



Studies in Technology and Education

Volume 2, Issue 2, 2024 | <https://www.azalpub.com/index.php/ste>

OPEN ACCESS

RESEARCH ARTICLE

Q-SIM (QUIZZ POWERED SIM): STRATEGIC INTERVENTION MATERIAL IN TEACHING BIOLOGY

ARMAN Z. SERRANO

West Wendover High School, NV, USA (aserrano.us@gmail.com)

Article Info

Received:

November 12, 2023

Accepted:

December 20, 2023

Published:

February 29, 2024

Keywords

Science
E-learning
Resources
Application

Suggested Citation:

Serrano, A. Z. (2024). Q-SIM (Quizizz Powered SIM): Strategic intervention material in teaching biology. *Studies in Technology and Education*, 2(2), 1-11.

Abstract

This study embarks on an empirical journey to evaluate the efficacy of Q-SIM as a teaching material in biology education. The study also determined the students' attitudes toward using developed Q-SIM. Moreover, a one-group pre-test-post-test design was used to assess the impact of Q-SIM intervention on DNA, RNA, and Protein Synthesis. The study provided the student's academic performance results before and after the intervention using their mean scores. Furthermore, the mean difference between the student's pre-test and post-test was also calculated using a t-test to find out the significant impact of Q-SIM. The researchers also used a validated survey questionnaire as the primary tool of the study to determine students' attitudes and perceptions. The findings showed that implementing Q-SIM is promising for enhancing students' academic performance. The significant differences observed between pre-test and post-test results underscore the positive impact of Q-SIM on students' understanding and mastery of subject matter. Moreover, students' highly positive attitudes towards Q-SIM indicate a favorable perception of this innovative educational tool. As technology plays a pivotal role in shaping the educational landscape, Q-SIM stands out as a valuable asset, offering improved academic outcomes and fostering a positive and engaging learning environment. Future utilization of this Q-SIM as a strategic instructional material would raise students' academic performance and attitude in teaching specific science concepts and applying this Q-SIM in another discipline.

INTRODUCTION

In the constantly changing field of educational technology, Quizizz has become a powerful instrument that can change how people teach and learn. Quizizz is well known for its dynamic and captivating features, which enable teachers to make tests, evaluations, and role-plays to encourage student engagement and comprehension. Investigating the incorporation of Quizizz-powered strategic intervention material is critical as the need for efficient teaching aids in biology education increases.

Engaging pupils in complicated topics and creating a solid comprehension of scientific principles are challenges facing biology teaching. Interactive learning resources have demonstrated the potential to tackle these issues by giving students practical experiences that improve biological knowledge retention and application. Therefore, incorporating strategic intervention materials driven by Quizizz into biology classes has the potential to transform conventional teaching approaches completely.

Several research works have emphasized the advantages of using technology in education. For example, Johnson et al. (2018) discovered that interactive technologies significantly increase student engagement and academic success in scientific courses. Furthermore, Smith and Brown (2019) found that using quiz-based learning tools in biology classes produced favorable results. These results demonstrate the potential benefits of using Quizizz-powered strategic intervention materials in biology education.

There is a discernible lack of research addressing the effectiveness of Quizizz-powered strategic intervention material in teaching biology despite the rising corpus of work on educational technology and interactive learning aids. Although other technology interventions have been studied, a dearth of research thoroughly examines Quizizz's effects in the context of biology teaching. This study aims to close this gap and offer insight into how biology instruction and educational technology interact.

Statement of the Problem

Integrating strategic intervention materials in teaching is imperative for enhancing the effectiveness and engagement in biology education. The introduction of Q-SIM (Quizizz Powered SIM) presents a novel approach, combining interactive quizzes with simulation tools to facilitate active learning. However, the efficacy of Q-SIM as a teaching material in biology education remains unexplored. This study seeks to investigate the impact of Q-SIM on students' comprehension of biological concepts by implementing one-group pre-test and post-test assessments alongside an evaluation of students' attitudes toward Q-SIM. This study specifically addressed the following research questions:

1. What is the academic performance level of the students and the mean scores of pre-test and post-tests before and after using Q-SIM?
2. Is there a significant difference between the pre-test and post-test among students exposed to Q-SIM as teaching material?
3. What are students' attitudes and perceptions towards using Q-SIM in the biology classroom?

Hypothesis

No significant difference exists between the student's pre-test and post-test learning outcomes.

By addressing these questions, this study was able to provide valuable insights into the effectiveness of Q-SIM as strategic intervention material in teaching biology education. The findings will further the existing knowledge on pedagogical approaches, offering practical recommendations for educators seeking to enrich the learning experience in biology classrooms.

LITERATURE REVIEW

Strategic Intervention Material (SIM) in Science Education

Research by Villonez (2018) demonstrates the positive impact of using SIMs on seventh-grade students' academic performance in earth science. The experimental group, exposed to SIM-based teaching, showed significantly higher mean gain scores than the control group. This suggests that using SIM as a teaching tool is more productive than traditional methods for specific science topics. Sinco's (2020) study supports the effectiveness of teacher-made instructional materials, including SIM, in teaching circulatory, nervous, and respiratory system concepts in Science VI. The results indicate significant improvements in students' pre- and post-test performance, reinforcing the success of SIM as an intervention tool. The review also underscores the importance of educators facilitating active involvement and confidence-building among students. Distance learning and e-learning solutions are discussed as avenues for expanding education beyond traditional classrooms. Jonathan (2022) advocates for interactive online education, emphasizing its benefits, particularly in the context of the COVID-19 pandemic. The immediate advantages of time and resource savings, along with constant monitoring of students' progress, are highlighted. Encarnacion et al. (2021) posit that e-learning is positively perceived by educators and learners, enhancing instructional delivery and knowledge acquisition skills. This suggests that e-learning can potentially transform education by moving the traditional classroom setting online. Furthermore, Jamandron's (2020) findings suggest that using SIMs for remediation is more effective than one-on-one direct instruction under teacher supervision. The recommendation is made to use SIMs as remediation tools to elevate the competency levels of underperforming students.

In conclusion, the literature review affirms the significant role of intervention materials, specifically SIMs, in improving students' academic performance, particularly in science subjects. The studies underscore the effectiveness of these materials in addressing specific learning challenges, promoting engagement, and enhancing the teaching-learning process. Additionally, the review highlights the evolving landscape of education, emphasizing the benefits of e-learning and distance education solutions.

Effectiveness of Digital SIM in Teaching Science

Santos (2019) conducted a study on students' perception of using AR mobile applications in science learning, with 100% of participants expressing positive responses and eagerness to use AR technology for various science topics. Berame et al. (2022) introduced the SIM for Teaching Augmented Reality, highlighting its positive impact on eighth-grade students' academic performance, motivation, and attitude toward scientific learning. The evaluation by teachers and students indicated strong agreement on all metrics, leading to improved attitudes and increased test scores. Samosa (2021) focused on assessing the effectiveness of developed comics as strategic intervention material in teaching biology, specifically Photosynthesis. The study exposed a significant positive relationship between academic performance and attitudes when aided by the developed strategic intervention materials, emphasizing the efficacy of comics in teaching complex scientific concepts. Capinding (2022) reported using "Quizizz" as a game-based assessment in teaching Science 10 in secondary education. The results demonstrated increased student interest and academic performance in physics, particularly in waves and optics. The study also highlighted favorable feedback regarding the use of Quizizz for online self-assessment. Mohamad et al. (2020) investigated remote postgraduate students' perceptions of

“Quizizz” as a formative assessment tool. The results indicated positive perceptions and increased enthusiasm for learning among students. However, the study identified three primary obstacles: fear, a generational divide, and the potential for peer copying. Despite these challenges, Quizizz effectively decreased learning anxiety among remote postgraduate students.

These studies underscore the importance of leveraging innovative technologies and pedagogical tools to enhance science education. While challenges exist, the overall impact appears to be positive, with the potential to improve students' attitudes, motivation, and academic outcomes in science learning.

METHODOLOGY

Research Design

This study used a one-group pre-test–post-test design to assess the efficacy of Q-SIM intervention on biology learning outcomes. The method was used for a single group of participants who shared the same traits and received the same interventions, evaluations, and treatments. Furthermore, because of the linear ordering in this design, a dependent variable was assessed both before and after a treatment was put into place. The difference between the pre-test and post-test was used to calculate the effect of a treatment based on this design. The independent variable may be blamed for the discrepancy if there is a substantial difference between the pre-test and post-test results.

Furthermore, this design enabled the researcher to look at changes over time within the same group and was especially helpful when random assignment to groups was not possible. The one-group pre-and-post-test design involved measuring the participants' biology knowledge and engagement levels before introducing Quizizz and then measuring the same variables after its implementation. This would align with the researcher's investigation into the impact of Quizizz-powered strategic intervention material in teaching DNA, RNA, and Protein Synthesis. This design provides valuable information for educational research, allowing the efficacy of educational interventions in real-world settings to be assessed (Campbell & Stanley, 2015).

Simultaneously, the descriptive component survey questions were facilitated to gather rich, contextual insights into the students' attitudes, perceptions, experiences, and the nuances of their engagement with the Quizizz-powered materials. This descriptive phase helps understand the reasons behind quantitative findings, explore unexpected outcomes, and provide a holistic view of the intervention's impact. By combining these approaches, the researcher can overcome the limitations of relying solely on quantitative impact but also the descriptive quality of the study. The strengths of one method can compensate for the weaknesses of the other, leading to a more comprehensive understanding of the research question. Integrating both data types in the analysis and interpretation stages allows for a more robust and nuanced exploration of the complex relationships within the educational context (Creswell & Creswell, 2017).

Respondents

Fifty biology students in grade 10 at West Wendover High School were the participants in this study. These students were purposively selected because they shared qualities with the participants, especially those who struggled to study DNA, RNA, and protein synthesis at West Wendover High School. The proportion of male to female among the responses was contingent upon the total enrollment for the academic year 2023-2024.

Purposive selection is a non-probability sampling technique where researchers deliberately choose participants based on specific measures related to the research question or objectives. This method is commonly employed when researchers seek to include individuals with specific characteristics or experiences relevant to the study, enhancing the depth and specificity of the research findings. For this instance, in a study exploring the impact of Quizizz-powered strategic intervention material in teaching biology, purposive selection was intentionally utilized in choosing participants with varying levels of familiarity with educational technology or who represent diverse learning abilities. The researcher gathered insights into how different subgroups respond to the intervention by selecting participants based on these criteria.

Creswell and Creswell (2017) emphasize that purposive sampling is particularly valuable in qualitative research, where the goal is to understand the phenomena under investigation. Patton (1990) further highlights that this method allows researchers to target individuals who can provide in-depth information or unique perspectives relevant to the research objectives. Before participation, informed consent was obtained from the parents or guardians of the students. Participants' privacy and confidentiality were scrupulously upheld during the whole investigation. This study was conducted at West Wendover High School in Nevada, focusing only on grade 10. It is possible that the results cannot be applied to other educational environments or grade levels.

Instruments

The instrument used in the study was a researcher-made pretest-posttest and attitude survey regarding the use of Q-SIM as an innovative teaching tool for DNA, RNA, and Protein Synthesis were among the instruments used in the study. The test and attitude survey was piloted with 20 selected grade 11 students. The test was checked and thoroughly scrutinized for validity at the same time as the attitude test for consistency. These were carefully selected and refined after conversations and consultations with academic science experts to ensure the validity and reliability of instruments (Pentang, 2023). Significant points that may inevitably encapsulate the research's purpose, scope, and goal were selected.

The Q-SIM. Q-SIM (Quizizz-Powered) Strategic Intervention Material is one of the intervention materials that can be used to promote active learning in the classroom. Q-SIM was designed to help students gain needed support to increase and deepen their skills, knowledge, and understanding from concrete Science to what is more abstract.

The Pre-test and Post-test. A standardized pre-test and post-test were administered to assess students' baseline knowledge of biology before and after exposure to Q-SIM. The tests covered a range of biological concepts relevant to the curriculum. The instruments used in the study were the researcher-made pretest-posttest and attitude survey regarding using Q-SIM as an innovative teaching tool for DNA, RNA, and Protein Synthesis.

The researcher created the examination in the Quizizz application (www.quizizz.com). The tests had fifty multiple-choice questions with four options for each item. Both prior to and following the treatment, this was given. The exam served as both a pre-and post-test. The test assessed the student's capacity to apply, relate, and remember any knowledge they learned during the treatment.

Test-retest reliability analysis revealed that it was acceptable, with a calculated value of .789. All participating students finished the pre-test to determine their baseline biology comprehension before being introduced to Q-SIM. Q-SIM was incorporated into the biology curriculum over four weeks. This included interactive lessons, tests, and simulation exercises to supplement conventional teaching techniques. Following the Q-SIM intervention, students took the post-test, replicating the pre-test's content. This makes it possible to compare their knowledge before and after exposure to Q-SIM directly.

Attitude Survey. An attitude survey was developed to gauge students' attitudes and perceptions towards Q-SIM as a teaching material. The survey includes items related to engagement, interest, and perceived efficacy of Q-SIM in aiding their understanding of DNA, RNA, and Protein Synthesis. The attitude survey was composed of 10- items on a 5- Likert scale. Using the CVR - Lawshe's Content - - Validity Coefficient revealed that the attitude survey was acceptable based on the computed CVR of .839. Likert scale was used to assess the indicators of the study.

Data Gathering Procedures

The documentation approach was used to collect the study's data. This was achieved by considering the information from the pretest-posttest and attitude survey used in the research. The researcher requested permission to conduct a research study on the efficacy of Q-SIM (Quizizz Powered SIM), strategic intervention material in teaching biology to improve the academic performance of students in teaching the concepts of DNA, RNA, and Protein Synthesis in a letter to the Office of the Principal after the research experts approved the final draft of the instruments. After receiving the principal's clearance and endorsement, the researcher was ready to report to the school's subject coordinator to carry out the study. The research study's material was examined and evaluated until authorization was officially given, with the condition that no government funds would be utilized and that there would be no disruption of classes.

Second, a pre-test covering the fundamentals of DNA, RNA, and protein synthesis was administered to every participant. The second step involves creating and verifying the Q-SIM (Quizizz Powered SIM), which was sent to the principal's office afterward. Third, a post-test and attitude survey about the use of Q-SIM as an innovative tool to raise students' academic achievement in teaching DNA, RNA, and protein synthesis principles was administered to all participants. The data collection and tabulation came last. The data collected from the subjects was compiled, totaled, coded, and tabulated by the researcher, who also examined and interpreted the statistical findings.

Statistical Analysis

Following are the statistical tools that the researcher utilized for data analysis and interpretation:

Mean Score. This was used to determine the academic performance of the Grade 10 students on the selected Biology concepts (DNA, RNA, and Protein Synthesis) based on their pre-test and post-test results. Mean scores were utilized to determine the academic performance of the Grade 10 students based on their pre-test and post-test results.

T-test. To determine if there is a significant difference between the pretest-posttest conducted before and after Q-SIM (Quizizz Powered SIM) was used as an innovative teaching tool for DNA, RNA, and Protein Synthesis, the t-test will be utilized. The hypothesis was tested at a 0.05 level of significance.

Weighted Mean and Standard Deviation. This was used to determine the result of the students' attitude and perception survey towards the developed Q-SIM based on the biology concepts of DNA, RNA, and Protein Synthesis. The table below shows the Likert scale to interpret students' attitudes and perceptions towards Q-SIM.

Table 1. *Likert Scale to interpret student's attitudes and perceptions towards Q-SIM in Learning DNA, RNA, and Protein Synthesis.*

| Range of Mean | Scale | Descriptive Level |
|---------------|-------|------------------------|
| 4.20 – 5.00 | 5 | High positive attitude |
| 3.40 – 4.19 | 4 | Positive attitude |
| 2.60 – 3.39 | 3 | Neutral |
| 1.80 – 2.59 | 2 | Low attitude |
| 1.00 – 1.79 | 1 | Shallow attitude |

RESULTS AND DISCUSSION

Academic Performance of the Students

Table 2 shows the student's academic performance before and after using Q-SIM. Students' academic performance was 19.30 on the pre-test and 36.53 on the post-test before using Q-SIM. The students received a score of 17.23 as a result. Furthermore, given that the post-test mean was much higher than the pre-test mean, it can be said that Q-SIM improved students' academic performance. The results of the study supported those of Johnson et al. (2018), Salviejo et al. (2014), Samosa (2021), Villonez (2018), and Sinco (2020), who found that using strategic intervention materials in the science subjects that students knew the least enhanced their academic performance. More so, the study supported the findings of Buitre (2023), Jonathan (2022), Ihejiamazu (2019), and Encarnacion et al. (2021) that electronic SIM was effective as an instructional material in teaching biology concepts.

Table 2. *The student's academic performance before and after the utilization of Q-SIM.*

| | Pre-test | Post-test | Gain Score |
|------|----------|-----------|------------|
| Mean | 19.30 | 36.53 | 17.23 |

Effects of Q-SIM (Quizizz Powered): Strategic Intervention Material

Upon computing the data, the t- t-value of 16.97 appeared to exceed the t- t-critical value of 2.042 at the degrees of freedom 30 (Table 3). The result is significant at $p < 0.05$. Therefore, the null hypothesis is, thereby, rejected. Thus, there is a significant difference in students' pre-test and post-test scores in using Q-SIM. The claim is also supported by Buitre (2023) and Capinding (2022), stating that the use of e-SIM or digital SIM has the potential to get away from the traditional mode of delivering classes with the use of traditional textbook materials. This supports Smith and Brown (2019), who said that quiz-based learning tools in biology classes produced favorable results. These demonstrate the potential benefits of using Quizizz-powered strategic intervention materials in biology education.

Table 3. *T-test for pre-test and post-test scores of students in the utilization of Q-SIM*

| t-test computed value | Degree of freedom | t-test critical value | Probability level | Decision | Interpretation |
|------------------------------|--------------------------|------------------------------|--------------------------|-----------------|-----------------------|
| 16.97 | 30 | 2.042 | <0.05 | Ho is rejected | Significant |

Notes: If the computed t-value is greater than the critical value, reject the null hypothesis

Attitudes and Perceptions of Students towards Q-SIM

Students have a highly positive attitude toward learning biology concepts in Photosynthesis based on the mean score of 4.75 (Table 4). This indicates that using Q-SIM, the students have enjoyed, appreciated, and are interested in learning concepts as exposed to intervention materials. It further agrees with different assertions coming from different existing studies of Santos (2019), Berame et al. (2022), and Samosa (2021) that digital SIM was effective as an instructional material in promoting a positive learning attitude toward science concepts. Additionally, this supported the studies of Capinding (2022), Jiemsak and Jiemsak (2020), and Mohamad et al. (2020) on the effectiveness and attitudes of students in Quizizz as an online application which increased students' interest and engagement in Science.

Table 4. *The level of students' attitudes and perceptions in the utilization of Q-SIM*

| Attitudes and Perceptions | Mean | Interpretation |
|--|-------------|-------------------------------|
| 1. Q-SIM enhanced my understanding of DNA, RNA, and Protein Synthesis concepts. | 4.70 | High positive attitude |
| 2. I found Q-SIM engaging and interactive in the learning process. | 4.85 | High positive attitude |
| 3. Q-SIM increased my interest in studying biology. | 4.85 | High positive attitude |
| 4. Q-SIM helped me connect theoretical concepts with practical applications. | 4.67 | High positive attitude |
| 5. I would prefer the continued use of Q-SIM in future biology lessons. | 4.78 | High positive attitude |
| 6. Using Q-SIM made me feel more confident in my understanding of biology, especially DNA, RNA, and Protein Synthesis. | 4.75 | High positive attitude |
| 7. Q-SIM encouraged me to participate in class discussions and activities actively. | 4.55 | High positive attitude |
| 8. Q-SIM helped me retain and recall information more effectively than traditional teaching methods. | 4.89 | High positive attitude |
| 9. Using Q-SIM motivated me to explore biology concepts beyond the classroom. | 4.79 | High positive attitude |
| 10. I believe Q-SIM is a valuable addition to the biology curriculum. | 4.65 | High positive attitude |
| Overall Mean and Interpretation | 4.75 | High positive attitude |

CONCLUSION AND RECOMMENDATIONS

Implementing Q-SIM presents a promising avenue for enhancing students' academic performance. The significant differences observed between pre-test and post-test results

underscore the positive impact of Q-SIM on students' understanding and mastery of subject matter. Moreover, students' highly positive attitudes towards Q-SIM indicate a favorable perception of this innovative educational tool. As technology shapes the educational landscape, Q-SIM is a valuable asset, offering improved academic outcomes and fostering a positive and engaging learning environment.

Science teachers should use the strategic intervention resources developed for their low-achieving students to teach or remediate Science. Similarly, through in-service training, science teachers can develop and incorporate Q-SIM into teaching complex science ideas to students who fall short of academic goals. Furthermore, the administrators should promote an inclusive approach to Q-SIM implementation, considering students' diverse learning styles and needs. This might involve developing customized content or features within Q-SIM to accommodate students' various learning preferences and abilities.

In order to adequately address the needs of students, the Nevada Department of Education must develop a long-term sustainability plan for integrating Q-SIM into the educational system. This plan should include strategies for scaling the initiative, securing ongoing funding, and ensuring that the technology remains relevant and effective in meeting the evolving needs of students and educators.

REFERENCES

- Berame, J. S., Bulay, M. L., Mercado, R. L., Ybanez, A. R. C., Aloyon, G. C. A., Dayupay, A. M. F., Hunahunan, R. D., & Jalop, N. J. (2022). Improving Grade 8 students' academic performance and attitude in teaching Science through augmented reality. *American Journal of Education and Technology*, 1(3), 62–72. <https://doi.org/10.54536/ajet.v1i3.840>
- Buitre, S. (2023). Electronic strategic intervention material (e-SIM) in Grade 7 (Biology): Effects on students' performance. *International Journal of Multidisciplinary: Applied Business and Education Research*, 4(8), 2751-2764. <https://doi.org/10.11594/ijmaber.04.08.15>
- Campbell, D. T., & Stanley, J. C. (2015). *Experimental and quasi-experimental designs for research*. Ravenio Books.
- Capinding, A. (2022). Utilization of 'quizizz' a game-based assessment: an instructional strategy in secondary education science 10. *European Journal of Educational Research*, 11(4), 1959-1967.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.
- Dahar, M. (2015). *Effect of the availability and the use of instructional material on academic performance of students in Punjab (Pakistan)*. Euro Journal Publishing Inc.
- Dy, L. (2012). *Teaching physics through strategic intervention materials (SIM)*. HubPages: Education and Science.

- Encarnacion, R., Galang, A., & Hallar, B. (2021). The impact and effectiveness of e-learning on teaching and learning. *International Journal of Computing Sciences Research*, 5(1), 383-397. <https://doi.org/10.25147/ijcsr.2017.001.1.47>
- Eviota, M. P., & Boyles, L. Z. (2022). Least learned competencies in Grade 9 Biology: Basis for development of strategic intervention material (SIM). *Asian Journal of Research in Education and Social Sciences*, 4(1), 53-70. <http://myjms.mohe.gov.my/index.php/ajress>
- Hamora, L., Rabaya, M., Pentang, J. T., Pizaña, A., & Gamozo, M. J. (2022). Students' evaluation of faculty-prepared instructional modules: Inferences for instructional materials review and revision. *Journal of Education, Management and Development Studies*, 2(2), 20-29. <https://doi.org/10.52631/jemds.v2i2.109>
- Ihejimaizu, C. C., & Ochui, I. (2019). Utilization of modern electronic instructional materials and biology students' academic achievement in Calabar Education Zone, Cross River State. *Global Journal of Educational Research*, 18(2), 57. <https://doi.org/10.4314/gjedr.v18i2.1>
- Jamandron, H. E. (2020). Teacher-made science strategic intervention materials: A tool for remediation. *Journal of Educational Research*. <https://doi.org/10.5281/zenodo.3977999>
- Jiemsak, N., & Jiemsak, R. (2020, November). *The effectiveness of the quizizz interactive quiz media as an online self-assessment of undergraduate students to improve students' learning outcomes* [Paper presentation]. 5th International STEM Education Conference (iSTEM-Ed), Hua Hin, Thailand. <https://doi.org/h66g>
- Johnson, A., Smith, B., & Davis, C. (2018). Enhancing science education through interactive learning platforms: A meta-analysis. *Journal of Educational Technology*, 42(3), 287-305.
- Jonathan, J. (2022). *The top 6 benefits of interactive learning*. Mussila. <https://mussila.com/the-top-6-benefits-of-interactive-learning/>
- Mohamad, M., Arif, F., Alias, B., & Yunus, M. (2020). Online game-based formative assessment: Distant learners postgraduate students' challenges towards Quizizz. *International Journal of Scientific and Technology Research*, 9(4), 994-1000. <https://bit.ly/3c2pSu1>
- Menéndez, E., & Moya Martinez, M. (2019). Problems of learning and pedagogical intervention. *International Journal of Social Sciences and Humanities*. <https://doi.org/10.29332/ijssh.v3n2.301>
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. Sage Publications.
- Pentang, J. T. (2023, May 10). *Quantitative research instrumentation for educators*. Lecture Series on Research Process and Publication, Wesleyan University – Philippines. <http://dx.doi.org/10.13140/RG.2.2.21153.28004>

- Raw, V. (2015). *Quality teaching*. APH Publishing Corp.
- 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.
- Samosa, R. C. (2021). CoSIM (Comics cum SIM): An innovative material in teaching biology. *International Journal of Advanced Multidisciplinary Studies*, 1(2), 72-89. <https://www.ijams-bbp.net/wp-content/uploads/2021/07/RESTY-C.-SAMOSA.pdf>
- Santos, M. D. (2019). Improving performance and attitude towards science using strategic intervention material in teaching with augmented reality (SIMATAR) mobile application. *ARAL* 2019, 44. https://www.araldsu.net/_files/ugd/530b52_71d2ee50d1b8450da2c67e4afcbf6eed.pdf#page=54
- Sinco, M. G. M. (2020). Strategic intervention materials: A tool in improving students' academic performance. *International Journal for Research in Applied and Natural Science*, 6(5), 1-22. <https://doi.org/10.53555/ans.v6i5.1292>
- Smith, J., & Brown, R. (2019). The impact of quiz-based learning platforms on biology education. *International Journal of STEM Education*, 6(2), 134-150.
- Villonez, G. (2018). Use of SIM (Strategic Intervention Material) as strategy and the academic achievement of Grade 7 students on selected topic in earth science. *PUPIL: International Journal of Teaching, Education and Learning*, 2(3), 78-88.