ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Module Legends Bangbang: An Electronic Strategic Intervention Material (e-SIM) to Augment the Learning of Cytology

Mark Alvin D. Rivas
Department of Education, Pedro C. Sese Sr. Memorial High School Masbate, Philippines

Dr. Milagros A. Celedonio
College of Education, Dr. Emilio B. Espinosa Sr. Memorial State College of Agriculture and Technology Masbate, Philippines

Abstract:- The purpose of this study was to examine the effectiveness of Electronic Strategic Intervention Material (e-SIM) in augmenting students' conceptual understanding of Cytology. The e-SIM was developed using PowerPoint Presentation 2016 and Visual Basic Application Macro. This material is a gamification utilizing the popular Mobile Legends Bangbang characters and animations. Participants were fifty (50) students from Pedro C. Sese Sr. Memorial High School, School Year 2022-2023. They were sought through matching technique from the population of Grade 8 students. This study made use of a mixed method. Descriptive developmental to obtain information concerning the development and validation of the material and quasi-experimental to investigate the effect of e-SIM to students' learning performance. Test results were computed through KR-20. Independent T-test was used to find the significant difference between the pretest and posttest of control and experimental group, Shapiro-Wilk Test for normality of data, Fleiss' Kappa for the agreement of raters and students' responses on e-SIM and frequency counts and percentage for the students' learning performance level in Cytology after the conduct of the study. Based on the test results, the participants performed better on posttest in conventional method of teaching and using e-SIM. However, there is a significant difference between the test scores of control and experimental group. The results show that experimental group does better than control group. This implies that adding quests or games to the e-SIM will make learning more exciting for students. Furthermore, feedback from students suggests that e-SIM, which uses characters and animations from Mobile Legends Bangbang, is engaging and motivates students to understand the material, leading to more substantial learning.

Keywords:- *Electronic Strategic Intervention Material, Conventional Method Of Teaching, Cytology, Augmentation, Mobile Legends.*

I. INTRODUCTION

The COVID-19 pandemic has produced tremendous economic, social, and political issues around the world. It has resulted in an educational crisis as well as a health crisis. Lockdowns and quarantines affected 87 percent of the world's student population, and 1.2 billion students were absent from the school and related educational institutions (UNESCO Learning Portal, 2020).

This has made a significant impact most especially in science education. Previous studies such as Tekkaya et al (2001), Çimer (2012) and Lawsin & Garcia (2017), had shown that the topics plant cell and animal cell, sexual and asexual reproduction, mitosis and meiosis are some of the least mastered competencies in K-12 curriculum Biology. Due to the pandemic, this problem had extravagated the students' learning acquisition of some topics in Cytology. In fact, the study of Santos, et. al. (2021) has asserted that the above-mentioned topics are some of the topics where the students have low conceptual understanding and least mastered competencies.

Since biology is one of the components of scientific subjects in K–12 curricula, understanding the difficulties of learners in this area will give teachers with insights and directions to better build pedagogical programs. To better impart science topics to learners, content enrichment through learner-friendly visuals and diagrams is recommended to facilitate learning, improve retention, and avoid misconceptions (Lopez, et.al., 2022).

Different methods of facilitating teaching and learning are required considering recent technological advancements to keep up with the trend and the rate of cognitive development of the new generation of students. Utilizing Electronic Strategic Intervention Material (eSIM) is one such strategy. It can be utilized in the classroom as a teaching tool to help students study Science, specifically Biology. Mitchell & Smith (2004) and Pho & Dinscore (2015) asserted that using game-based learning can enhance users' motivation, enjoyment, and engagement while facilitating memory and information retrieval and fostering the growth of a variety of social and cognitive skills.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Pedro C. Sese Senior Memorial High School is in a remote area, it is difficult to find a strong signal from any internet network provider, including Smart and Globe, and it lacks internet connectivity. Students are therefore not exposed to learning possibilities that incorporate technology. There aren't many educational resources available, especially in science. Some teachers frequently employ traditional teaching strategies, which might occasionally have a negative impact on students' performance in science. To ensure that their learners grasp the lessons they are being taught, teachers must be able to combine the right learning resources (Cordero & Gil, 2018).

To improve student comprehension and provide a visually engaging way for the lessons in Cytology to be represented, the researcher created a material entitled "Module Legends Bangbang: An Electronic Strategic Intervention Material (e-SIM) to augment the learning of Cytology". The researcher used a powerpoint game template that was adapted from the popular Montoon game "Mobile Legends: Bangbang." This online mobile game is thought to be current for today's youth. In fact, Philippines is the top-ranked nation when it comes to this game (Elona, 2022).

A. Statement of the Problem

➢ *This Study Sought Answers to the Following Questions:*

- What lessons in Cytology was utilized in the Electronic Strategic Intervention Material (e-SIM)?
- How do the experts evaluate the e-SIM?
- What are the mean pretest and posttest scores of Grade 8 students in Cytology taught using conventional method of teaching and using *e*-SIM?
- What are the learning performance level in Cytology of both control and experimental group after the conduct of the study?
- Is there a significant difference in the mean posttest scores between the control and experimental group?
- What are the students' feedback in using the Electronic Strategic Intervention Material?

B. Assumptions

➢ *The Researcher Assumed the Following:*

- Varied lessons in Cytology were utilized in the development of e-SIM.
- The experts validated the e-SIM using the standard validity tool adapted from DepEd LRMDS.
- The students'/respondents' performances before and after the conventional method of teaching and using the Electronic Strategic Intervention Material are different.
- The learning performance level in Cytology of both control and experimental group after the conduct of the study vary.
- There was a significant difference in the mean posttest scores between the control and experimental group.
- The students' feedback in using the *e*-SIM vary.

C. Hypothesis

- H_o: There is no significant difference between the mean posttest scores of Grade 8 students in Cytology taught using the conventional method of teaching and Electronic Strategic Intervention Material.

II. METHODOLOGY

A. Research Design

This study utilized a mixed method. Descriptive developmental design was used to obtain information concerning the development and validation of the developed electronic strategic intervention material (e-SIM), and quasi-experimental design was used to investigate the effect of Electronic Strategic Intervention Material (e-SIM). The experimental group were the students who utilized the Electronic Strategic Intervention Material, and the control group were the students who were taught using conventional method of teaching. A test questionnaire composed of 30 multiple – choice items of three Cytology topics was used in the pretest and posttest. The scores gathered was interpreted through statistical analysis using Kuder Richardon – 20 (KR-20), to test for reliability.

The quasi-experimental design which was adapted from Saclao (2016) is illustrated on Figure 1 below.

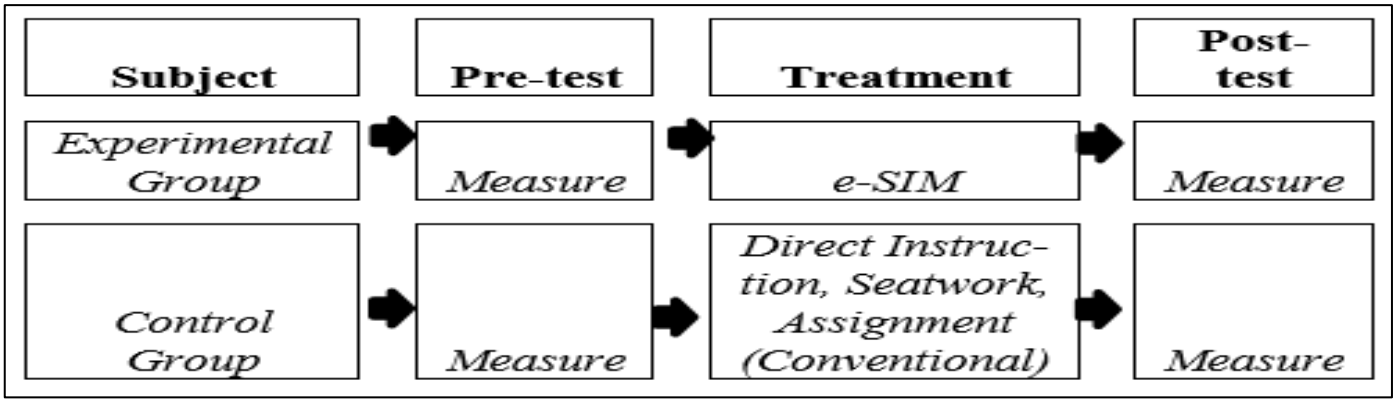

Fig 1: Quasi-Experimental Design

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

The study was composed of two phases. Phase 1 was the development of the electronic strategic intervention materials/e-SIM. Phase 2 was the evaluation and investigation of the impact of e-SIM on grade 8 students' learning in cytology.

The study was guided by the steps of instructional design method, specifically by the ADIE model (see Figure 2). The model has been modified for the study, and hereby composed of the following stages (see Figure 3).

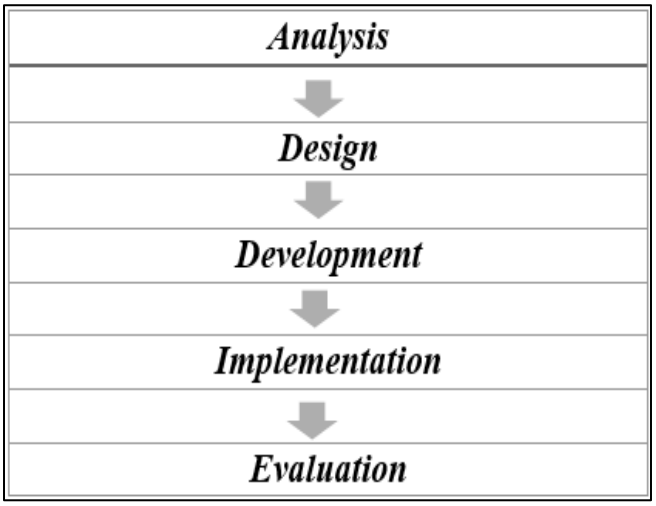

Fig 2: Original ADIE Model

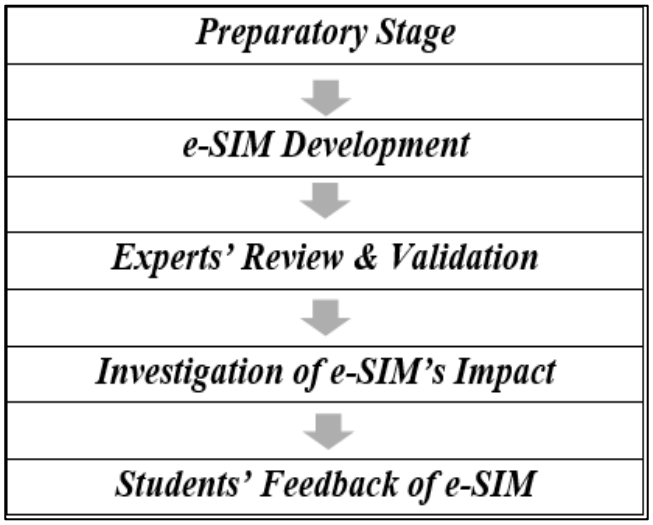

Fig 3: Instructional Design Model of the Study

B. Material Development Procedures

➢ *Preparatory Stage*

This comprises the idea and planning of the developed instructional materials. Based on item analysis from three consecutive years (2019-2022), the findings revealed that most Grade 8 students exhibit inadequate conceptual knowledge in several cytology themes. As a result, the researcher devised a plan to provide learning materials to address this issue. This stage established the preparation of materials and other essential issues in the construction of the e-SIM.

➢ *Material Development*

This covers the creation of the instructional materials and their design. To develop the e-SIM, the following steps were taken: (1) Formulating a rationale; (2) Selecting goals and learning objectives; (3) Determining the content; (4) Exploring effective learning and teaching strategies; (5) Concentrating on assessment; (6) Considering learner support; and (7) Planning an evaluation strategy.

- **Formulating e-SIM Rationale.** The necessity to educate 8th graders about cytology drove the creation of these electronic strategic intervention materials. Students in eighth grade routinely report that plant and animal cells, sexual and asexual reproduction, and cell division are among the most difficult topics in the K–12 curriculum, according to data taken at the start of each school year. This was not the first time the researcher interfered on behalf of learners. Every year, there was an intervention. Learners had only a few reference-book exercises before. The researcher created these educational resources. Prior evaluations were not as thorough or scientific as the current ones. In the current study, the researcher scrupulously recorded their every step. Cytology is essential for eighth graders to understand before moving on to higher science. According to the study, dedicated practice is necessary to master science. Therefore, Grade 8 students should participate in at least some of the many hands-on activities in these e-SIMs.
- **Deciding On Goals and Learning Objectives of the e-SIM.** The content and context of the e-SIM are both indicated by the materials' overarching goal. In order to help students become more proficient in Cytology, specific goals were set. Learning outcomes are not about what the teacher can provide the student, but rather what the lesson can show them by the end of the course or intervention program (using e-SIM).
- **Determining The e-SIM Content.** The topics tackled in this e-SIM were as follows:

✓ **e-SIM 1**. The Difference Between Animal and Plant Cell

- Differentiate plant and animal cells according to presence or absence of certain organelles.
- Explain why cell is considered the basic structural and functional unit of all organisms.

✓ **e-SIM 2**. Reproduction Being Both Asexual and Sexual

- Differentiate asexual from sexual reproduction in terms of: Number of individuals involved and similarities of offspring to parents.

✓ **e-SIM 3.** How Cells Divide to Produce New Cells

- Compare Mitosis and Meiosis, and their role in the cell-division cycle.
- Explain the significance of meiosis in maintaining the chromosome number.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

➢ *Exploring Effective Learning and Teaching Strategies.*

Ramsden (1992) states that even well-designed modules with valuable learning outcomes might fail if the teaching techniques are ineffective in motivating and supporting students to achieve them. The researcher used Graphic Interchange Format (GIF), captivating photos, icons, cover pages, and "Mobile Legends Bangbang" characters in these e-SIMs to attract learners. It was observed that learners lose interest in reading thick or voluminous learning materials, thus the researcher employed essential concepts or phrases instead of extensive explanations and definitions. These materials have the following features:

- **What this e-SIM is all about.** It provides a preview of the material that will be taught.
- **What you are expected to learn.** It presents the focus skills.
- **How to learn from this e-SIM.** This contains instructions on how to use these learning materials and lists the qualities a learner must possess to successfully complete these intervention materials.
- **Pretest.** A measurement that identifies a student's achievement gaps. In this study, students' Cytology weaknesses were identified and used as the basis for a remediation-based intervention program.
- **Guide Card.** This provides the topic at hand and the skills the learners are expected to acquire. It introduces the required activities for students. In addition, it reviews the previously learned principles.
- **Activity Card.** This specifies the task(s) the learner must complete to develop the skill. It offers sufficient examples and workable solutions. If the student has trouble completing the exercises, he can always refer to an example for guidance.
- **Assessment Card.** This allows the learner to assess his mastery of the skill after completing the task/tasks. The result of the assessment also informs the researcher of the knowledge/skills the student did not comprehend, allowing the instructor to revise or enhance the materials to further develop/enhance the identified skills.
- **Enrichment Card.** This extends learning by introducing additional concepts and exercises for the continued application of acquired knowledge/skills. This will require the student to think creatively and develop higher order thinking skills.
- **Reference Card.** This provides additional information and emphasizes pertinent facts or details pertinent to the topic at hand. In addition, it provides a list of additional reading materials for the learner.
- **Posttest.** This evaluation assesses the student's progress in Cytology after an intervention course has been completed.
- **Answer Key.** This section contains a list of the answers to the pretest and posttests, which may be found on the very last page of the materials.

➢ *Concentrating On Assessment.*

Assessment procedures should support deep learning and match learning outcomes. The researcher informed respondents of their progress through formative assessment in this e-SIM. This technique relied on the researcher's comments to increase learning. Summative assessment was also utilized to accredit Grade 8 students after an e-SIM. With these e-SIMs, assessment was carefully considered and linked to learning outcomes. An e-SIM's learning results rarely satisfied one assessment method. Multiple methods should be used to create an assessment strategy. It's crucial not to over assess students based on the unit of the study. This is an unacceptable load for students, so a program's evaluation timeline must be designed in advance to avoid this issue.

➢ *Considering Learner Support.*

The researcher never left his target respondents to answer these electronic learning materials from day one of the intervention program until its end. The proponent encouraged and directed learners through e-SIM exercises. The researcher provided free answer sheets.

➢ *Planning Evaluation Strategy.*

Designing and developing modules is ongoing. This e-SIM's evaluation methods helped the researcher review and improve his module. The researcher employed Yaghmale (2023)'s content validity technique to examine the questionnaire.

➢ *The Content of e-SIM*

The Electronic Strategic Intervention Material (e-SIM) was developed using PowerPoint Presentation 2016. It discussed the definitions and processes involved in some topics in Cytology. The “Mobile Legends:Bangbang” game inspired PowerPoint template was used by the researcher because this is relevant to the students. The researcher asked permission to Moonton, the developer of the famous online mobile game on utilizing some of the features in the game.

The modules created were entitled “Module Legends Bangbang: An Electronic Strategic Intervention Material (e-SIM) to augment the Learning of Cell Division” and Module Legends Bangbang: An Electronic Strategic Intervention Material (e-SIM) to augment the Learning of Cell Structure and Reproduction”, respectively (*see Figure 4).*

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

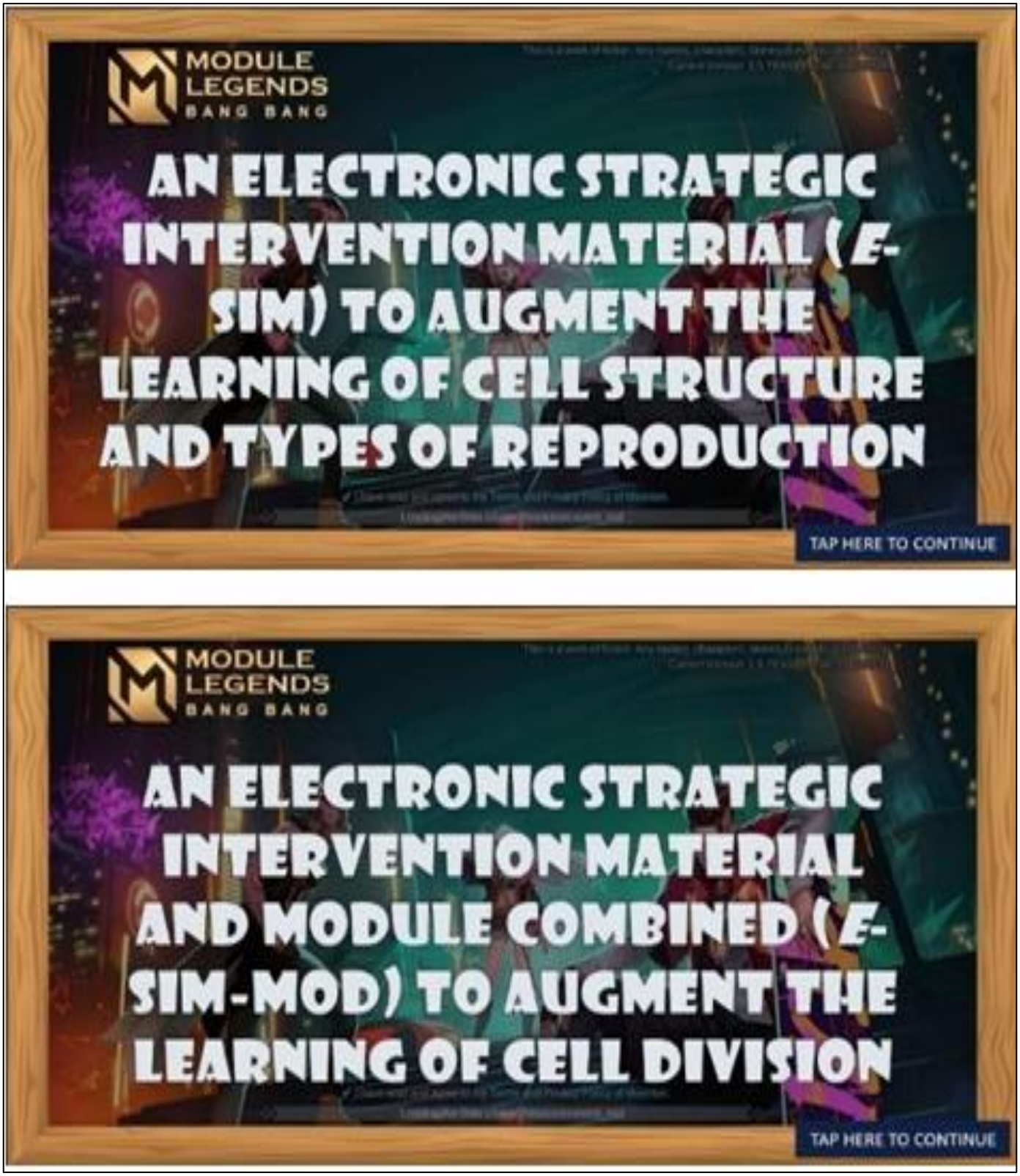

Fig 4: Title Slide of the e-SIM

The Most Essential Learning Competencies which are "Comparing Mitosis and Meiosis, differentiate plant cells from animal cells according to presence or absence of organelles and differentiate asexual from sexual reproduction in terms of number of parents involved and similarities of offspring to parents" were part of the e-SIM (*see Figure 5).*

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Fig 5: Title MELC Slide of the e-SIM

On the other hand, the guide slides of the e-SIM were presented to serve as guide to students on what they would do throughout the whole game *(see Figure 6).* To obtain ranks (elite, master, grandmaster, epic, legend, mythic and mythical glory) respectively, the warrior must finish each topic until the last slide of the material.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Fig 6: Guide Slide of the e-SIM

The introduction slides were presented as a short overview about the topic to be discussed. In the first material, it includes the reproduction in the form of Cell Division. It further explains the parts and functions of chromosomes since they play an important role in cell division. In the second material, it gives a short background about the cell and reproduction (*see Figure 7*).

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Fig 7: Introduction Slide of the e-SIM

For parts of the discussion, the content was made to be self-discovery by clicking some parts of the e-SIM *(see Figure 8)*.

In the Meiosis part, GIF or Graphic Interchange Format was included because Wylie (2021) asserted that animation significantly boosts the amount of interest shown by students. Discussions also used key terms or phrases instead of voluminous definitions or explanations so that the students. This was done to ensure that students would never lose interest in reading it (Saclao, 2016).

In the part of plant cell and animal cell, discussions of the definition and function of each organelle includes representation of certain material, organization, or notable personalities to associate each organelle's function and purpose, which helps to better understand the concept. This picture association was incorporated for the students to help them learn and better grasp the concepts they are having trouble with and do not understand (Rothwell, 2017).

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Fig 8: Discussion Slide of the e-SIM

After the discussion of all related concepts, it follows the assessment. *(see Figure 9).* The user may enter his/her answer and click it. If he/she will get the correct answer, it will proceed to the next item/slide. If not, it will ask the user to try again (see *Figure 10*).

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Fig 9: Assessment Slide of the e-SIM

Fig 10: Answering an Assessment Slide of the e-SIM

After the student's quest on each material, it follows the enrichment slide (see *Figure 11*) which he/she is going to answer. The student cannot proceed to the next slide until he/she got all the correct answers. It will notify him/her if what number he gets the incorrect answer for him/her to correct.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Fig 11: Enrichment Slide of the e-SIM

Right after finishing all the discussions, assessments and enrichment tasks included in the game, the students in the experimental group will then be tasked to answer the posttest. Their scores will automatically obtain on the material after finishing the said test (see *Figure 12*).

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

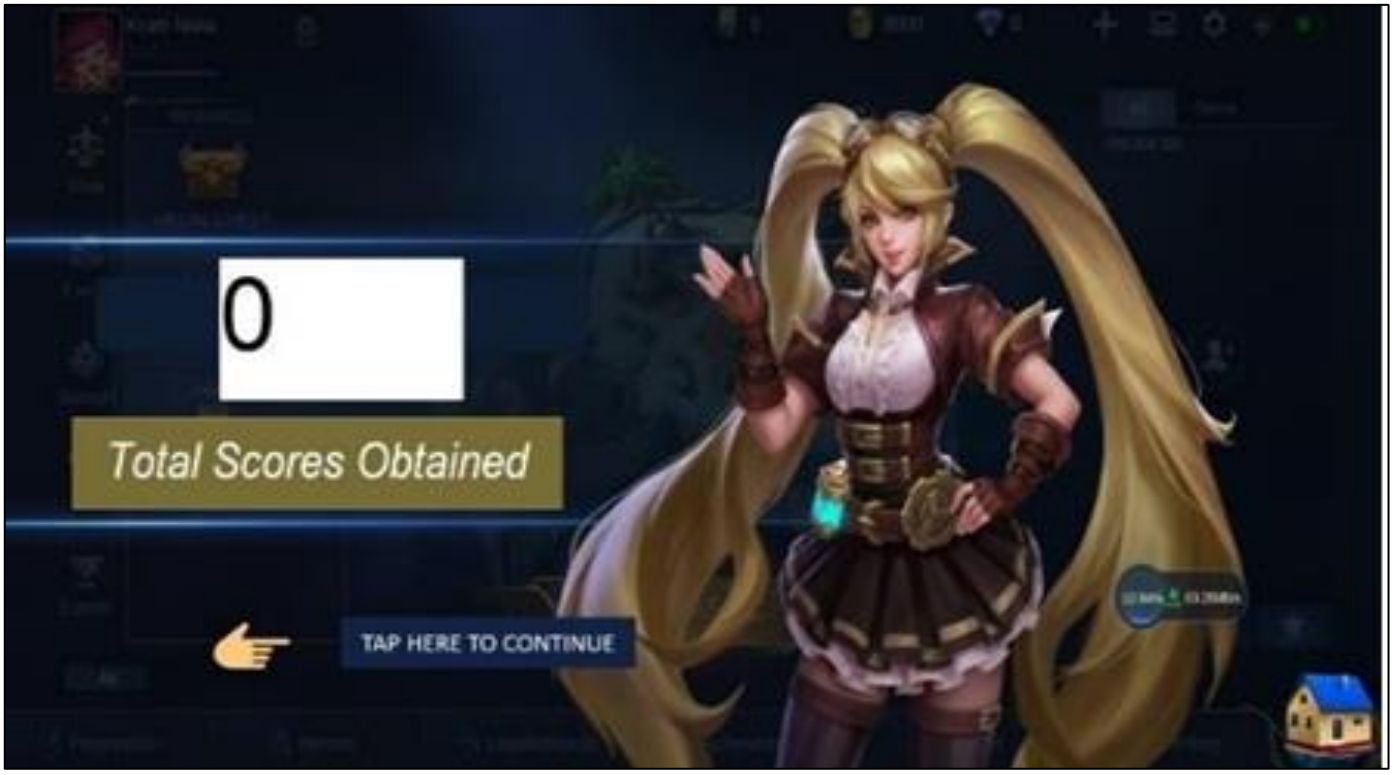

Fig 12: Posttest Slide of the e-SIM

Before the game to end, the user can proceed to explore and freely review the Resources slide (*see Figure 13*), and about the Developer slide *(see Figure 14)* anytime he/she wants. Resources Slide presents all the relevant materials and references utilized in the e-SIM. On the other hand, the Developer Slide shows the relevant information about the author of the material.

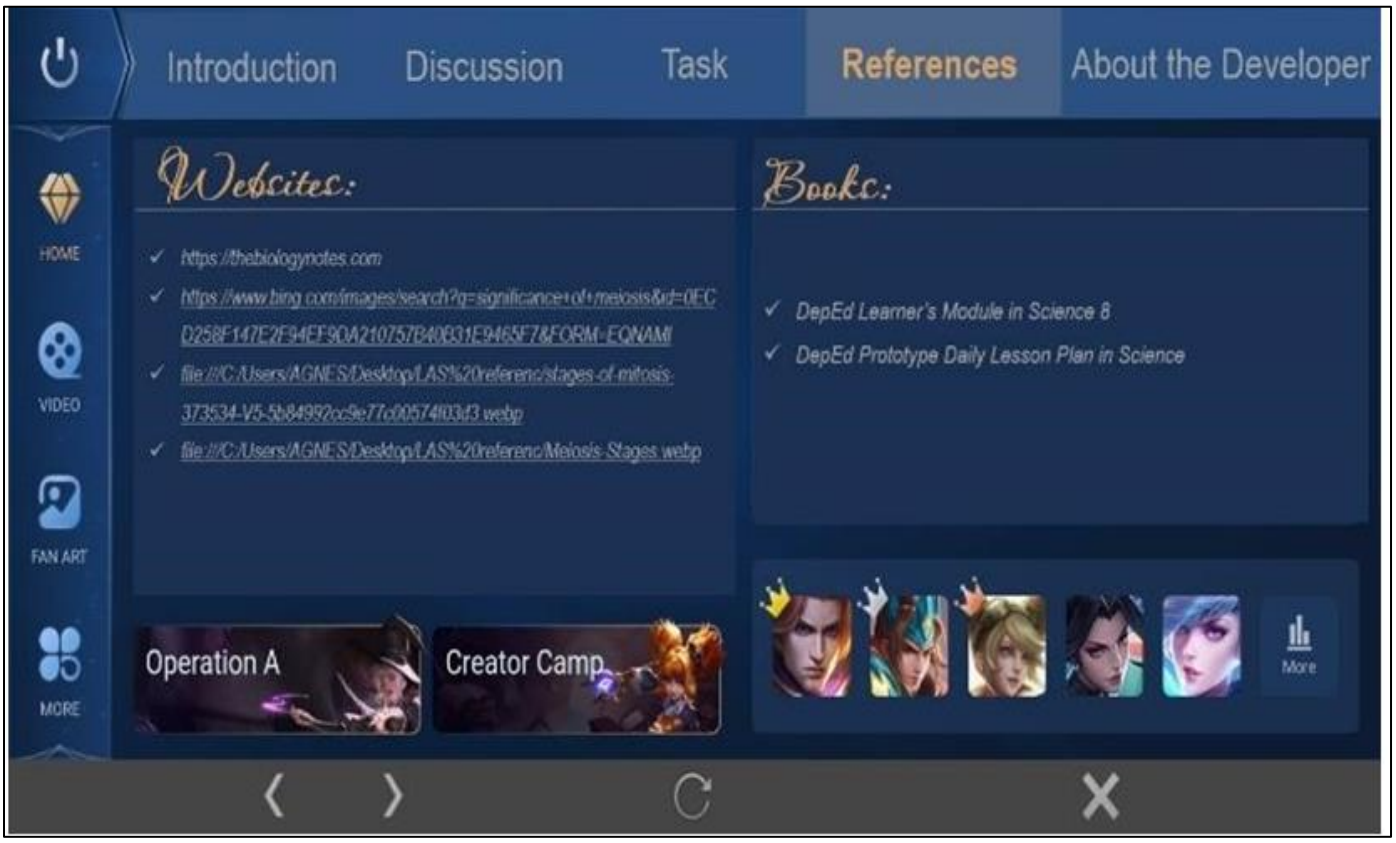

Fig 13: Resources Slide of the e-SIM

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Fig 14: About the Developer Slide of the e-SIM

C. Respondents

A total of fifty (50) Grade 8 students in Pedro C. Sese Sr. Memorial High School who have been chosen through matching technique, were the respondents of the study. The experimental and control group comprised of 25 students each. Students' demographics were the same. Each group had equal number of boys and girls. The researcher made sure that the profile of the two groups is almost equivalent. This is to ensure that the two groups are analogous in terms of scientific ability.

D. Validation of the e-SIM

Science Education Program Supervisors of the Division of Masbate and two Master Teacher II in Science have been asked to use and to evaluate the developed e-SIM. The researcher utilized a rating sheet for validity of Electronic Strategic Intervention Material adapted from DepEd LRMDS.

E. Data Gathering Procedure

Two days after the pretest, the researcher held lessons on Cytology using the e-SIM and conventional method of teaching for ten (10) days, one hour per session. The researcher administered a posttest afterwards. A posttest for experimental group was included in the developed e-SIM material and the students' score will be obtained automatically on the said material right after finishing the test. On the other hand, written posttest had been administered in the control group and has been manually checked by the researcher.

F. Administration

To avoid disrupting classes, the researcher sought permission from his school head to use fifty (50) Grade 8 students as his respondents and to hold lessons on Cytology of the eSIM during Independent Cooperative Learning (ICL). The researcher obtained authorization to utilize the computer laboratory, where students will learn about cell, cell structure, plant cell and animal cell, sexual and asexual reproduction and cell division using the said material.

G. Instrumentation

For the pretest, the researcher used a 30-item test questionnaire and the items in the pretest have been renumbered for the posttest. The questionnaire has been validated by Science Education Program Supervisor from the Division of Masbate and two Master Teacher II in Science. The researcher used a content validity tool from Yaghmale (2003). A validity tool derived from DepEd LRMDS had been used to identify teachers' responses to the e-SIM and an evaluation sheet adapted from Lapie et al. (2015) had been used to evaluate students' responses.

H. Statistical Tool

In this study, Fleiss' Kappa (Interrater Reliablity) was used for content validation. Kuder Richardson-20 (KR-20) was utilized in finding the average score of the students in pretest and posttest, to test for reliability.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

On the other hand, ANOVA (Analysis of Variance) was utilized to compare across categories of profiles. Independent T Test was utilized to see if there is a significant difference between the pretest and posttest among groups. Boxplot was utilized to visually compare the posttest results of two groups.

Further, frequency counts and percentage were used to present categories of students' profiles and to determine the learning performance in cytology of both control and experimental group after the conduct of the study.

III. RESULTS AND DISCUSSION

A. Results of e-SIM Validation

Three (3) raters were consulted prior to the implementation of the developed material to assess its validity. The researcher employed a content validity tool adapted from the DepEd LRMDS. The tool covers four aspects that must be validated: content quality, instructional quality, technical quality, and other findings.

For the content quality, three (3) raters judged the developed e-SIM according to the given ten (10) rubrics/criteria. Fleiss Kappa showed that there was an almost perfect agreement between the raters' judgements, K = 1.000 (95% CI, .686 to 1.314), p < .001 (*see Table 1*).

➢ *Some of the Reasons that may have Contributed to the Posttests' Results of the Experimental Group are the Following:*

- Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject and grade/year level it was intended.
- Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives.
- Content is accurate and is up to date.
- Content is logically developed, organized and is free from cultural, gender, racial, or ethnic bias.
- Content stimulates and promotes critical thinking and is relevant to real-life situations.
- Language (including vocabulary) is appropriate to the target user level.
- Content promotes positive values that support formative growth.

On the evaluation sheet, these justifications were in almost perfect agreement. In other words, the posttest result was significantly influenced by the reasons mentioned.

Thus, the electronic strategic intervention material (e-SIM) significantly contributed to students' mastery, enrichment, and reinforcement of the chosen least mastered cytology competencies (Saclao, 2016). This content greatly aided students in becoming more proficient and comprehending (Rodrigo, 2015).

Since respondents could play and study at the same time, they were able to better understand the concepts provided in the content. Junior High school students must therefore be actively involved in their education and in the teaching-learning process (Knowles, 1968).

Table 1: Results of Raters' Feedback in the Developed Material in Terms of Content Quality

CRITERIA	Fleiss Kappa Value	INTERPRETATION
1. Content is consistent with topics/skills found in the DepEd Learning Competencies.	1.0	Almost Perfect Agreement
2. Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives.	1.0	Almost Perfect Agreement
3. Content is accurate.	1.0	Almost Perfect Agreement
4. Content is up to date.	1.0	Almost Perfect Agreement
5. Content is logically developed and organized.	1.0	Almost Perfect Agreement
6. Content is free from cultural, gender, racial, or ethnic bias.	1.0	Almost Perfect Agreement
7. Content stimulates and promotes critical thinking.	1.0	Almost Perfect Agreement
8. Content is relevant to real-life situations.	1.0	Almost Perfect Agreement
9. Language (including vocabulary) is appropriate to the target user level.	1.0	Almost Perfect Agreement
10. Content promotes positive values that support formative growth.	1.0	Almost Perfect Agreement
Fleiss Kappa Overall Value	1.0	Almost Perfect Agreement

For the instructional quality, same three (3) raters judged the developed e-SIM according to the given ten (10) rubrics/criteria. Fleiss Kappa showed that there was an almost perfect agreement between the raters' judgements, K = 1.000 (95% CI, .642 to 1.358), p < .001 (*see Table 2*).

➢ *Some of the Reasons that may have Contributed to the Posttests' Results of the Experimental Group are the Following:*

- Purpose of the material is well defined.
- Material achieves its defined purpose.
- Learning objectives are clearly stated and measurable.
- Level of difficulty is appropriate for the intended target user.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

- Graphics / colors / sounds are used for appropriate instructional reasons. Material is enjoyable, stimulating, challenging, and engaging.
- Material effectively stimulates creativity of target user.
- Feedback on target user's responses is effectively employed.
- Target user can control the rate and sequence of presentation and review.
- Instruction is integrated with target user's previous experience.

On the evaluation sheet, these justifications were in almost perfect agreement. In other words, the posttest result was significantly influenced by the reasons mentioned. Indeed, learners' knowledge and cognition are entrenched not only in themselves but also in the tools used in the teaching and learning process (Hutchins, 2000).

Furthermore, students were motivated to comprehend the information since it was meaningful to them because of the game (Huk and Ludwigs, 2009).

As a result, it is critical to involve students in the planning and evaluation of their instruction (Dacumos, 2016).

Table 2: Results of Raters' Feedback in the Developed Material in Terms of Instructional Quality

Criteria	Fleiss Kappa Value	Interpretation
1. Purpose of the material is well defined.	1.0	Almost Perfect Agreement
2. Material achieves its defined purpose.	1.0	Almost Perfect Agreement
3. Learning objectives are clearly stated and measurable.	1.0	Almost Perfect Agreement
4. Level of difficulty is appropriate for the intended target user.	1.0	Almost Perfect Agreement
5. Graphics / colors / sounds are used for appropriate instructional reasons.	1.0	Almost Perfect Agreement
6. Material is enjoyable, stimulating, challenging, and engaging.	1.0	Almost Perfect Agreement
7. Material effectively stimulates creativity of target user.	1.0	Almost Perfect Agreement
8. Feedback on target user's responses is effectively employed.	1.0	Almost Perfect Agreement
9. Target user can control the rate and sequence of presentation and review.	1.0	Almost Perfect Agreement
10. Instruction is integrated with target user's previous experience.	1.0	Almost Perfect Agreement
Fleiss Kappa Overall Value	1.0	Almost Perfect Agreement

For the technical quality, same three (3) raters judged the developed e-SIM according to the given eleven (11) rubrics/criteria. Fleiss Kappa showed that there was a moderate agreement between the raters' judgements, K = .462 (95% CI, .148 to 776), p = .004 (*see Table 3*).

➢ *Some of the Reasons that may have Contributed to the Posttests' Results of the Experimental Group are the Following:*

- Screen displays (text) are uncluttered, easy to read, and aesthetically pleasing.
- Visual presentations (non-text) are clear and easy to interpret.
- Visuals sustain interest and do not distract user's attention.
- The design allows the target user to navigate freely through the material.
- The material can easily and independently be used.

On the evaluation sheet, these justifications were in almost perfect agreement. In other words, the posttest result was significantly influenced by the reasons mentioned.

Table 3: Results of Raters' Feedback in the Developed Material in Terms of Technical Quality

Criteria	Fleiss Kappa Value	INTERPRETATION
1. Audio enhances understanding of the concept.	0.0	Poor Agreement
2. Speech and narration (correct pacing, intonation, and pronunciation) is clear and can be easily understood.	0.3	Fair Agreement
3. There is complete synchronization of audio with the visuals, if any.	0.3	Fair Agreement
4. Music and sound effects are appropriate and effective for instructional purposes.	0.3	Fair Agreement
5. Screen displays (text) are uncluttered, and aesthetically pleasing.	1.0	Almost Perfect Agreement
6. Visual presentations (non-text) are clear and easy to interpret.	1.0	Almost Perfect Agreement
7. Visuals sustain interest and do not distract user's attention.	1.0	Almost Perfect Agreement
8. Visuals provide accurate representation of the concept discussed.	0.3	Fair Agreement
9. The user support materials (if any) are effective.	0.3	Fair Agreement
10. The design allows the user to navigate freely through the material.	1.0	Almost Perfect Agreement
11. The material can easily and independently be used.	1.0	Almost Perfect Agreement
Fleiss Kappa Overall Value	.46	Moderate Agreement

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

For the other findings, same three (3) raters judged the developed e-SIM according to the given four (4) rubrics/criteria. Fleiss Kappa showed that there was an almost perfect agreement between the raters' judgements, K = 1.000 (95% CI, .434 to 1.566), p < .001 (see Table 4).

➢ *Some of the Reasons that may have Contributed to the Posttests' Results of the Experimental Group are the Following:*

- The material has no conceptual and factual errors since the material was based on the Self Learning Modules which were quality assured.
- There is no grammatical and / or typographical errors.
- There is no obsolete information, errors in the visuals, etc.

On the evaluation sheet, these justifications were in almost perfect agreement. In other words, the posttest result was significantly influenced by the reasons mentioned.

Thus, this conclude that, poor writing can therefore be a problem for students. Poor spelling, grammar, or punctuation are obvious signs of poorly written content. Prevalence of spelling mistakes is poorly written, difficult to understand, boring and difficult to remember (Varnhagen, 2000).

Fortunately, these variables were not obvious in the content, resulting in improved student performance while using the electronic strategic intervention material.

Table 4: Results of Raters' Feedback in the Developed Material in Terms of Other Findings

Criteria	Fleiss Kappa Value	INTERPRETATION
1. Conceptual errors.	1.0	Almost Perfect Agreement
2. Factual errors.	1.0	Almost Perfect Agreement
3. Grammatical and / or typographical errors.	1.0	Almost Perfect Agreement
4. Other errors (i.e., computational errors, obsolete information, errors in the visuals, etc.).	1.0	Almost Perfect Agreement
Fleiss Kappa Overall Value	**1.0**	**Almost Perfect Agreement**

B. Students' Feedback in using e-SIM

Table 5 shows that there was an almost perfect agreement between samples Rater 1 to Rater 25 with K = 0.955.

➢ *Some of the Reasons Contributed to the Results of their Posttest are the Following:*

- Instructions for using the module are clear.
- I enjoyed using the electronic strategic intervention material.
- I find the textual contents not wordy and boring to read.
- I can easily remember the concepts and ideas being emphasized in the module.
- I am enlightened the concepts that confused before.

On the evaluation sheet, these justifications were in perfect agreement. In other words, the posttest result was significantly influenced by the reasons mentioned.

Table 5: Results of raters' feedback in the developed material in terms of other findings.

Criteria	Fleiss Kappa Value	Interpretation
1. Instructions for using the module are clear.	1.0	Almost Perfect Agreement
2. I find it easy to navigate my way around the module.	0.71	Substantial Agreement
3. I find the textual contents not wordy and boring to read.	1.0	Almost Perfect Agreement
4. The module is easy to use.	1.0	Almost Perfect Agreement
5. I can easily remember the concepts and ideas being emphasized in the module.	0.92	Almost Perfect Agreement
6. I am enlightened the concepts that confused before.	1.0	Almost Perfect Agreement
7. I enjoyed using the electronic strategic intervention material.	1.0	Almost Perfect Agreement
Fleiss Kappa Overall Value	0.95	Almost Perfect Agreement

➢ *Some of the Reasons Contributed to the Results of their Posttest are the Following:*

- Instructions for using the module are clear.
- I enjoyed using the electronic strategic intervention material.
- I find the textual contents not wordy and boring to read.
- I can easily remember the concepts and ideas being emphasized in the module.
- I am enlightened the concepts that confused before.

On the evaluation sheet, these justifications were in perfect agreement. In other words, the posttest result was significantly influenced by the reasons mentioned.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

The evaluation also shows that the Grade 8 students found utilizing e-SIM, which included Mobile Legends:Bangbang characters and animations, to be fun and thrilling. This made learning several cytology-related concepts fun. The respondents could play and study at the same time, which helped them understand the concepts covered in the content more thoroughly (Mitchell & Smith, 2004).

C. Pretest and Posttest Results

To find the average scores of the students in pretest and posttest, Kuder Richardson – 20 (KR-20) was performed, to test for reliability.

As shown in table 6, the mean pretest scores of control and experimental group were 7.64 and 7.84 respectively. Based on these results, there was an increase of 8.44 on the mean posttest score of the respondents who were taught using conventional method of teaching. It implies that there is an acquisition of learning and the use of conventional method improved knowledge and understanding.

The mean posttest score of students who utilized the Electronic Strategic Intervention material have increased to 17.6. It is interesting to note that electronic strategic intervention material promotes better learning of concepts than traditional method (Milne & Otieno, 2007). The use of e- SIM has been found out effective.

Table 6: Kuder Richardson – 20 Showing the Pretest Results of both Treatment

	Mean	**Std. Deviation**	**N**
Pretest (Control)	7.6400	2.37837	25
Pretest (Experimental)	7.8400	1.90788	25

Table 7: Kuder Richardson – 20 Showing the Pretest Results of both Treatment

	Mean	**Std. Deviation**	**N**
Posttest (Control)	16.0800	2.69134	25
Posttest (Experimental)	25.4400	2.06317	25

D. Boxplot Results

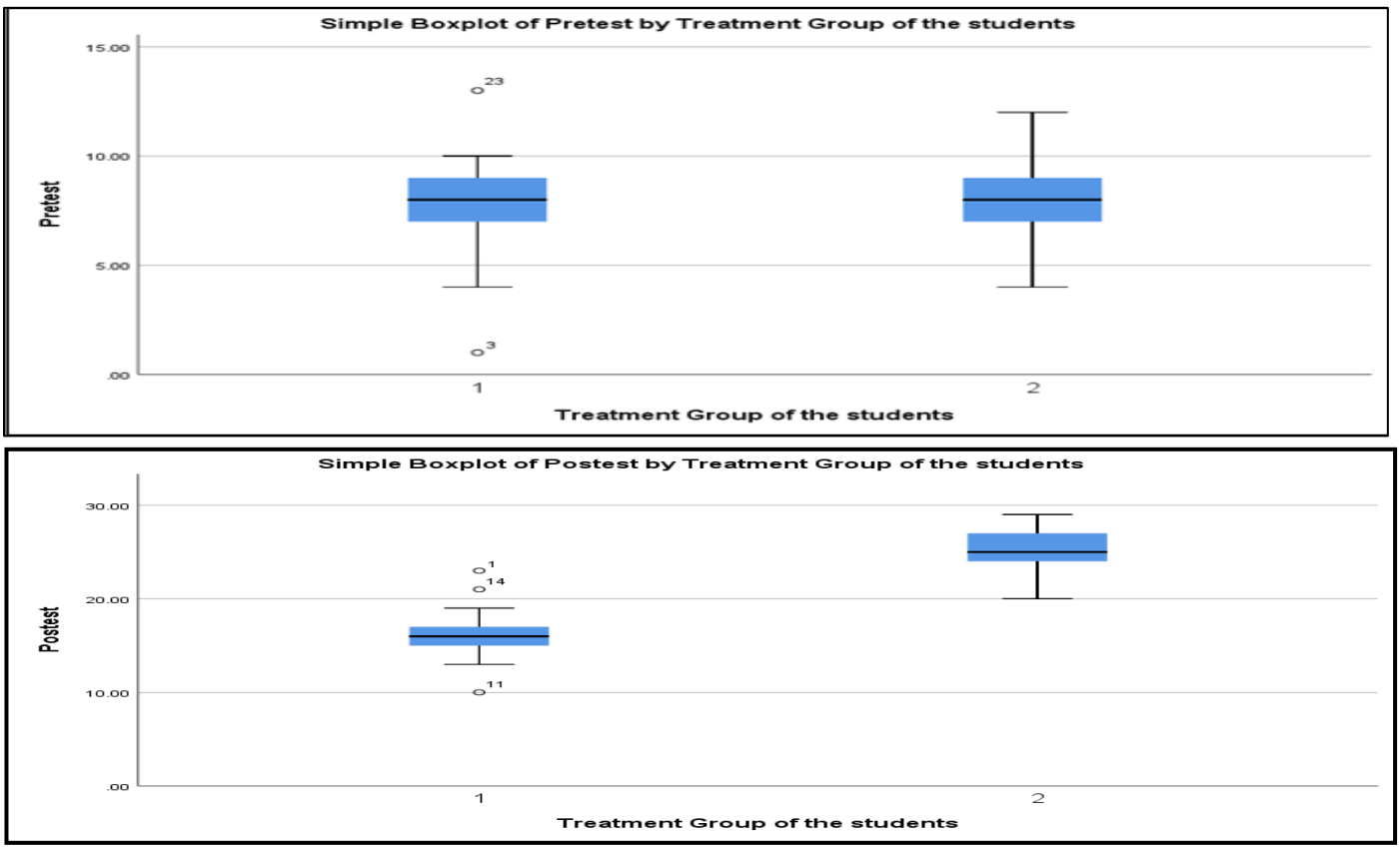

Fig 15: Boxplot Results of Two Groups

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

Based on figure 15, it shows that the pretest scores of both control (1) and experimental group (2) have a median of 8.0 and interquartile range of 2.0. Thus, there is no significant difference in terms of pretest results among two groups. It can be seen in the figure also that pretest results in control group (1) has one outlier located above the "maximum" and one outlier located below the “minimum” value.

On the other hand, the posttest scores of control group (1) has a median of 16.0 and interquartile range of 3.0 while experimental group (2) has a median of 25.0 and interquartile range of 3.0. It can be seen in the figure also that posttest results of control group (1) has two outliers above the “maximum” value and one outlier below the “minimum” value.

Thus, we can see that there is a quite difference in terms of learning acquisition among two groups. Experimental group who utilized the Electronic Strategic Intervention Material has a higher academic performance than control group who underwent conventional method of teaching.

E. Learning Performance in Cytology of the Experimental Group after the conduct of the Study

Table 8 presents the data about the learning performance in cytology of the experimental group after the utilization of electronic strategic intervention material (e-SIM). Frequency counts and percentage were used to treat the data gathered.

It could be seen on the table that there is an increase in the learning performance after the conduct of the study. Twenty-three or 92 percent were found to be on the outstanding level on their performance level. They were students whose proficiency was found between 90 and above.

Further, the data reveal that there are two or 8 percent of the group obtain very satisfactory level of performance in learning cytology. These students learned the skills in cytology greater than what was expected of them.

Table 8: Learning Performance Level of the Experimental Group after the Conduct of the Study

Learning Performance Level	**Pretest**		**Posttest**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Outstanding	0	0%	23	92%
Very Satisfactory	0	0%	2	8%
Satisfactory	0	0%	0	0%
Fairly Satisfactory	0	0%	0	0%
Did not Meet Expectations	25	100%	0	0%
Total	25	100%	25	100%

F. Learning Performance in Cytology of the Control Group after the Conduct of the Study

Table 9 presents the data about the learning performance in cytology of the control group after the conventional method of teaching. Frequency counts and percentage were used to treat the data gathered.

It could be seen on the table that there is an increase in the learning performance after the conduct of the study. One or 4 percent was found to be on the outstanding level on their performance level, fifteen or 60 percent found to belong in satisfactory level, five or 20 percent of the students found to be fairly satisfactory, and one or 4 percent who did not meet the expectations. They are those students who did not meet the expected competencies to be acquired.

Comparing the two groups, those who have undergone the electronic strategic intervention material have greater number of students whose performance belonged to satisfactory and above than those who did not. Twenty-five or 100 percent are for those who were taught with e-SIM, while nineteen or 76 percent of satisfactory level and above for those who were taught using conventional method of teaching.

Generally, these results implied that those students who were taught using electronic strategic intervention materials performed better than without. Thus, effectiveness of teacher’s approach really depends on the use of tools, techniques, and strategies to enhance learning (Drucker, 2006).

Table 9: Learning Performance Level of the Experimental Group after the Conduct of the Study

Learning Performance Level	**Pretest**		**Posttest**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Outstanding	0	0%	1	4%
Very Satisfactory	0	0%	3	12%
Satisfactory	0	0%	15	60%
Fairly Satisfactory	1	4%	5	20%
Did not Meet Expectations	24	96%	1	4%
Total	25	100%	25	100%

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

G. Testing of Null Hypothesis

To determine if there is a significant difference in the pretest and posttest data across categories of treatment group of the students, Independent T test was performed.

Table 10 shows that, the pretest scores among treatment groups was not statistically significant *t(48) = -.328, p = .744*, but there was a significant difference in terms of posttest scores among treatment groups *t(48) = -13.801, p = .000*. To determine the effect size of the posttest scores among treatment groups, Cohen's d was utilized, and it shows that Cohen's *d = (25.44 - 16.08) / 2.397914 = 3.903393* which means that the utilization of e-SIM has a huge effect on the learning performance of the experimental group than conventional method of teaching.

The results indicated that the academic performance in cytology of the two groups differ in favor of the experimental group. It meant that those students who had undergone learning with the use of electronic strategic intervention materials (e-SIM) performed better than those without. The use of e-SIM was effective in terms of augmenting the students' learning of cytology. These results confirmed further that the use of instructional materials such as e-SIM to supplement the books and modules as used in teaching by the teachers, were effective to help students continue to make progress on a particular standard (Dahar, 2011).

Table 10: Results of Independent T Test

			Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre-Test	Equal variances assumed	.60	.4	-.328	48	.744	-.2000	.6098	-1.4261	1.0261
	Equal variances not assumed			-.328	45.8	.744	-.2000	.6098	-1.4275	1.0275
Post-Test	Equal variances assumed	.66	.4	-13.8	48	.000	-9.360	.6782	-10.723	-7.996
	Equal variances not assumed			-13.8	44.9	.000	-9.360	.6782	-10.726	-7.993

Electronic Strategic Intervention Material and the utilization of Mobile Legends:Bangbang characters and features significantly increases students' motivation. It gives a higher level of activity and engagement. The e-SIM really helped the students become more proficient and increase their understanding (Rodrigo, 2015). Indeed, learners' knowledge and cognition are not confined to themselves alone but is also embedded in the objects or tools being utilized in the teaching and learning process (Hutchins, 2000).

Furthermore, they were inspired to understand the content of the material because it was meaningful to them, because of the game (Huk and Ludwigs, 2009). Therefore, it is essential to include the students in the design and assessment of their instruction (Dacumos, 2016).

These findings were similar to the results of the study conducted by Salviejo, Aranes and Espinosa (2014) which showed that the use of Strategic Intervention Material – Based Instruction (SIM-BI) is effective in terms of improving students' performance and learning approach. It has motivating properties that demand learners' attention and have a significant impact on them. The surface learners performed equally well as the deep learners when SIM-

BI was used. The positive results of students' feedback on the material suggested that the e-SIM was appreciated and appealed to both types of learners.

In conclusion, this study found that Electronic Strategic Intervention Material (e-SIM) greatly improves students' understanding of cytology topics. Indeed, if the instructional approach piques students' interests, learning will take place (Malana, 2020).

IV. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

A. Findings

➢ *The Findings of the Study Were the Following:*

- Cell Structure, Plant Cell and Animal Cell, Sexual and Asexual Reproduction, and Cell Division are the topics that were utilized in the Electronic Strategic Intervention Material.
- Three (3) raters were consulted prior to the implementation of the developed material to assess its validity. The researcher employed a content validity tool adapted from the DepEd LRMDS. The tool covers four aspects that must be validated: content quality, instructional quality, technical quality and other findings. The Fleiss Kappa results of validation are: content quality, 1.0 (almost perfect agreement); instructional quality, 1.0 (almost perfect agreement); technical quality, .48 (moderate agreement); and other findings, 1.0 (almost perfect agreement).

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

- The mean pretest and posttest scores of twenty-five (25) Grade 8 students taught using conventional method of teaching has a difference of 8.44, while the mean pretest and posttest scores of twenty-five (25) Grade 9 students taught using Electronic Strategic Intervention Material has a difference of 17.6.
- Those who have undergone the electronic strategic intervention material have greater number of students whose learning performance belonged to satisfactory and above, than those who did not. 25 or 100 percent are those who were taught using e-SIM, while 19 or 76 percent of satisfactory level and above for those who were taught using conventional method of teaching.
- There is a significant difference in the posttest scores of Grade 8 students taught using the conventional method of teaching and Electronic Strategic Intervention Material.
- Students' feedback signifies that using e-SIM, also integrating Mobile Legends: Bangbang characters and features, is enjoyable and exciting.

B. Conclusions

➢ *Based on the Findings of the Study, the Following Conclusions were Drawn:*

- There is an improvement of performance among the twenty-five (25) students of Pedro C. Sese Sr. Memorial High School in teaching some topics in Cytology using conventional method of teaching.
- There is an improvement of performance among the twenty-five (25) students of Pedro C. Sese Sr. Memorial High School in teaching cell structure, plant cell and animal cell, sexual and asexual reproduction, and cell division using the "Module Legends Bangbang".
- Those students who were taught using electronic strategic intervention materials performed better than those who were taught using conventional method of teaching.
- The significant difference between the posttest scores of the fifty (50) respondents of Pedro C. Sese Sr. Memorial High School implied that incorporating Electronic Strategic Intervention Material into teaching was a more effective learning aid.
- The Electronic Strategic Intervention Material makes learning fun and engaging. It allows enjoyment and learning to take place. Indeed, teaching in a technologically oriented learning environment raises students' accomplishment levels.
- The Electronic Strategic Intervention Material boosts the interest of students in learning. Indeed, learners' knowledge and cognition are embedded not only in themselves but also in the objects and tools used in the teaching and learning process. As a result, students' academic performance has improved.

C. Recommendations

➢ *In the Light of the Foregoing Findings and Conclusions, the Following are Recommended:*

- The "Mobile Legends: Bangbang", an Electronic Strategic Intervention Material (e-SIM) must be used as a learning tool in teaching cytology to help students in improving their understanding and mastery with such concepts.
- The integration of additional assessment in the e-SIM in the form of quest or game will make learning in Science more exciting for students. Thus, students who form part in the control group can be subjected to use the gamified Science topics to enhance learning and improve the lessons.
- To achieve meaningful learning, teachers should adopt a planned learning material in Science to improve students' scientific power through the use of innovative and creative learning.
- Encourage administrators, Science Supervisors, and teachers to make e-SIM in all topics not only the least mastered skills in each subject area.
- Science teachers must be provided with helpful workshops and training sessions to enable them to design and use educational games in Science.
- Conduct similar studies on utilizing electronic strategic intervention material in other discipline and other grades.

ACKNOWLEDGEMENT

The researchers wholeheartedly thank the DEBESMSCAT Graduate School, Science EPS of SDO Masbate Province, and PCSSMHS faculty and students for their valuable help and support for making this study into fruition.

REFERENCES

[1]. Çimer, A. (2012). What makes biology learning difficult and effective: Students' views? Educational Research and Reviews, 7(3).
[2]. Cordero, J.M. and Gil-Izquierdo, M. (2018) The Effect of Teaching Strategies on Student Achievement: An Analysis Using TALIS-PISA-Link. Journal of Policy Modeling, 40, 1313-1331.
[3]. Dacumos, L.P.N. (2016). Perspective of secondaryteachers in the utilization of science strategic intervention material (SIM) in increasing learning proficiency of students in science education. AsTEN Journal of Teacher Education, 1(2), 1-15
[4]. Dahar, M. (2011). Effect of the Availability and the Use of Instructional Material on Academic Performance of Students in Punjab (Pakistan), Euro Journal Publishing Inc. Notes
[5]. Drucker, P. (2006) Innovation and Entrepreneurship Practice and Principles. Harper Business, New York.
[6]. Elona, J. (2022). PH dominates international MLBB tournaments with seven championships, the most in the world.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14637041

[7]. Huk, T., & Ludwig, S. (2009). Combining Cognitive and Affective Support in Order to Promote Learning. Learning and Instruction, 19, 495-505.
[8]. Hutchins, E. (2000). Distributed Cognition. San Diego: IESBS University of California.
[9]. Knowles, M. S. (1968). Andragogy, not pedagogy. Adult Leadership, 16(10), 350-352, 386.
[10]. Lapie, A.G.P., et. al. (2015). Development and evaluation of an interactive learning module on summation notation using comics. 669-671
[11]. Lawsin, N.L.P., & Garcia, G. (2017). Development of digital courseware in Transmission Genetics (published Master's Thesis). Philippine Normal University, Manila.
[12]. Lopez, E.N., et.al. (2022). Content analysis of cell division concepts in senior High School Biology textbooks.JPBI (Journal Pendidikan Biologi Indonesia), 8(2), 159-177.
[13]. Malana, M.L. (2020). Attitude and Level of Performance of Students in Chemistry. International Journal of Psychosocial Rehabilitation. 24 (8), 10148-10154
[14]. Mitchell, A. and Smith, C.S. (2004). The use of computer and video games for learning: A Review of Literature. Learning and Skills Development Agency, London, UK.
[15]. Pho, A., & Dinscore, A. (2015). Game-based learning. Tips and trends.
[16]. Rodrigo, R. (2015). Importance of Strategic Intervention Materials. Retrieved from: http://udyong.gov.ph/index.php?option=comcontentview=article&id=6925:importanc e-of-strategic-intervention-materials&catid=90&Itemid=1267
[17]. Rothwell, D. (2017). Creative Thinking Techniques. Retrieved from: https://davidrothwellgraphics.wordpress.com/2017/01/16creative-thinking-techniques/
[18]. Salviejo, E., Aranes, F. & Espinosa, A. (2014). Strategic intervention material-based instruction, learning approach and students' performance in Chemistry. International Journal of Learning, Teaching and Educational Research, 2(1), 91-123.
[19]. Santos, J.T.D., Lim, R. R., & Rogayan, D. V. Jr. (2021). Least mastered competencies in biology:Basis for instructional intervention.JPBI (jurnal Pendidikan Biologi Indonesia), 7(2), 208-221.
[20]. Tekkaya C., Ozkan O., & Sungur S. (2001). Biology concepts perceived as difficult by Turkish High School students. Journal of Hacettepe University Education Faculty, 21, 145-150.
[21]. UNESCO Learning Portal (2020). Brief 3. Learning and Teaching Materials Paris.
[22]. Varnhagen, C. K. (2000). Shoot The Messenger And Disregard The Message? Childrens Attitudes Toward Spelling. Reading Psychology, 21, (2, 115-128).
[23]. Vincent, T. (2019). Learning on a loop: Make it memorable with animated GIFs.
[24]. Wylie (2021). Experiences in an Online Learning Community. Walden Dissertations and Doctoral Studies. 11245.
[25]. Yaghmale F., PhD. (2003). Content validity and its estimation. Journal of Medical Education, 25-27.