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Utilization of Interactive Electronic Strategic Intervention Material (eSIM) in Competency Attainment of Grade 7 Students in Biology at Dagatan Integrated National High School

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Abstract

This study aimed to determine the effectiveness of utilizing interactive Electronic Strategic Intervention Material (eSIM) in the competency attainment of Grade 7 students in Biology at Dagatan Integrated National High School. A mixed-methods research design was employed, involving pre-test and post-test assessments, survey questionnaires, and interview guides. Participants were Grade 7 students who utilized the interactive eSIM for learning Biology concepts, specifically plant and animal cells. Findings revealed that students' competency levels improved significantly from satisfactory (pre-test) to outstanding (post-test) after the intervention. Students perceived the guide card, activity card, assessment card, enrichment card, and reference card as highly effective in enhancing their understanding of Biology concepts. Key distinct features of eSIM included interactivity, accessibility, clear visual design, contextualization, and gamified elements. However, students encountered difficulties such as technical and accessibility issues, user-related challenges, content-related difficulties, and limited instructional support. Proposed improvements included developing an offline-accessible version, optimizing file size, conducting digital literacy orientation, integrating glossaries and audio narrations, and adopting a blended learning approach with teacher facilitation. The study concludes that interactive eSIM is an effective digital tool for improving competency attainment in Biology.

Keywords: *interactive eSIM, Electronic Strategic Intervention Material, competency attainment, Biology education, Grade 7, digital learning, blended learning, science education, student perception, plant and animal cell*

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Introduction

Science education plays a vital role in shaping individuals and societies in today's rapidly advancing world. As a discipline, science equips learners with essential knowledge, critical thinking skills, and the ability to solve real-life problems through observation, experimentation, and logical reasoning. In an age where scientific innovations continuously reshape industries, health systems, and communication, fostering a solid foundation in science among students has become more crucial than ever.

This study aimed to determine the effectiveness of utilizing interactive electronic Strategic Intervention Materials (eSIM) in the competency attainment of Grade 7 students in Biology at Dagatan Integrated National High School.

1. What are the distinct features of Electronic Strategic Intervention Materials in Biology?
2. What is the level of competency attainment of Grade 7 students in Biology before and after the utilization of interactive eSIM in terms of:
    2.1 Pre Test; and
    2.2 Post Test?
3. How do students perceive the effectiveness of interactive eSIM in enhancing their understanding of Biology concepts in terms of:
    3.1 guide card;
    3.2 activity card;
    3.3 assessment card;
    3.4 enrichment card; and
    3.5 reference card?
4. What difficulties encountered by the students in using interactive eSIM as learning tool in Biology?
5. Based on the results, what improvements may be proposed to further enhance the utilization of interactive eSIM?

Methodology

Research Design

This study employed a **mixed-methods research design**, integrating both **quantitative and qualitative** data collection techniques to comprehensively analyze the effectiveness of the interactive Electronic Strategic Intervention Material (eSIM) in the competency attainment of Grade 7 students in Biology.

Participants

Participants were 20 parents or guardians of SPED learners enrolled in public schools in District 2 of SDO Manila. A **purposive sampling** technique was used, targeting parents actively

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involved in managing their child's behavior and who had access to mobile devices. SPED and receiving teachers were also consulted during data collection for qualitative validation.

Research Instrument

To gather the necessary data for the study, the researcher utilized the use of pretest and post-test, survey questionnaire and interview guide as primary instruments.

Pretest and Post Test. The primary data collection instrument was a 30-item test designed to assess students' knowledge and understanding of key science topics in biology which includes the plant and animal cell. This test was administered as pre-test before the eSIM implementation to gauge the prior knowledge of the learners. Also, it was administered to the same learners as post-test after the implementation of the eSIM to measure the competency attainment of the learners in biology.

Questionnaire. A questionnaire is a research instrument that consists of a set of questions or other types of prompts that aims to collect information from a respondent.

Interview Guide. An interview guide is a written framework containing questions, prompts, or themes that direct the flow of a research interview.

Data Collection Procedure

The test and questionnaire were collected immediately after the respondents completed them. The teacher manually checked the test papers, and the scores were recorded in a spreadsheet for organization and analysis. The interview results were recorded with permission from the participants and their parents. The interviews were transcribed and coded for thematic analysis.

Data Analysis

Descriptive research method (frequency, percentage, ranking, and weighted mean) were used to summarize responses. For the interview, thematic analysis was used.

Results

The pre-test results showed that the students were at the satisfactory level, while the post-test results indicated a significant improvement, with outstanding level.

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1: Distinct Features of Electronic Strategic Intervention Materials in Biology

Table 1 presents the thematic analysis of students' responses on the distinct features of Electronic Strategic Intervention Materials (E-SIMs) in Biology.

Table 1

Distinct Features of Electronic Strategic Intervention Materials

Participant	Coded Response	Thematic Category	Themes
1	The E-SIM help us visualize biological processes."	Multimedia integration	nteractive and Engaging Learning Design
2	We can open the E-SIM anytime."	Easy access through devices	Accessibility and Convenience
3	shows the correct answers right away."	Self-assessment tasks	nteractivity for Self-Paced Learning
4	"It's convenient. the graphics and colors make it easier to understand topics."	Easy access through devices; High-quality visuals; Organized layout;	Accessibility and Convenience; Visual Presentation and Clarity
5	"Easier to relate to the lessons."	Real-life biological cases examples	Contextualization and Real-Life Application
6	"We can click and explore diagrams, making the lessons more engaging."	Multimedia integration;	Interactive and Engaging Learning Design
7	"It's easy to use."	Simple navigation; Organized modules; Clear instructions	User-Friendly Interface
8	"There's a test after each module, and it shows our score immediately."	Built-in tests;	Integration of Assessment Tools
9	"It feels fun and exciting, like playing a game while learning."	Game-like elements; Audio-visual appeal;	Motivation and Engagement Boost
10	"The lessons are interactive"	nteractive activities; Studentengagement	Interactive and Engaging Learning Design

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2: Level of Competency Attainment of Grade 7 Students in Biology

As presented in Table 2, the pre-test results reveal the initial level of competency of Grade 7 students in Biology prior to the utilization of the Electronic Strategic Intervention Materials or E-SIMs

Table 2
Pre Test

Score Range	Frequency	Percentage	Rank
Outstanding 25-30	0	0	5
Very Satisfactory 19-24	7	16	3
Satisfactory 13-18	24	55	1
Failed 7-12	12	27	2
Do Not Meet Expectation 1-6	1	2	4
Total	**44**	**100**	

In table 3, the post-test results of Grade 7 students in Biology revealed a significant improvement in performance following the utilization of the Electronic Strategic Intervention Materials or E-SIMs.

Table 3
Post Test

Score Range	Frequency	Percentage	Rank
Outstanding 25-30	38	86	1
Very Satisfactory 19-24	6	14	2
Satisfactory 13-18	0	0	4
Failed 6-12	0	0	4
Do Not Meet Expectation 1-6	0	0	4
Total	**44**	**100**	

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Section 3: Perceive Effectiveness of Interactive eSIM in Enhancing Students' Understanding of Biology Concepts.

Table 4 shows the students' perceptions of the effectiveness of the guide in helping them navigate the lesson and attain the competency in biology.

Table 4
Students' Perception on the Effectiveness of Guide Card

The Guide Card is Effective in ..	Weighted Mean	Verbal Interpretation	Rank
1. presenting the learning objectives clearly, helping me understand the goals of the lesson.	3.36	Effective	5
2. providing an overview of the topic, which makes the flow of the lesson easier to follow.	3.50	Very Effective	3
3. capturing my attention and motivating me to become more focused at the start of the lesson.	3.50	Very Effective	3
4. highlighting the essential concepts and key points that support my understanding of the topic.	3.50	Very Effective	3
5. giving clear and organized directions that guide me in completing the required learning tasks.	3.61	Very Effective	1
Composite Mean	**3.494**	**Effective**	

Table 5 shows the students' perception on the effectiveness of Interactive Electronic Strategic Intervention Materials (eSIM) in terms of Activity Card.

Table 5
Students' Perception on the Effectiveness of Activity Card

The Activity Card is Effective in …	Weighted Mean	Verbal Interpretation	Rank
1. providing exercises that help me apply what I have learned from the lesson.	3.50	Very Effective	2
2. making learning more engaging through interactive tasks and activities.	3.50	Very Effective	2
3. guiding me step by step in completing the required tasks.	3.50	Very Effective	2
4. helping me practice and improve my skills in the lesson.	3.39	Effective	4.5
5. allowing me to check my understanding by doing meaningful activities.	3.39	Effective	4.5
Composite Mean	**3.456**	**Effective**	

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Table 6 shows the students' perception on the effectiveness of Interactive Electronic Strategic Intervention Materials (eSIM) in terms of Assessment Card.

Table 6
Students' Perception on the Effectiveness of Assessment Card

The Assessment Card is Effective in …	Weighted Mean	Verbal Interpretation	Rank
1. helping me check how much I have learned from the lesson.	3.27	Effective	2.5
2. allowing me to see which parts of the lesson I need to improve.	3.16	Effective	4.5
3. giving me activities that test my understanding of the topic.	3.27	Effective	2.5
4. making me more confident in knowing whether I achieved the learning objectives.	3.16	Effective	4.5
5. providing feedback that helps me learn from my mistakes.	3.39	Effective	1
Composite Mean	**3.25**	**Effective**	

Table 7 shows that Enrichment Card is very effective in deepening student's understanding of the lesson through advanced tasks.

Table 7
Students' Perception on the Effectiveness of Enrichment Card

The Enrichment Card is Effective in …	Weighted Mean	Verbal Interpretation	Rank
1. providing additional activities that challenge me to go beyond the basic lesson.	3.50	Very Effective	3.5
2. helping me apply what I learned in new and creative ways.	3.50	Very Effective	3.5
3. deepening my understanding of the lesson through advanced tasks.	3.61	Very Effective	1
4. encouraging me to explore and discover more about the topic.	3.50	Very Effective	3.5
5. developing my critical thinking and problem-solving skills.	3.50	Very Effective	3.5
Composite Mean	**3.522**	**Very Effective**	

Table 8 presents the students' perception on the effectiveness of Interactive Electronic Strategic Intervention Materials (eSIM) in terms of Reference Card.

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Table 8
Students' Perception on the Effectiveness of Reference Card

The Reference Card is Effective in …	Weighted Mean	Verbal Interpretation	Rank
1. providing me with useful sources that support my learning.	3.39	Effective	4
2. helping me find additional information to better understand the lesson.	3.50	Very Effective	2
3. guiding me toward reliable references for further study.	3.39	Effective	4
4. supporting my independent learning by giving me extra materials to explore.	3.61	Very Effective	1
5. making it easier for me to connect the lesson with other learning resources.	3.39	Effective	4
Composite Mean	**3.456**	**Effective**	

Section 4: Difficulties Encounter by Students in Using Interactive eSIM as Learning Tool in Biology

Table 9
Difficulties Encountered by the Students

Participant	Coded Response	Thematic Category	Themes
1	"weak internet."	Poor Internet Connectivity	Technical and Accessibility Issues
2	"terms are hard to understand."	Complex Biological Terms	Content-Related Difficulties
3	"signal is slow."	Poor Internet Connectivity	Technical and Accessibility Issues
4	"I sometimes get confused about how to use the eSIM."	Low Digital Literacy	User-Related Challenges
5	"My phone hangs when I open the eSIM."	Device Limitations	Technical and Accessibility Issues
6	"not enough storage space. There's no teacher to explain it right away."	Device Limitations; Lack of Immediate Feedback	Technical and Accessibility Issues; Limited Instructional Support
7	"I'm not used to digital lessons, so it's a bit hard at first."	Low Digital Literacy	User-Related Challenges
8	"I get distracted by messages when using my phone for eSIM."	Distractions During Use	User-Related Challenges
9	"There are words I still can't explain even after reading."	Complex Biological Terms	Content-Related Difficulties
10	"There's a lot to read in one module, and it's hard to remember everything."	Information Overload	Content-Related Difficulties

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Table 9 presents the analysis of the difficulties encountered by Grade 7 students in using the interactive Electronic Strategic Intervention Material (eSIM) as a learning tool in Biology.

Section 5: Proposed Improvements on interactive eSIM

The researcher proposed the develop an offline-accessible version of eSIM, optimizing file size and system requirements, conducting digital literacy orientation sessions, integrating built-in glossaries, audio narrations, and short concept videos, and adopting a blended learning approach with teacher facilitation.

Discussion

Table 1 presents, the participants' feedback reveals that interactivity, accessibility, and clear visual design were the most valued features of the E-SIM, significantly contributing to enhanced comprehension and engagement. Contextualization, usability, and assessment integration further supported effective learning, while self-paced and gamified elements fostered motivation and autonomy.

Moreover, table 2 results revealed that learners' achievement improved from below expectations prior to the intervention to a satisfactory level after its implementation, indicating that digitalized lesson inputs serve as valuable tools for motivating and supporting pupils in grasping science concepts, particularly in online and blended learning contexts. In table 3 findings this suggest that the use of interactive E-SIMs was highly effective in enhancing students' comprehension and mastery of Biology concepts. The substantial increase in scores implies that the multimedia features, interactive quizzes, and contextualized content of the E-SIMs contributed to deeper understanding and sustained engagement.

The result shows in table 4 shows indicated that the guide card, effectively supports learners by providing clear directions, emphasizing key concepts, and enhancing motivation, thereby contributing to a more organized and engaging learning experience. The result indicated in table 5, shows that the Activity Card effectively supports learners by providing interactive and meaningful exercises that enhance engagement, reinforce understanding, and promote the practical application of knowledge and skills. The result showed in table 6 revealed that the Assessment Card effectively supports learners in evaluating their understanding, identifying areas for improvement, and building confidence in achieving the learning objectives, thereby enhancing the overall learning process. Table 7 result showed that the Enrichment Card effectively enhances students' learning by providing advanced, engaging, and thought-provoking activities that promote deeper understanding, creativity, and the development of critical thinking and problem-solving skills. As shown in table 8, it can be deduced from the result that the Reference Card effectively supports students' independent learning by providing relevant and reliable materials that enhance comprehension, encourage exploration, and strengthen connections between the lesson and additional learning resources.

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The purpose of table 8 analysis is to identify the common barriers that affect students' learning experiences and limit the full utilization of the eSIM's features. This analysis indicates that students experienced difficulties related to technical and accessibility issues, user-related challenges, content related difficulties, and limited instructional support.

The proposed improvements stem from the recognition that effective integration of technology in education requires both technical readiness and pedagogical soundness. Therefore, improving the interactive eSIM aligns with the goal of providing equitable and quality digital education that promotes meaningful and independent learning:

1. Develop an offline-accessible version of the interactive eSIM Description.
2. Optimize file size and system requirements.
3. Conduct digital literacy orientation sessions.
4. Integrate built-in glossaries, audio narrations, and short concept videos.
5. Adopt a blended learning approach with teacher facilitation.

Conclusion

Based on the major findings of the study, the researcher drew the following conclusions:

1. Based on the interview, students perceived the E-SIM to be an interactive, accessible, and visually clear learning tool with contextualized content and built-in assessments that enhanced their understanding, engagement, and motivation, supporting self-directed learning in Biology.

2. The pre-test results showed that the students were at the satisfactory level, while the post-test results indicated a significant improvement, with outstanding level.

3. The enrichment card, guide card, activity card, reference card and assessment card was found to be effective.

4. Students experienced difficulties related to technical and accessibility issues, user-related challenges, content-related difficulties, and limited instructional support.

5. The researcher proposed the develop an offline-accessible version of eSIM, optimizing file size and system requirements, conducting digital literacy orientation sessions, integrating built-in glossaries, audio narrations, and short concept videos, and adopting a blended learning approach with teacher facilitation.