Anatolian Journal of Education
e-ISSN: 2547-9652

April 2024 ● Vol.9, No.1
www.e-aje.net
pp. 145-156

Exploring Student Academic Performance and Motivation in Physics Through Electronic-Strategic Intervention Material (e-SIM)

Ernesto Manlapig Jr
De La Salle University, Philippines, *ernesto_manlapigjr@dlsu.edu.ph*

Eunice Bernadette Acuña
De La Salle University, Philippines, *eunice_acuna@dlsu.edu.ph*

Aivielle Mae Manuel
De La Salle University, Philippines, *aivielle_manuel@dlsu.edu.ph*

Strategic Intervention Material (SIM) is an instructional learner material developed to enhance the academic performance of low-performing students. This study aimed to develop e-SIM and investigate its effect on the student's academic performance and learning motivation in Newton's Laws of Motion. The participants were 40 students from Grade 12 ABM and HUMSS strands drawn from a private school in Valenzuela City, Philippines. A quasi-experimental design was utilized in this study using a one-group pre-test and post-test design since the study aims to measure the cause-and-effect of using e-SIM in learning physics. The quantitative data of this research was obtained through a motivational scale, concept test (pre-test and post-test), and e-SIM. The data was analyzed by average mean, p-value, and Wilcoxon Signed Ranks Test. According to the analysis result, there is a significant difference between the academic performance and learning motivation of the students using e-SIM. The use of e-SIM in enhancing academic performance and learning motivation in Newton's second law of motion is recommended.

Keywords: strategic intervention material, academic performance, learning motivation, physics, Newton's laws of motion, and low-performing students

INTRODUCTION

Classical mechanics is an essential branch of physics for high school students, considering that most topics in physics subjects are taught in the secondary level compromises of classical mechanics. Classical mechanics involves examining the motion of objects when subjected to the influence of natural forces (Idema, 2020). Newton's Laws of Motion is one of the most fundamental concepts in classical mechanics. Since ancient Greece, scientists have studied motion in the context of physics; Newton provides a more thorough explanation. Newton's laws of motion were applicable to any situation involving the concepts of force and motion (Erfan & Ratu, 2018). The concepts of Newton's laws of motion require students to use problem-solving skills to understand these laws more deeply.

Problem-solving is regarded to be an essential component of physics teaching and learning (Bajracharya et al., 2016; Docktor et al., 2015). However, the students perceive physics to be difficult because of its association with problem-solving, formulas, and calculations. The students reported having trouble carrying out computations, solving problems, and building the meanings of ideas in physics (Erinosho, 2013). In addition, most students enrolled in physics subjects experience difficulty in solving problems in physics class (Sartika, 2018).

Citation: Manlapig Jr, E., Acuña, E. B., & Manuel, A. M. (2024). Exploring student academic performance and motivation in physics through electronic-strategic intervention material (e-SIM). *Anatolian Journal of Education*, 9(1), 145-156. https://doi.org/10.29333/aje.2024.9110a

It can be argued that students' problem-solving difficulties can affect their performance and learning motivation in physics. The result shows that students' proficiency in solving physics problems affects their achievement and motivation in physics (Abubakar & Danjuma, 2012; Docktor et al., 2015). An intervention to improve and strengthen the problem-solving skills of the students must be identified as soon as possible for them to have a meaningful experience in physics class. Identifying an intervention to improve their problem-solving skills will help them perform well in physics class.

Literature Review

Digitization in Education

Digitization has spread throughout every aspect of the 21st century and is now a part of our quick and practical daily needs. There is no exception in education, which necessitates technology as a tool that may maximize the process' simplification and assistance. Mobile learning is the most viable option now for encouraging and aiding language learners on the go (Chachil, 2015).

Anticipating a decline in student interest in learning, attributed to the allure of smartphones over books, can be addressed by creating educational content designed for smartphones. Specifically, we have opted for compatibility with Android operating systems, as it enjoys widespread usage compared to other operating systems. The advantage of employing smartphone-based instructional materials lies in their user-friendly nature, allowing students to use them independently. Furthermore, their portability enables convenient access to learning resources anytime and anywhere (Hediansah & Surjono, 2019).

According to the study conducted by Liliarti & Kuswanto (2018), the developed learning media, in the form of an Android application, improved students' understanding of Newton's laws of motion. The learning media was designed to enhance the diagrammatic and argumentative representation ability, and the material's content relates to Newton's laws of motion. Field testing was conducted to determine the feasibility of the learning media, and the increase in the diagrammatic and argumentative representation competence could be seen from the differences in scores before and after the learning process.

Strategic Intervention Material

During the COVID-19 pandemic, the development and implementation of effective instructional materials play a pivotal role in enhancing students' learning experiences. Among these materials, Strategic Intervention Materials (SIMs) have emerged as a significant pedagogical tool aimed at facilitating meaningful learning and addressing the diverse educational needs of learners. These SIMs are provided to students to assist them in acquiring a competency-based skill that they could not develop through regular classroom instruction (Dacumos, 2016). These resources are designed strategically, integrating various instructional strategies and content to empower educators and students.

In the context of the Philippine curriculum, the Department of Education mostly employs strategic intervention material to enhance students' academic performance in a particular topic (Dizon, 2021). According to DepEd Memo No. 117, "Training Workshop on Secondary teachers were trained in the creation of Strategic Intervention Materials (SIMs)-Based Instruction (BI) for Successful Learning as part of increasing and creating intervention materials as a strategy for remediating low student performance at school. Instructional media are employed as tools to facilitate the learning process. Reading-writing media, Speaking-listening media, and Computer-Based Teaching were all covered in the training workshop" (Aranes, 2018).

Integration of Digitization and Strategic Intervention Material

The integration of e-SIMs into the teaching of Newton's laws of motion is vital in the context of education's ongoing digitization, aligning with the evolving digital landscape. This offers an engaging approach to teaching complex scientific concepts and equips students with essential digital literacy and problem-solving skills, which are increasingly demanded in the 21st century. In the study conducted by Osborne & Hennessy (2003), as cited in Lee et al. (2011), utilizing ICT in science classrooms is advantageous for students. It enhances their critical thinking abilities, improves their data handling and collection proficiency, and increases their accessibility to visually presented knowledge. Additionally, it heightens motivation and engagement among students. This finding is consistent with the research conducted by Kareem (2015).

The rapid digital transition that is reshaping many aspects of modern life, including education, highlights the necessity of this research. Digital tools and technology are now essential in the twenty-first century since they provide creative ways to improve learning processes and make them simpler (Brown & Green, 2016). The expectations and learning choices of learners have changed in this digital era (Prensky, 2001). Although effective in the past, traditional teaching methods increasingly struggle to engage and motivate learners. However, the attraction of smartphones and other digital gadgets over traditional instructional resources presents a significant barrier to keeping learners interested in studying (Katz & Macklin, 2007). It is crucial to provide educational content that is in line with today's learners' digital preferences to solve this issue and ensure that education stays engaging and relevant (Johnson et al., 2015). In order to meet learners' expectations for on-the-go learning, mobile learning - especially on Android platforms - emerges as a viable option (O'Bannon & Thomas, 2014). Due to their user-friendliness, e-SIMs stand out as promising tools in this context, giving learners convenient and independent access to learning resources whenever and wherever they want (Keengwe, 2015).

The significance of this research is closely related to how rapidly education is becoming digital. Education must change to take advantage of technology's ability to improve learning possibilities as society embraces the digital age (Bates & Sangrà, 2011). The importance of this research is directly tied to how quickly education is becoming digital and integrating of e-SIMs (Interactive Educational Simulations) into physics classrooms is a ground-breaking approach tackling several important challenges.

E-SIMs, as emphasized by Clark & Mayer (2016), provide an entertaining method for teaching challenging scientific ideas like Newton's laws of motion, boosting comprehension and recall. In addition, Binkley et al. (2012) highlight their significance in building problem-solving abilities and computer literacy - qualities that are essential in today's labor market - along with facilitating a deeper comprehension of physics ideas. According to Hwang & Wu (2014), e-SIMs support educational inclusion and close the achievement gap by providing access to excellent learning resources for students from a variety of backgrounds. Additionally, Liu et al. (2019) emphasize how flexible E-SIMs are, accommodating different learning styles and tempos and giving students choice in how they interact with the subject matter.

In light of these compelling factors, this study explores how e-SIMs affect learners' academic performance and motivation concerning to Newton's equations of motion (Clark & Mayer, 2016; Binkley et al., 2012; Hwang & Wu, 2014; Liu et al., 2019). The results are predicted to shed light on the effectiveness of e-SIMs in improving physics education - a crucial field of research with significant ramifications for educators and learners in the digital age. We examine the effects of E-SIMs while also attempting to address the difficulties of problem-solving abilities and offer a forward-thinking solution in a time of technology development and changing educational dynamics (Binkley et al., 2012). This research makes a more inclusive, efficient, and technologically advanced educational environment possible (Hwang & Wu, 2014).

Recent studies reveal the efficiency of enhancing the academic performance using e-Module and SIM in science classes. Based on the existing studies, the implementation of SIM can enhance the academic performance of students in Biology (Sinco, 2020), Chemistry (Salviejo et al., 2014), and Physics (De Jesus, 2019). However, limited studies have been conducted on the effectiveness of e-SIM in the student's academic performance and learning motivation in Newton's second law of motion. Also, minimal studies have been conducted to assess the effectiveness of SIM in the learning motivation of students in physics class.

This research study aims to determine the effect of strategic intervention material (SIM) on the students' academic performance and learning motivation in Newton's laws of motion. Specifically, this study seeks to answer the following objectives:

1. What is the academic performance of the learners in Newton's Second Law of Motion before and after utilizing the Electronic Strategic Intervention Material?
2. What is the level of motivation of the learners towards physics before utilizing the Electronic Strategic Intervention Material?
3. Is there a significant difference in the academic performance of the learners before and after utilizing the Electronic Strategic Intervention Material?
4. Is there a significant difference between the level of motivation of the learners before and after utilizing the Electronic Strategic Intervention Material?

METHOD

Research Participants

The student participants of the study consisted of 40 Grade 12 students from ABM and HUMSS strands. In most conventional educational research investigations, it is necessary to have a sample size of at least 30, and ideally more, to employ more powerful statistical tests and draw valid inferences (Mertler & Charles, 2011). The group of participants who received the intervention was selected in a non-random way - which makes it a quasi-experimental design. These students are currently enrolled in the first semester of the academic year 2022-2023 in a private school in Valenzuela City, Philippines.

Research Design

The descriptive-experimental design was used by the researchers. Since one group of students completed remediation utilizing the e-SIM, a quasi-experimental was employed in this study since the researchers attempted to utilize a cause-and-effect of using e-SIM in assessing the academic performance and learning motivation of the students in physics other than randomization. The academic performance of the students was measured using their scores in a concept test about Newton’s second law of motion before and after the intervention.

Moreover, their learning motivation was measured using their scores in the Motivation Scale Questionnaire which was developed by Ence et al. (2020). In addition, a pre-test -post-test design was employed in this study. A pre-test - post-test design is often employed in one-group experiments where participants are monitored before and after the experiment is implemented (Kowalczyk, 2016). To evaluate the effectiveness of the intervention, the pre-test and post-test were administered and compared. The students' perceived effect of the e-SIM was analyzed using a descriptive survey.

Research Instruments

In order to carry out this study, the researchers used the following instruments and tools in conducting this study: The students' Pre-test and Post-test in Newton's Second Law of Motion, Newton's Second Law of Motion Electronic-Strategic Intervention Material, and Motivation Scale for Physics Learning developed by Ence et al. (2020).

The Student's Pre-test and Post-test in Newton's Second Law of Motion is a multiple-choice test consisting of 15-item questions to measure the student's level of mastery in terms of concepts, relationships, and problem-solving.

This study introduced and tested the "Newton's Second Law of Acceleration" e-SIM intervention material. It contains the following crucial elements: Guide Card, Activity Card, Assessment Card, Enrichment Card, and Reference Card. A Guide Card presents the lesson's overview and key concepts; an Activity Card where students put their knowledge into practice; Assessment Card helps the learner master the skill after completion; Enrichment Card that extends learning with additional exercises; and a Reference Card that offers additional information or resources for further readings.

Strategic Intervention Material, or SIM, is a teaching tool used in classroom instruction to encourage student engagement and hence, enhance knowledge levels (Dy, 2018). It was purposefully developed to give students who perform poorly on the topic remedial education. It is provided to students who struggle to comprehend the subject matter concepts throughout their time in the traditional classroom setting (Chod, 2021). The structure of e-SIM is shown in the following figures.

Figure 1
Guide Cards & Activity Cards

Figure 2
Assessment Cards, Enrichment, & Reference Cards

The reliability coefficient for the student's pre- and post-tests on Newton's second law of motion was examined by the physics teacher and it is satisfactory. The Motivation Scale for Learning Physics survey (PhysPort Assessments: Motivation Scale Towards Physics Learning) is a 22-item survey that seeks to ascertain the levels of pre-service undergraduate science teachers' motivation for physics learning using the e-SIM. Each statement is rated using a five-choice rating scale, where 1 means strongly disagree, 2 means disagree, 3 means undecided, 4 means agree, and 5 means strongly agree.

Research Procedure

Pre-test administration was the initial phase of the study. Before the intervention materials, it was handed to the learners. The 30-minute test with 15 questions was administered to 40 grade 12 STEM student responses and covered Newton's Second Law of Motion.

After the pretest, the student participants received the e-SIM during their Physical Science classes. At the end of the class, the students give the researcher a report for monitoring. During the monitoring, the e-SIM responses were examined to assess the student's progress. For as long as they need to, students who could not respond to the e-SIM exercises must read and study the same material.

The administration of Newton's Second Law of Motion Post-Test and the Motivation Scale towards Physics Learning survey (Ence et al., 2020) to the learners came next. A focus group discussion was held to validate the survey participants' responses and get feedback on the e-SIM. The study's last stages included data verification, encoding, and analysis. Also, random students were interviewed regarding their honest opinions on using the e-SIM in their physics class.

FINDINGS

Based on the results obtained by the researchers, the following data were interpreted:

Students' Academic Performance Before and After Intervention

Table 1 shows that the minimum and maximum score of the pretest was 14 and 15, respectively, with a standard deviation of 1.92. Meanwhile, for the post-test, the minimum and maximum scores were 10 and 15, with a standard deviation of 1.27. Therefore, there was a variation between these results. The mean score increased from 9.73 to 14.08, around 44.71% improvement.

Table 1
Pre-test and post-test results

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test score	40	3	14	9.73	1.92
Post-test score	40	10	15	14.08	1.27
Valid N (listwise)	40				

The remarkable improvement from the pre-test to the post-test results from students participating in simple yet meaningful learning activities. The studies of Sinco (2020), Villonez (2018), Marimla & Dimalanta (2015), Dy (2015), Plenos (2015), Barredo (2014), Salviejo et al. (2014), and Gultiano (2012), which all concluded that the use of SIM improves students' performance in science subjects. The SIM is effective at helping students achieve competency-based science skills while demonstrating effective learning transfer, according to Plenos (2015), Barredo (2014), and Gultiano (2012).

Students' Learning Motivation Before and After Intervention

Table 2
Descriptive statistics of students' learning motivation before and after ıntervention

Sub-factors	N	Pre-intervention		Post-intervention	
		Mean	Std. Deviation	Mean	Std. Deviation
Self-efficacy	40	3.28	0.42	3.71	0.38
Appreciation reward	40	4.05	0.62	4.23	0.39
Value of learning physics	40	3.80	0.68	4.00	0.44
Overall	40	3.55	0.43	3.88	0.32

Table 2 shows the students' learning motivation before and after the intervention. The mean of self-efficacy of the students increased from 3.28 to 3.71, respectively, around 13.12%, which is the highest improvement among the three sub-factors. In addition, it can also be gleaned from the table the minimal increase in the mean of appreciation reward increased from 4.05 to 4.23, respectively, with 4.44% increase. The mean value of learning physics also increased from 3.80 to 4.00, respectively, with 5.26% development.

Difference in the Academic Performance of the Learners Before and After Utilizing the Electronic Strategic Intervention Material

Table 3
Data normality test of pretest and posttest results

	Shapiro-Wilk		
	Statistic	df	Sig
Pre-test score	0.92	40	0.01
Post-test score	0.72	40	0.00

Based on Table 3, the results of the normality test show that the significance $p<0.05$, it can be concluded that the data is not normally distributed. Hence, the test uses the non-parametric difference test – the Wilcoxon Signed Rank Test. The results of the Wilcoxon Test are presented in Table 4.

Table 4 shows the results of the Wilcoxon Test, $Z=-5.46$ with a significance $p<0.05$ indicates that the electronic strategic intervention material that the learners effectively increase the academic performance of the students.

Table 4
Wilcoxon test results on academic performance

Test statistics[a]	Pretest score-Post test score
Z	-5.46[b]
Asymp. Sig. (2-tailed)	0.00

Note. a. Wilcoxon Signed Ranks Test
b. based on negative ranks

This result is similar to the finding of Togonon (2011), who stressed that students exposed to SIMs perform better on the post-test than on the pretest. The results of the study were also in line with the findings of Dy (2011) that strategic intervention materials are highly regarded as tools for remediating poor achievements of the learners. Bunagan (2012) also supported these findings, which defined SIM as meant to re-teach the concepts and skills. It is material given to students to help them master competency-based skills that they could not develop during classroom teaching.

Difference in the Level of Motivation of the Learners Before and After Utilizing the Electronic Strategic Intervention Material

Based on Table 5, the Wilcoxon test, in the overall result, Z=-4.00, with the significance p=0.00<0.05; therefore, the electronic strategic intervention material is effective in increasing the level of motivation of the learners toward physics. We can also glean from the table that the self-efficacy Z=-4.41.

p<0.05, the electronic strategic intervention material is also effective in increasing the level of self-efficacy of the students. However, the e-SIM is not effective in increasing the appreciation reward and values of the learners with Z=-1.72 p>0.05 and Z=-9.80 p>.05, respectively.

Table 5
Wilcoxon test results on level of motivation

Test statistics[a]	Self-efficacy B-Self-efficacy A	Appreciation reward B-Appreciation reward A	Values B-Values A	Overall B-Overall A
Z	-4.41[b]	-1.72[b]	-0.98[b]	-4.4[b]
Asymp. Sig. (2-tailed)	0.00	0.09	0.33	0.00

Note. a. Wilcoxon Signed Ranks Test
b. based on negative ranks

Motivation is a driving force of learning; it directs behavior toward distinctive learning targets which the learner strives for (Ormrod, 2014). When students become motivated, they believe they can be effective in accomplishing desired learning goals and they attribute their learning results under their control and with the effort they expended. The students were motivated in using the SIMs and encouraged them to learn more concepts in science. In an open-ended interview, the students mentioned that they enjoyed using SIMs because it is easy to comprehend, it is visually appealing, and the activities are thrilling. When the student like the material there will most likely be an increase in their efforts and determination to learn more, and they become motivated (Sinco,2020).

CONCLUSION, DISCUSSION AND SUGGESTIONS

The implementation of e-SIM as an instructional material has been carried out efficiently. It has led to the following conclusions: First, the implementation of e-SIM in teaching Newton's second law of motion resulted in a positive effect and enhanced students' academic performance. It can be observed from the data that the scores have improved and increased from the pretest to the post-test after the implementation of e-SIM. Second, the implementation of e-SIM in teaching Newton's second law of motion can improve the learning motivation of students. However, values and appreciation awards have only a moderate effect on students' learning motivation. Lastly, it can be concluded that the implementation of e-SIM can help improve the academic performance and learning motivation of the students in Newton's second law of motion. This can be attributed to the experiences of the students with the interactivity and creativity of e-SIM after the use of it. Physics concepts are mostly associated with mathematics, and the content e-SIM provided them eased their anxiety about solving physics problems.

One of the key findings of this study is the positive effect of e-SIM on student academic performance and learning motivation in physics. The data reveals a statistically significant improvement in the post-test of the students compared to their pre-test scores. This result is similar to the study conducted by Aranda et al. (2019), which showed a positive correlation between utilizing SIM in science class and the post-test results of the experimental group. In addition, based on the study conducted by Suarez et al. (2020), their findings revealed that integrating SIM is effective in increasing students' academic performance in science. Also, a similar finding was revealed in the study of Herrera &

Soriano (2016), which showed an increase in the academic performance of the students in learning physics.

Moreover, the results of this study showed a notable enhancement in the learning motivation of the participants after implementing e-SIM in learning physics. This result complements the study conducted by Salviejo et al. (2014), which showed that implementing SIM in learning chemistry improved the engagement and motivation of the students.

Considering the positive effect of integrating e-SIM in Newton's laws of motion on academic performance and motivation of the students, it is essential to address the limitations of this study and further explore the effectiveness of integrating e-SIM in learning physics. Teachers should consider using e-SIM in teaching other topics in Physics. In addition, it is highly encouraged to conduct similar studies in other science disciplines to assess the effect of e-SIM in the inter-multidisciplinary field of sciences. The findings presented in this study are constrained due to the small sample size. Future research with a larger and more diverse group of students can provide more robust insights in conducting the effect of e-SIM on students' academic performance and motivation in learning physics. Also, future studies might incorporate a control group and experimental group to compare directly between students using e-SIM and students using conventional ways of teaching. Future researchers could utilize e-SIM in a long-term implementation to provide significant data on the effectiveness of e-SIM in learning physics. Lastly, future research might consider employing qualitative research methods that involve interviews or focus groups to gain deeper insights into students' perceptions, experiences, and motivations regarding e-SIM.

REFERENCES

Abubakar, S. M., & Danjuma, I. M. (2012). Effects Of Explicit Problem-Solving Strategy On Students` Achievement And Retention In Senior Secondary School Physics. ATBU *Journal of Science, Technology and Education*, 1(1), 123–128.

Aranda, Y. A., Diaz, R. A., Sombilon, M., & Gicana, C. F. (2019). Integrating strategic intervention materials (SIM) in Science to low achieving learners. *Journal of Science Teachers and Educators*, II (1), 1-9.

Bajracharya, R. R., & Thompson, J. R. (2016). Analytical derivation: An epistemic game for solving mathematically based Physics problems. *Physical Review Physics Education Research*, 12(1).https://doi.org/10.1103/physrevphyseducres.12.010124

Barredo, K. J. (2014). Evaluating the Effectiveness of Using Strategic Intervention Material in Improving the Academic Performance in Science. SlideShare. http://www.slideshare.net/kbarredo/action-research-for-strategic-interventionmaterials

Bates, A. W., & Sangrà, A. (2011). Managing Technology in Higher Education: Strategies for Transforming Teaching and Learning. Jossey-Bass.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining twenty-first century skills. In Assessment and Teaching of 21st Century Skills (pp. 17-66). Springer.

Brown, T. H., & Green, T. D. (2016). The essentials of instructional design: Connecting fundamental principles with process and practice (3rd ed.). Pearson.

Chachil, K., Engkamat, A., & Sarkawi, A. (2015). Interactive Multimedia-based mobile application for learning Iban language. Procedia - Social and Behavioral Sciences, 167, 267-273.

Clark, R. C., & Mayer, R. E. (2016). E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning. Wiley.

Cordova, R.C., Medina, G. J. D., Ramos, T.R., and Alejo, A.R (2019). Effectiveness of competency based strategic intervention materials in English 7. *DLSU Research Congress 2019*.https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2019/lli-II-019.pdf

De Jesus, R. (2020). Improving the Least Mastered Competencies in Science 9 Using "Pump It Up!" Electronic Strategic Intervention Material. *DLSU Research Congress 2019* https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2019/lli-II-011.pdf

Dizon, N. H., De Guzman, M. F. D., Uy, L. F., & Ganaden, A. R. (2021). "Education Concerns in Public Secondary Schools of Division of Zambales, Philippines: An Education Response to COVID 19 Pandemic of 2020", *EAS Journal of Humanities and Cultural Studies*- Volume-3 | Issue-2| April-March 2021

Docktor, J. L., Strand, N. E., Mestre, J. P., & Ross, B. H. (2015). Conceptual problem solving in high school physics. *Physical Review Special Topics - Physics Education Research, 11(2).* https://doi.org/10.1103/physrevstper.11.020106

Dy L. (2011). Teaching mathematics through Strategic Intervention Materials (SIM).Retrieved from http://jhody.hubpages.coom/hub/

Dy, J. O. (2018). Strategic Intervention Materials (SIM) in Teaching Science IV (Physics)

Ence, E., Çağap, H., & Deneri, Y. (2020). Development and validation of motivation scale towards Physics learning. *International Journal of Physics and Chemistry Education, 12(4),* 61–74. https://doi.org/10.51724/ijpce.v12i4.129

Erfan, M., & Ratu, T. (2018). Analysis of Student Difficulties in Understanding The Concept of Newton's Law of Motion. *JIPF (Jurnal Ilmu Pendidikan Fisika), 3(1),* 1. https://doi.org/10.26737/jipf.v3i1.161

Erinosho, S. Y. (2013). How do students perceive the difficulty of physics in secondary school? An exploratory study in Nigeria. *International Journal for Cross-Disciplinary Subjects in Education*, 3(Special 3), 1510–1515. https://doi.org/10.20533/ijcdse.2042.6364.2013.0212

Espinosa, A. A. (2014). Strategic Intervention Material-Based Instruction, Learning Approach and Studentsâ€TM Performance in Chemistry.|

Gultiano, A. (2012). Effects of strategic intervention material (SIM) on the academicachievements in Chemistry of public high school students. Retrieved fromhttp://www.slideshare.net/neoyen/strategic-intervention-material.

Hediansah, D., & Surjono, H. D. (2019). Building Motivation and Improving Learning Outcomes with Android-based physics books: Education 4.0. *Anatolian Journal of Education, 4(2),* 1-10. https://doi.org/10.29333/aje.2019.421a

Herrera, F. T., & Soriano, A. T. (2016). The Efficacy of the Strategic Intervention Materials (SIM) to the Achievement in Physics of a Selected Group of Public School Students in Las Nieves, Agusan del Norte. *Annals of Studies in Science and Humanities, 2(2),* 22-33.

Hwang, G. J., & Wu, P. H. (2014). Applications, impacts and trends of mobile technology-enhanced learning: A review of 2008-2012 publications in selected SSCI journals. *International Journal of Mobile Learning and Organisation, 8(2),* 83-95.

Idema, T. (2020). 1: Introduction to classical mechanics. *Physics LibreTexts*. https://phys.libretexts.org/Bookshelves/University_Physics/Book%3A_Mechanics_and_Relativity_(Idema)/01%3A_Introduction_to_Classical_Mechanics

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., & Hall, C. (2015). NMC Horizon Report: 2015 Higher Education Edition. The New Media Consortium.

Kareem A. A., (2015). Effects of Computer-Assisted Instruction on Students' Academic Achievement and Attitude in Biology in Osun State, Nigeria

Katz, I. R., & Macklin, A. S. (2007). Information and Communication Technology (ICT) Literacy: Integration and Assessment in Higher Education. Educause Quarterly, 30(2), 24-31.

Keengwe, J. (2015). Mobile technologies in educational organizations. IGI Global. Learning, Teaching and Educational Research.https://www.ijlter.org/index.php/ijlter/article/view/10

Kowalczyk, D. (2016). Research methodologies: Quantitative, qualitative, and mixed methods [video file]. Retrieved from http://study.com/academy/lesson/research-methodologies-quantitative-qualitative-mixed-method.html

Lee, S. W.-Y., Tsai, C.-C., Wu, Y.-T., Tsai, M.-J., Liu, T.-C., Hwang, F.-K., et al. (2011). Internet-based science learning: a review of journal publications. *International Journal of Science Education*, 33(14), 1893e1925.

Liliarti, N., & Kuswanto, H. (2018) Improving the Competence of Diagrammatic and Argumentative Representation in Physics through Android-based Mobile Learning Application. *International Journal of Instruction*, 11(3), 106-122. https://doi.org/10.12973/iji.2018.1138a

Marimla, A.S., & Dimalanta, O.G. (2015). Development and evaluation of strategic intervention material in Science V. *Research Journal of Social Sciences, 8(12),* 1-6

Mertler, C. A., & Charles, C. M. (2011). Introduction to educational research (7th ed.). Boston: Sage.

O'Bannon, B., & Thomas, K. (2014). Mobile phones in education: The case of language learning via texting. *The Journal of Interactive Learning Research, 25(2),* 243-261.

Osborne, J., & Hennessy, S. (2003). Literature review in science education and the role of ICT: Promises, problems and future directions. Report 6..Retrieved on: http://hal.archives-ouvertes.fr/docs/00/19/04/41/PDF/ osborne-j-2003-r6.pdf.

Plenos, J. (2015). Effectiveness Of The Teacher-Made Science Strategic Intervention Material In Increasing The Performance Level Of Grade Six Pupils Of Bacongco Elementary School In The Specified Competency, p. 6

Prensky, M. (2001). Digital natives, digital immigrants. On the Horizon, 9(5), 1-6.

Sadsad, M. P. (2022). Utilizing the competency-based strategic intervention materials as tool to assess performance of students in grade 9 Physical Education. *International Journal of advanced multidisciplinary studies Volume II, Issue 7* July 2022, eISSN: 2799-0664. https://www.ijams-bbp.net/wp-content/uploads/2022/08/IJAMS-JULY-ISSUE-76-107.pdf

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.

Sartika, D., & Humairah, N. A. (2018). Analyzing Students' Problem Solving Difficulties on Modern Physics. *Journal of Physics: Conference Series,* 1028, 012205. https://doi.org/10.1088/1742-6596/1028/1/012205

Sinco, M. G. (2020). Strategic Intervention Materials: A Tool in Improving Students' Academic Performance. Zenodo. *International Journal For Research In Applied And Natural Science.* https://zenodo.org/record/3870630

Suarez, M., & Casinillo, L. (2020). Effect of strategic intervention material (SIM) on academic performance: evidence from students of science VI. *Review of Socio-Economic Research and Development Studies,* 4(1), 20-32.

Togonon, I. (2011). Development and evaluation of project–based SIM (PB–SIM) in teaching high school chemistry. Technological University of the Philippines.

Villonez, G. L. (2018). Use of SIM (Strategic Intervention Materials) 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.