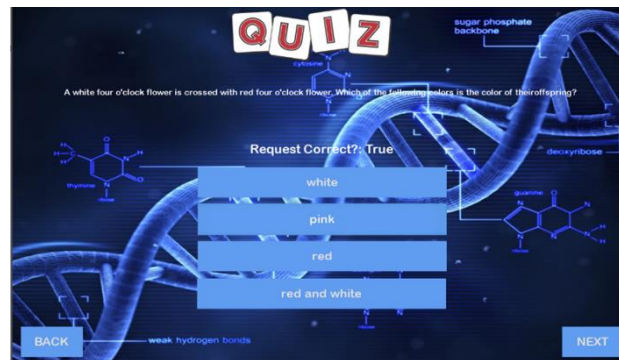


Figure 8. Quiz Game Proper of the Scitocin mobile app

Video Lesson Dashboard. This feature of the mobile app (see Figure 9) shows the list of videos that a user can watch while using the Scitocin Application. The Video Lectures are based on the Modules of the Scitocin, and it has only three topics namely: (1) Heredity: Inheritance and Variation, (2) Biodiversity and Extinction and (3) Ecosystem: Life Energy.



Figure 9. Video Lesson Dashboard of the Scitocin mobile app

Video Lesson. This part of the mobile app (see Figure 10) displays the video lesson of each module and lesson. This feature can automatically play the video.



Figure 10. Video lesson of the Scitocin mobile app

Game Dashboard. This part of the mobile app (see Figure 11) is the selection medium of the available games in the application. Each module has a corresponding game according to the topics being discussed in each lesson.



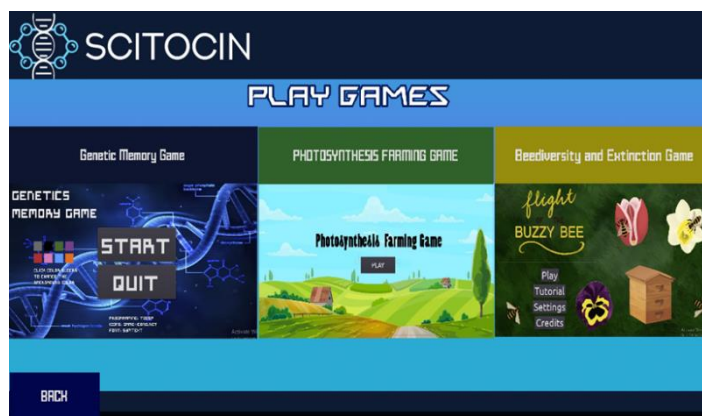


Figure 11. Game Dashboard of the Scitocin mobile app

Genetics Memory Game. This game (see Figure 12) is embedded in the Scitocin Application and connected with the first competency on Heredity and Genetics. The purpose of this game is to match genetics symbol and displays the definition of the genetic term.



Figure 12. Genetics Memory Game of the Scitocin mobile app

Photosynthesis Farming Game. This game (see Figure 13) is also embedded in the Scitocin Application connecting with the second competency on the topic on Photosynthesis. The goal of the game is to plant crops, let it grow and harvest the crops.



Figure 13. Photosynthesis Farming Game of the Scitocin mobile app

Beediversity and Extinction. Beediversity and extinction concept deals with the bee performance in collecting nectar to get honey. If the bee does not gather enough nectar and pollen, then it will go extinct. It will target the competency about extinction and biodiversity.



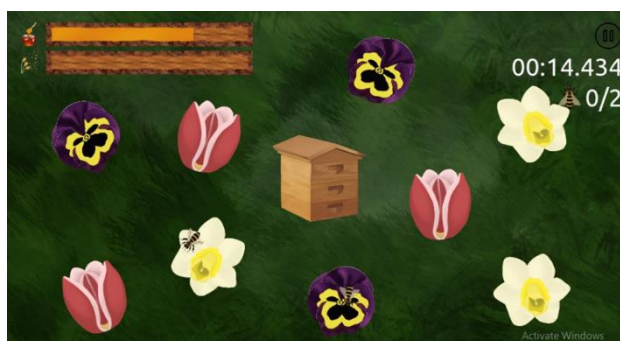


Figure 14. Beediversity and Extinction Game of the Scitocin mobile app

These necessary parts and features of the Scitocin mobile application conform to the findings in the study of Alden (2017), that mobile devices and applications predicted to have a substantial effect on teaching and learning in the coming years. Teachers can use the widespread accessibility of phones to create a more participatory and engaging learning environment. The teacher may create a novel learning experience and involve learners in the classroom and outside of it by exploiting the specific capabilities of the phones, increasing academic motivation among students (Jones et al. 2018). Smartphones can help students study more effectively by delivering authentic and contextual learning opportunities (Sharples et al., 2016). Learning using mobile devices can be unstructured and tailored to meet specific needs. It opens new channels for learning, such as studying outside of the classroom and learning on flexible time and place (Liu et al, 2016).

Furthermore, this developed mobile learning application, specifically the game could also help the learners learn new things and improve their problem-solving abilities according to Ricci, et. al, (2018). Modern learners engage well to interactive learning; therefore, these game-based learning solutions have been an enormous success. Game-based education puts the user in the forefront, forcing them to participate actively in the learning process (Lex, 2018). In addition, the videos created by the researcher will be viewed by the students at home that will serve as their lecture. This is to give the students ample time to study the video and understand it thoroughly thereby coming to class prepared.

EXPERTS' AND STUDENTS' ACCEPTABILITY EVALUATION

Scitocin is name of the developed mobile learning application. This mobile learning application contained different features for the purpose of addressing the least learned competencies in Living Things and their Environment topics. Six experts such as educational technology expert, instructional development expert, education program supervisor in science, and IT expert, and twenty students enrolled under Science, Technology, and Engineering class have examined and evaluated the mobile learning application. In the part of experts, they were gathered and asked to test the Scitocin and afterward they evaluate the app based on the criteria. In the part of students, they were asked to download the Scitocin to test its function and different features, and they were asked to evaluate the app based on the criteria. The study determined the overall acceptability of the Scitocin mobile app and in terms of content, instructional quality, technical quality, presentation and organization, accuracy and up-to-datedness of information, and assessment.

Table 4. Overall Acceptability of the Scitocin- mobile learning application

The mobile app in terms of:	Students		Experts		SD	Mean	Description
	M	S	M	S			
Content	4.54	0.08	4.38	0.18	0.14	4.46	Acceptable
Instructional Quality	4.60	0.05	4.50	0.06	0.04	4.55	Very Acceptable
Technical Quality	4.50	0.04	4.16	0.08	0.04	4.33	Acceptable



Presentation and Organization	4.74	0.06	4.50	0.09	0.05	4.62	Very Acceptable
Accuracy and Up-to-Datedness of Information	4.50	0.11	4.63	0.06	0.03	4.56	Very Acceptable
Assessment	4.64	0.01	4.63	0.02	0.00	4.63	Very Acceptable
Overall	4.59	0.04	4.46	0.05	0.05	4.53	Very Acceptable

As to the overall acceptability of the developed Scitocin mobile app, it has an overall rating of "Very acceptable" ($M=4.53$, $SD=0.05$). This shows that the Scitocin mobile learning app has excellently met the standards and no revision is needed.

In particular, the students have rated the presentation and organization part as the highest with a mean of 4.74 and SD of 0.06. In addition, for the experts, the assessment obtained the highest rating ($M=4.63$, $SD=0.02$). In terms of the average mean, the highest rating was attributed from assessment ($M=4.63$, $SD=0.00$) but the lowest rating was accounted from technical quality, and they are very acceptable and acceptable accordingly.

In general, the overall rating of the students in terms of overall acceptability was "very acceptable" ($M=4.59$, $SD=0.04$) and an overall rating of "acceptable" was found out from the experts ($M=4.46$, $SD=0.05$).

Based on the result, the respondents agreed that the Scitocin mobile learning application is very acceptable in terms of content, instructional quality, technical quality, presentation and organization, accuracy and up-to-datedness of information, and assessment and in terms of its overall rating. This implies that the developed Scitocin mobile learning application is worthy and can serve as an instructional material that will help the students learn at their own pace.

This result is in accordance with the study of Robles (2009) who cited that the development of learning package was found to be reliable as revealed by the high percentage obtained in the strongly agree category of the instrument. The developed CALP was valid to its objective, contents, manner of presentation and usefulness and therefore could be used as an alternative instructional material for enrichment and remediation.

In addition, the findings of this study cohere with the result of Sagirani, et.al (2018) that mobile learning is a classification of an application designed for education and expressly, to meet the demands of students, with the purpose of providing additional learning opportunities using more efficient mobile devices. To meet this problem, an m-learning application that was previously established with internet-based and android must be created. The m-learning application was created utilizing the concept of game to fit the habits of the students, in this case high school learners. Gamification is a method of teaching that use game components to motivate students, increase their comfort level, and increase their interest in learning process.

CONCLUSION

Most of the students still struggle in the topics in Living Things and their Environment as evinced by their least learned competencies and corroborated with the teachers' perception.

The Scitocin mobile learning application not only consists of the basic parts such as learning objectives and discussion but also contains distinct features namely, e-module, video lessons, and educational games. In e-module, learners can be able to read the localized learning materials with different activities and practice quiz. The video lesson serves as the additional mode of relaying topics and lesson to learners for in-depth comprehension and to have a better understanding in the topics. These video



lessons serve as the discussion part wherein students can understand the lesson by simply watching the video with comprehensive explanation about the topic. And lastly educational games, learners can play different games anchored on the least learned competencies.

The developed Scitocin mobile learning application met the standards, and no major revision is needed as reflected in the evaluation by the experts and students. The content, instructional quality, technical quality, presentation and organization, accuracy and up-to-datedness of information, and assessment were adequate, sufficient, and appropriate for the intended users. Thus, the developed mobile learning application is fitted to help the students learn the concepts in Living Things and their Environment topics easily. The developed Scitocin mobile application can be used to cater the needs of the 21st century learners of a technology-enhanced instructional material that is flexible, innovative, interesting, and acceptable which would facilitate their construction of knowledge through e-module, video lesson, and educational games.

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