

Development of Strategic Intervention Material (SIM) to Improve the Least Mastered Skill in Central Dogma among the Grade 10 Learners

Alexis Labe^{1,3}, Debbie Ann Laguindab^{1,3*}, Monera Hairulla¹, Vanjoreeh Madale²

¹ College of Education, Mindanao State University – Iligan Institute of Technology, Bonifacio Ave., Tibanga, Iligan City, 9200, Philippines

² Integrated Developmental School, Mindanao State University – Iligan Institute of Technology- Bonifacio Ave., Tibanga, Iligan City, 9200, Philippines

³ Department of Science and Technology, 2nd floor, DOST Main Building, DOST Compound, Gen. Santos Ave., Bicutan, Taguig City, Metro Manila, 1631

*Corresponding author email: alexis.labe@g.msuiit.edu.ph

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Abstract

The study focused on the development of a Strategic Intervention Material (SIM) and its effectiveness in improving students' performance in the topic of Central Dogma of Molecular Biology. The study was conducted at Cabalantian National High School, to selected thirty-two (32) Grade 10 learners. Topics include DNA Replication, Transcription and Translation which was identified as the least mastered learning competency based on the test results. The study used quasi-experimental research method. The developed SIM was evaluated by master teacher and science teachers in terms of Sub tasking, Congruence, Usability and Replicability. The results of the study showed a significant difference between the pre-test and post-test scores, indicating that the SIM positively impacted student outcomes. The activities provided in the SIM played a substantial role in this improvement. Students had a positive view of the SIM, finding it enjoyable and interesting, and it contributed to a positive attitude towards learning science concepts. Overall, the study suggests that using intervention materials is recommended as an effective strategy for improving students' performance in science education.

Keywords: Strategic Intervention Materials, Mobile SIM Legend, Science Education

1. Introduction

Science education is a critical component of preparing students for the modern world and enabling them to understand the natural world. However, the education system in the Philippines faces various challenges that hinder the effective delivery of science education. One of the most significant problems is the lack of adequate resources, such as science laboratories, equipment, and instructional materials, which are essential for hands-on learning and experimentation. This shortage of resources limits students' opportunities to

engage in scientific inquiry and gain practical experience, which is crucial in developing scientific skills and knowledge.

The latest findings of the Program for International Student Assessment (PISA) reveal that Filipino students continue to struggle in math, reading, and science, remaining among the world's weakest performers. Despite the education department's efforts to implement reforms and prepare students for the test, the results show no significant improvement from the previous cycle in 2018. The PISA results indicate that just less than a quarter of Filipino students who took the test in 2022 attained the minimum level of proficiency in all three subjects, a worrying statistic. Furthermore, the Philippines performed worse than the global average in all categories, indicating that there is still a long way to go to catch up with the rest of the world. The PISA test, conducted by the Organization for Economic

Co-operation and Development (OECD), evaluates the literacy of 15-year-olds every three years since 2000. The latest cycle involved 81 countries and was postponed by a year due to the COVID-19 pandemic. These results are among the first international assessments to capture the impact of the pandemic on most education systems worldwide. The OECD noted that there was a significant decline in student performance across nations, unprecedented in its history, highlighting the need for urgent action to address the learning gaps caused by the pandemic.

Learners progress at their own speed through various learning activities. Educators are challenged by the unique differences and characteristics of learners in handling their class (Alfiler, 2021). Education is affected by individual differences, which reveal that each person varies in background, skills, maturity, motivation, attitude, learning style, learning pace, and ability. Educational advancements have been created to meet the needs of learners and address their problems, aiming to improve the quality of their learning (Bangayan-Manera, 2019). Approaches such as cooperative learning, computer-assisted instruction, and peer tutoring have been proven to be successful in enhancing students' performance. Strategies like individualized instruction, programmed instruction, and modular/intervention approach are designed to address individual differences. According to Taguian (2022), teaching innovation occurs when teachers utilize diverse and engaging teaching methods, and varied and substantial content to stimulate students' interest in learning, thus fostering positive attitudes towards proactive learning and enhancing students' learning capability.

The field of science is vast, and understanding its intricate mechanisms can be challenging for some learners. Learning science is crucial for mental development, although many learners find it overwhelming due to its complexity and abstract concepts. Dandan (2022) emphasized the difficulties learners face in analyzing, appreciating, recognizing, and processing fundamental scientific concepts.

Genetics is considered one of the most difficult topics to teach and learn in Biology. Mussard and Reiss (2022) explained why learning genetics is especially challenging. They pointed out that a number of studies indicate that genetics is challenging since it involves a lot of abstract ideas that are not immediately visible to the human senses. Venville and Treagust (2002) found that high school students had difficulty connecting concepts like 'genes' with 'proteins', and 'DNA structure' with 'protein syntheses, because these lessons failed to integrate these concepts. This finding suggests that students may struggle to grasp the underlying principles of molecular biology, which can hinder their ability to succeed in higher-level science courses.

The researcher authentic experience in teaching Central Dogma entrenched the construction of this study. Over the years in teaching Science 10, the researcher observed the consistent low performance scores of some students in the topic of Central Dogma.

To address the declining academic performance of students in Science and Technology, the Department of Education (DepEd) has implemented a solution. As per

DepEd Order No. 39, S. 2012, interventions are necessary to bridge learning gaps. Strategic Intervention Material, an instructional material for remediation purposes is one of the solutions employed to enhance academic achievements of students performing low in the field of science and technology (Suarez and Casinillo, 2020).

The use of SIM in the education system has been beneficial in promoting successful learning and improving academic performance. It is an interactive and engaging tool that allows students to explore and study at their own pace. Results of the study Suarez and Casinillo (2020) showed that the use of SIM is effective in terms of improving students' performance particularly on the topic pertaining to the least mastered skills in Science VI. Furthermore, Bastida R. and Bastida G. (2022) assessed the impact of Strategic Intervention Material (SIM) on grade 11 senior high school level learning outcomes using a quasi-experimental research design. The results showed that the application of SIM can help to increase the learning outcome of the senior high school students than using traditional way of teaching.

With that, the researchers embarked on developing a SIM in Science 10 entitled "Mobile SIM Legend: 'Decoding Legends in the Central Dogma'" specifically aimed to address the least mastered skills of students in science 10. This study also aims to evaluate the effectiveness of the developed SIM in improving the performance of the students. The SIM focuses on the topic Central Dogma of Molecular Biology as it is the identified least mastered competency in science 10 based on the test results from the Third Quarter Summative Exam (S.Y. 2023-2024).

This study is significant for the following: Curriculum designers may be able to create curricula that enhance students' academic performance and lead to high-quality education through the use of this study. The findings of this study may also help school administrators and science supervisors plan and create the right kind of intervention materials for students who struggle with science. This study may assist science teachers select relevant intervention materials for their science classes and may inspire other educators to devise their own pedagogical approaches and techniques for reinforcing concepts that students find unclear. Low-achieving students may be able to make sense of things through this study. This might also aid in overcoming their learning challenges with regard to the topic Central Dogma.

The general objective of this study was to develop a Strategic Intervention Material in Central Dogma of Molecular Biology. Specifically, the study aims to answer the following questions: (1) Is there a significant difference between the pre-test and post test scores of the students? (2) What are the perceptions of the student respondents in using the strategic intervention material? and the following are the null hypothesis and alternative hypothesis of the study: HO: There is no significant difference in the pre-test and post test scores of the learners; HA: There is a significant difference in the pre-test and post test scores of the learners.

2. Methods

2.1 Research Design

The researchers used the quasi-experimental one group Pre-Test–Post-Test design was used because one group of students underwent remediation using the SIM: "Mobile SIM Legend!". The pre-test and post-test were taken and compared to determine the effect of the intervention. Descriptive survey was used to determine the students' perceived effect of the SIM. Since the SIM is meant as a re-teaching tool (Bunagan, 2016), only selected students who had low performing scores have been selected. This study used only the data obtained from the experimental group.

This study used the 4D model in developing the SIM. The model of research is divided into steps namely: "Define", "Design", "Develop" and "Disseminate". The method started by defining the students need which is the need to re-learn the least

mastered competency. Next step was the design and development of the strategic intervention material. The last step was to disseminate the developed SIM.

2.2 Research setting and respondents

The respondents were selected from a pool of Grade 10 students with low performance scores on the least mastered topic based on the Third Quarter Summative Test. Thirty-two (32) students were selected using simple random sampling. The names of the pooled students were written on a sheet of paper and randomly drawn in this sampling technique. The researcher obtained approvals from relevant authorities, sought consent from respondents' parents, ensuring confidentiality, and following data protection regulations. The respondents were not physically and emotionally forced or harmed and that their responses were treated with utmost confidentiality.

2.3 Development of the “Mobile SIM Legend”

The Mobile SIM Legend is a strategic intervention material that was used in this study. It was based primarily on the DepEd SIM format. The parts of the Mobile SIM Legend are as follows: Title Card, Guide Card, Activity Card, Assessment Card and Reference Card.

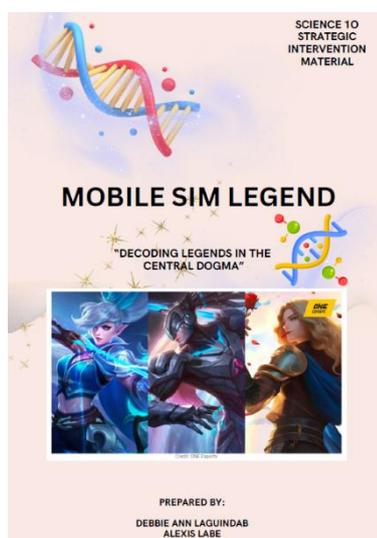
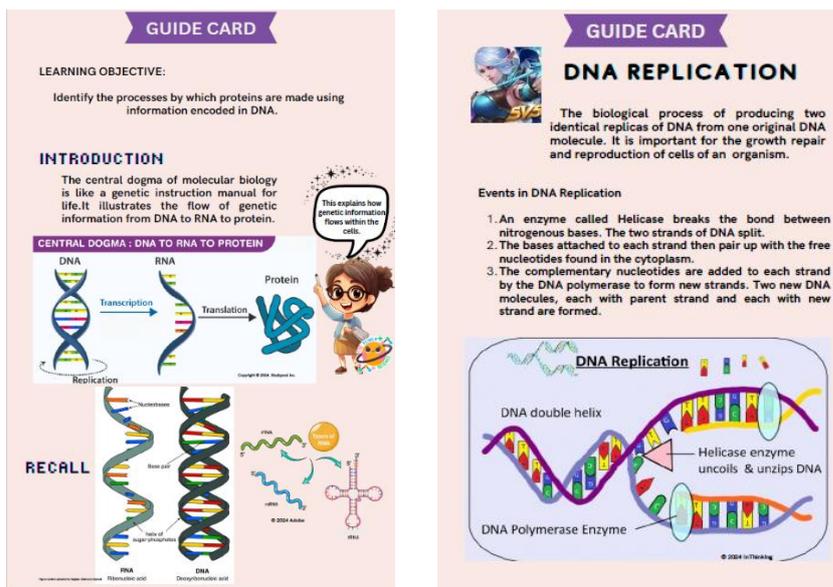


Figure 2.1 Title Card

The title card of the SIM was inspired the online battle arena game *Mobile Legends: Bang Bang*. The game was developed and published by Chinese developer Moonton, a subsidiary of ByteDance. It was released in 2016 and grew in popularity, most prominently in Southeast Asia. The SIM's cover page was created with the intention of drawing in attention of the learners and being aesthetically pleasing. The illustrations and text in “Mobile SIM Legend” were both interesting and relevant, effectively capturing student attention. Images used were credit from source.

Figures 2.2 shows the guide card that provide a sneak peek at what the students will study and demonstrates concentration abilities. Incorporating interesting resources, including as images, videos, infographics, and other media, can keep students from becoming disinterested and promote improved performance.



Figures 2.2 Guide Card

2.4 Research Instrument

1. Pre-Test and Post-Test

The Student's Pre-Test and Post-Test in Central Dogma is a multiple-choice type consisting of 15 items. It was adapted from the assessment found in the DepEd Science 10 Learning Material and was revised for the purpose of the study.

The Pre-Test was given before the intervention, to gauge students' baseline understanding of the Central Dogma. Questions about transcription, translation, and function of mRNA were designed in multiple-choice type. Post-Test was administered immediately after the intervention. A Post-Test was immediately done whereby the same questions used in the Pre-Test were used to assess learning gains.

2. Students' Perception Survey:

After the intervention, a short survey was conducted to assess students' perceptions of SIM. Questions posed included ratings of their engagement with the material and how clearly the content of the SIM conveyed the understanding of the Central Dogma.

The Students' Perception Survey used was based on the SPS developed by Sinco (2020). It is a 10-item questionnaire which aims to describe the perception of the student on the use of the "Mobile SIM Legend". Each statement is rated using five-choice rating scale, where 1 means Strongly Disagree, 2 means Disagree, 3 means Moderately Agree, 4 means Agree, and 5 means Strongly Agree.

Table 2.3 Interpretation

Scale	Verbal Description	Equivalent
4.21-5.00	Strongly Agree	Very High
3.41- 4.20	Agree	High
2.61-3.40	Moderately Agree	Moderate
1.81-2.60	Disagree	Low
1.00-1.80	Strongly Disagree	Very Low

2.4 Data Collection

The first part of the study was the Pre-Test administration. It was given to the students prior to the intervention material. 32 student-respondents were given the 15-item Student's Pre-Test in Central Dogma System and the test lasted for 30 minutes. The SIM was given to the student respondents during the remedial classes after Pre-test administration. The

students stayed 80 minutes after class to answer the SIM. The responses to the SIM were checked to monitor the progress of the students. Learners who were unable to complete the SIM activities will have to continue answering until they were able to do so. The duration of the SIM administration lasted for 2 weeks for the 32 student respondents. The next part was the administration to the students of the Post-Test as well as the Students Perception Survey developed by Sinco (2020). The last part of the study was data checking, encoding, and analysis.

2.5 Data Analysis

To determine the effectiveness of the strategic intervention material in enhancing the performance of the students in positive, zero, and negative, integral exponents, the following statistical tools were utilized:

The mean, standard deviation, and dependent sample t-test were computed using MS Excel ToolPak for correctness and accuracy.

Mean - These tools were used to answer research question 1 to determine the average of the scores and the extent of deviation for a group as a whole in the pre-test and post-test taken by the students. The following guide was used for interpretation:

Table 2.5 Qualitative Description for Test Results

Parameter	Qualitative Description
12.20 – 15.00	Very High Performance
9.40 – 12.19	High Performance
6.60 – 9.39	Average Performance
3.80 – 6.59	Low Performance
1.00 – 3.79	Very Low Performance

3. Result

3.1. Comparison of Students' Pretest and Posttest

Table 3.1 Test Results of the students-respondents on Central Dogma of Molecular Biology

	Mean	Sd	Min	Max	Verbal Description
Pre-test	5.78	1.95	2	9	Low Performance
Post-test	12.06	1.98	8	15	High Performance

Table 1 presents the comparison of pretest and posttest results of the students, with mean scores of 5.78 and 12.06, respectively. The pretest results indicate low performance, while the posttest results show high performance. The difference between the two results is significant, indicating that the students have improved their understanding of the subject matter. Using a Strategic Intervention Material (SIM), the students could understand the concepts of the Central Dogma of Molecular Biology even with less guidance from the teacher. The material provided various activities and exercises that allowed the students to learn independently. As a result, there was a significant increase in the mean score of the students, demonstrating the effectiveness of the intervention material.

This finding is similar to the study of Sinco (2020), who found that using SIMs deepens the student's knowledge and understanding of the least mastered concepts in science. Based on these results, the Strategic Intervention Material (SIM) is an effective tool that can be used to improve students' understanding of specific topics, such as the Central Dogma of Molecular Biology. By providing students with various activities and exercises, the SIM allows them to learn at their own pace and improve their mastery of the subject matter.

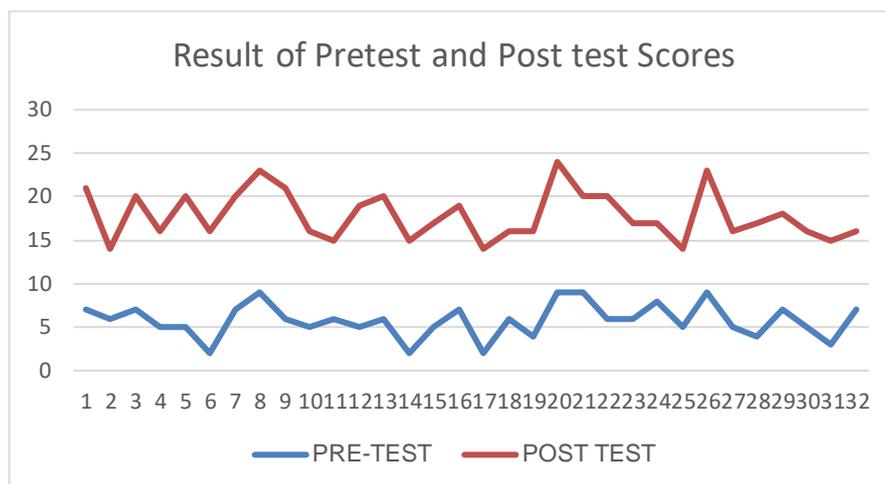


Figure 3.1: Pre-Test and Post-Test Scores of Students

The line graph shows each student's pre- and post-test individual results. While the orange line—post-test scores—shows a notable rise across most pupils, the blue line—pre-test scores—shows generally lower values. The difference between the two lines shows that students did better after utilizing SIM, implying improved knowledge of the Central Dogma of Molecular Biology. This graphical depiction enhances the statistical results and supports SIM's efficiency in raising students' conceptual knowledge.

3.2. Significant Difference between the Pretest and Posttest Results

Table 3.2 Difference between the Pre-test and Post-test Performance of the Students

	SD	df	t-test	p-value	Decision
Pre-Test	1.946616	31	-12.8111	3.19E-14	Reject the Ho
Post Test	1.982789				

$\alpha=0.05$

Table 2 indicates a significant difference between the pre-test and post-test results of the students (t-value=-12, p-value=0.000). This shows that the student's performance improved after using intervention material, which helped them better understand and master the Central Dogma of Molecular Biology concepts. The activities provided in the material played a crucial role in this improvement.

These findings are consistent with previous studies by De Jesus (2019) and Arpilleda (2021), demonstrating that intervention materials improve learners' achievement levels. Using the SIM led to a significant improvement in students' performance from pre-test to post-test. The results of this study suggest that using the SIM as a remediation tool significantly impacts the learners' performance in Central Dogma of Molecular Biology. Furthermore, these studies showed that learners exposed to intervention materials have a better potential to increase or enhance their performance in the subject. Therefore, intervention materials are recommended as an effective strategy for improving students' performance in science education.

3.3. Students' perception in using the SIM

Table 3.3 Student Respondents perception in using the SIM

Statements	Mean	SD	Description	Equivalent
1. The SIM helps me understand the process in Central Dogma of Molecular Biology that were not understood during the regular classroom teaching.	4.22	0.7	Strongly agree	Very high
2. Confusing concept of the Central Dogma was clearly presented.	4.28	0.51	Agree	Very high
3. The instructions are simple and easy to follow	3.78	0.7	Agree	High
4. The SIM offers interesting activities	4.03	0.68	Agree	High
5. The SIM is student-friendly material	4.25	0.71	Strongly agree	Very high
6. SIM used words and terms suited to my reading comprehension	4.22	0.6	Strongly agree	Very high
7. I enjoyed reading and doing all the activities provided in the SIM	4.13	0.65	Agree	High
8. I can setup my own pace in learning without feeling pressured about time	4.38	0.65	Strongly agree	Very high
9. The SIM inspired and encouraged me to learn more concepts in science	4.28	0.76	Strongly agree	Very high
10. I want to use SIM during remediation class.	3.63	0.6	Agree	High

The data in Table 3 reflect the consolidated responses of 32 students on their perception of using the strategic intervention material. Table shows the student respondents strongly agree that the SIM helps them understand the process in Central Dogma of Molecular Biology that were not understood during the regular classroom teaching (mean = 4.22). The student respondents also agree that the instruction in SIM is simple and easy to follow (mean = 3.78) and they strongly agree that the SIM is student-friendly material (mean = 4.25). Student respondents further reveal that the confusing concept of Central Dogma was clearly presented (mean= 4.28). Most of the students agreed that they enjoyed reading and doing all the activities in the SIMs (mean = 4.13) because they offer interesting topics (mean = 4.03). This finding was the same to the findings of Acuña, Gutierrez and Areta (2015) wherein they concluded that the integration of reading skills in the development of SIMs may facilitate the learning of science concepts in a sense that the pupils actively engaged and participated in activities that connect to their real-life experiences, a view anchored on constructivist view of learning. Student respondents agreed to use SIMs during remediation (mean = 3.63) and that they strongly agree that they can set up their own pace in learning without feeling pressured about time (mean= 4.38). The findings align with a study by Acedillo et al. (2022) showing that participants had positive perceptions of the effectiveness of using strategic intervention material in science. The simplified material was well-received by both students and teachers, indicating that implementing SIM in schools will likely be straightforward.

5. Conclusion

The study aimed to evaluate the effectiveness of intervention material in improving the mastery of Grade 10 students in the Central Dogma of Molecular Biology. The data analysis showed a modest increase in student achievement after the intervention, suggesting that the intervention material improved students' knowledge and comprehension of the concept. The study's objectives were supported by statistical analysis, which indicated a significant difference (t-value=-12, p-value=0.0000) between pretest and posttest scores, with the latter showing a higher average. This implied that

using Strategic Intervention Materials in learning the least learned concepts helped the student's attained higher score. The students had a positive perception on the use of Strategic Intervention Materials. Students find it enjoyable and interesting, and it contributes positive attitude towards learning more concepts in science. The researchers suggest for further research, to test the effectiveness of SIM in learning Central Dogma of Molecular Biology.

However, the study had several limitations. The sample size was too small, and this was done in only one school. Future studies should be able to consider using bigger sampling sizes while finding means in longitudinal approach to find out an aspect of retention over a longer period. To bolster the study, it would also be beneficial to implement it into various teaching contexts or grade levels.

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