[1]Jojimar S.J. Julian

[2]Carl Adam Estacio

[3]Adrian Oquendo

[4]Justine Renniel Bogate

[5]Wendyll Listones

Flow with Mechanics: A 7E Instructional Material in General Physics 1

Abstract: - The COVID-19 pandemic has changed the world and has had a profound effect on education. Under the new normal, the learning environment drastically changed, and it affected the students' understanding of various school lessons. The researchers developed Flow with Mechanics: A 7E Instructional Material in General Physics 1 to help the learners in coping up with the lessons in this school setup. In developing Flow with Mechanics, the researchers used the ADDIE model. The instructional material is interactive and was based on the 7E Learning Cycle to improve students' critical thinking skills in learning Fluid Mechanics. It was validated by the experts, and then implemented on Grade 12 Science, Technology, Engineering, and Mathematics students at Cardona Senior High School. It revealed that Flow with Mechanics: A 7E Instructional Material in General Physics 1 is worth developing and is effective for use as per the result of the analyses.

Keywords: 7E Learning Cycle, Education, Fluid Mechanics, Physics

I. INTRODUCTION

The COVID-19 pandemic has changed the world. Due to the nature of the virus, particularly how it is transmitted, it has altered human behaviors, relations, and lifestyles, and had profound impacts on the economic, political, and cultural landscapes of societies across the world.

The educational system is firmly affected by the pandemic. The learning environment under the new normal will be very different. The landscape of child protection and child rights will now encompass not only the physical school but more extensively, The cyber world and the home as a "school".

According to DepEd, the streamlining of the K–12 Curriculum into the Most Essential Learning Competencies (MELCs) and the use of multiple learning delivery modalities such as distance learning and blended learning, either on top of or in place of face-to-face learning, are key elements of the learning strategies that will operationalize the Basic Education Learning Continuity Plan (BE-LCP).

The Basic Education Learning Continuity Plan (BE-LCP) lays up the basic education course for the coming school year. Specifics for implementation will be enshrined in relevant guidelines, rules, or directives, and operationalized through programs, projects, and activities.

As stated in the study, "Why Do I Slog Through the Physics?" Understanding High School Students' Difficulties in Learning Physics", conducted by Ekici (2016), students cite the physics course's content as the primary reason for its perceived difficulty. Specifically, students believe the physics course to be challenging, regardless of whether they are successful or not.

According to Suarez, Kahan, Zavala, and Marti (2017) in their research entitled "Students' conceptual difficulties in hydrodynamics" states that according to physics education studies, the conceptual challenges involved with

[1] Faculty of the College of Education, University of Rizal System, Morong, Province of Rizal Philippines, jojimar.julian@urs.edu.ph,

[2]Faculty of Child Jesus of Prague School, Binangonan, Province of Rizal Philippines, carladamestacio@gmail.com

[3]Faculty of St. Martin Montessori School Inc., Angono, Province of Rizal Philippines,]oquendo121401@gmail.com

[4]Faculty of Raises Montessori Academe, Binangonan Province of Rizal Philippines, justinerenniel@gmail.com

[5]Faculty of Southridge Private Highschool, Antipolo City, Province of Rizal Philippines, [dyll.liel@gmail.com

understanding fluid phenomena have received somewhat unequal attention. Students' grasp of ideal fluid hydrodynamics, on the other hand, has gotten little attention.

A research article entitled “Development and Validation of Physical Science Workbook for Senior High School” by Rogayan Jr., and Dollete, aimed to develop relevant, research-based, and responsive instructional materials in response to the challenges of the K-12 curriculum. The developed workbook was found to be very much acceptable as validated by the experts.

Based on the findings of the study of Asrizal, Amran, Ananda, Festiyed, & Khairani (2018), the use of integrated science instructional material on pressure in daily life by integrating digital age literacy is effective in a scientific approach to improve knowledge competence, attitudes competence, and digital age literacy skills on grade VIII students at a 95% confidence level, according to the findings.

Presidential Decree No.6-A, Section 5 states that “One of the educational objectives is to design, utilize, improve instructional technology and develop or produce textbooks and other instructional material leading to quality education”.

However, with the unprecedented events brought about by the COVID-19 pandemic, schools forcefully closed their operation in March 2020 to contain its spread which may affect the welfare of learners, teachers, and educational stakeholders inadvertently. This compromised the Department of Education‟s plans to open the classes every June of the year. As a result, the department released DepEd Order No. 12, s. 2020 establishing the adoption of the Basic Education Learning Continuity Plan (BE-LCP) that contains sets of educational interventions through necessary K-12 curriculum adjustments, alignment of learning materials, deployment of multiple learning delivery modalities, provision of training for teachers and school leaders, and proper orientation of parents/guardians.

Moreover, Warliani, Muslima, and Setiawan (2017), stated that one of the constructive approaches to learning is the 7E learning cycle. This learning in science courses increases the academic and conceptual achievement of the students. The lesson consists of the phases: determine, engage, explore, explain, elaborate, expand, and evaluate.

Furthermore, Anisah, et. Al. (2020), asserted in their study entitled, “The Effectiveness of 7E Learning Cycle Model to Improve Student Motivation in Work and Energy Topic”, that Learning strategies can be used to increase motivation. Student motivation will be increased through student-centered learning based on constructivism theory. Using the constructivism-based learning model, known as learning cycle 7E, is one of the strategies. Learning cycle 7E has several advantages, including increasing student motivation to learn because it involves students actively and makes learning more meaningful.

In addition, Lubiano, & Magpantayn (2021), quoted in their study entitled, “Enhanced 7E Instructional Model towards Enriching Science Inquiry Skills”, that Suardana et al. (2018) argue that the evolution of the 7E instructional model is the result of collaborative ideas sparked by constructivist and inquiry-based learning approaches in science teaching. Williams (2017) emphasized Dewey's ideas about inquiry as a starting point for enhancing modern-day skills like creativity, communication, information and communication technology (ICT), literacy, and numeracy.

Istuningsih, Baedhowi, & Sangka (2018) asserts that achieving learning objectives may be accomplished by making the learning process engaging through the use of technology as a learning medium. In line with the implementation of curriculum 2013, which uses a scientific method in teaching-learning activities to promote student-centered learning, the use of electronic learning media paired with the learning model is one successful strategy. E-modules based on learning cycle 7E are one useful medium for implementing the scientific method.

Suardana, et. al., (2018) found out that students who learned using the 7E learning cycle model based on local culture had stronger critical thinking abilities than students who learned through the discovery learning model. Students' critical thinking abilities might be developed through the 7E learning cycle, which is based on local culture, for both high-level and low-level senior high school students.

Moreover, the findings of the study of Primanda, Distrik, & Abdurrahman, (2019) show that student worksheets based on the 7E Learning Cycle for Newton's Law of Motion are useful and helpful in improving students' conceptual knowledge and problem-solving abilities in physics. In practice, the outcomes of using student worksheets in students' learning and favorable reactions show that they are helpful both in boosting students' grasp of ideas and in solving physics problems.

Based on the mentioned problems, and the positive implications of using the 7E Learning Cycle, the researchers conducted this study that aims to develop and test the acceptability of Flow with Mechanics: A 7E Instructional Material in General Physics 1, to help the learners in coping up with the lessons, specifically in Fluid Mechanics under the new normal school setup.

II. METHODOLOGY

The study was conducted using a descriptive, developmental, and experimental research approach. The descriptive method of research is a sort of study that aims to learn about the current status of a phenomenon. This form of research aims to present a complete picture of a situation, person, or event (Rahi, 2017).

McCombes (2020) stated that Descriptive research tries to characterize a population, circumstance, or phenomenon in a methodical and precise manner. It can answer the questions of what, where, when, and how, but not why. A descriptive research plan can study one or more variables using a range of research methods. Unlike experimental research, the researcher does not influence or change the variables; instead, they are observed and measured. The study is descriptive in that it strives to describe the level of acceptability of Flow with Mechanics: An Instructional Material on Selected Topics in General Physics 1.

Meanwhile, Beb (2017) described the developmental method as a set of research literature that is directly related to instructional development, implying that output will be generated after this study is completed. In other words, the systematic study of designing, producing, and carefully evaluating educational materials, procedures, and products that must meet the standard or criterion is known as the descriptive developmental method.

Moreover, in the realm of instructional technology, developmental research is especially essential. The most prevalent types of developmental research are those in which the product development process is investigated and explained, and the end product is assessed. The impact of the product on the learner or the organization is the focus of the second type of developmental study. The third form of research focuses on a broad examination of design creation or evaluation processes as a whole or as individual components. Reports of actual developmental research (practice) should be distinguished from explanations of design and development procedural models (theory). The researchers used a developmental research approach since this study sought to develop instructional material in selected topics in General Physics 1, in Fluid Mechanics to be exact.

An experimental design is a strategy for allocating experimental units to treatment levels, as well as the statistical analysis that goes along with it. According to Sugiyono (2006:80), experimental research is a study that seeks to determine the cause-effect connection between variables in a controlled environment. An experiment is a section of study in which variables are changed and the effects on other variables are evaluated. The experimental technique in educational research is the use and adaption of the classical approach of experimentation. It is a scientifically advanced procedure. It provides a technique of study for determining basic links between phenomena under controlled settings, or, more simply, for identifying the conditions behind the occurrence of a specific phenomenon. The description and study of what will be or what will occur under precisely controlled settings are known as experimental research. The researchers utilized an experimental method by using a control and experimental group to determine the level of performance of Grade 12 STEM students as revealed by their pre-test and post-test scores with respect to the selected topics in General Physics 1.

III. RESULTS AND DISCUSSION

A. Development of Flow with Mechanics: A 7E Instructional Material in General Physics 1

The instructional material was developed and validated using the ADDIE model of instructional design. This is composed of the following stages: Analysis, Development, Design, Implementation, and Evaluation. During the

first stage, analysis, instructional problems were clarified, objectives were established, and the learning environment and the tools to assess learner's existing knowledge were identified. The design phase focused on the learning objectives, instruments, contents, and learning activities, lesson planning and media selection. It was an orderly method of identifying, developing and evaluating a set of strategies targeted for attaining the goals. Moreover, during the development, the researchers created the contents that were generated in the design phase and worked to develop and/or integrate technologies. The researcher made use of the outcome of the two previous stages and used this information to create an instructional material that will relay what needs to be taught to the learners. The implementation stage was a continuous modification of the Flow with Mechanics to make sure maximum efficiency and positive results are obtained. Lastly, the evaluation phase aimed to determine if the goals have been met and to establish what will be required to further improve the efficiency of the web application. The instructional material went through content validation of Physics Experts and IT Experts.

B. Experts' Evaluation on the Level of Acceptability of the Developed Flow with Mechanics: A 7E Instructional Material in General Physics 1 as Perceived by the Physics Experts

Table 1

Composite Table on the Physics Experts' Evaluation Level of Acceptability on the Developed Flow with Mechanics: A 7E Instructional Material in General Physics 1

OVERALL		
Aspects	Mean	Verbal Interpretation
1. Content	4.85	Very Highly Acceptable
2. Objectives	4.80	Very Highly Acceptable
3. Language and Style	4.82	Very Highly Acceptable
4. Organization and Presentation	4.79	Very Highly Acceptable
5. Usefulness	4.79	Very Highly Acceptable
6. Integration of 7E Learning Cycle	4.91	Very Highly Acceptable
Grand Mean	4.83	Very Highly Acceptable

It could be inferred from the table that based on the Composite Table on the Physics Experts' Evaluation Level of Acceptability on the Developed Flow with Mechanics: A 7E Instructional Material in General Physics 1, the web application attained the highest mean on Integration of 7E Learning Cycle, which is 4.91, verbally interpreted as 4.91. On the other hand, the lowest mean attained is 4.79, which corresponds to two aspects which are Organization and Presentation and Usefulness. The grand mean of the acceptability of the web application as perceived by the Physics Experts is 4.83, verbally interpreted as "Very Highly Acceptable"

The results indicate that Flow with Mechanics is truly acceptable, as agreed upon by the Physics Experts. It indicated that the online application has adequate material and objectives, as well as that the language and style employed are suitable and appropriate to the students. The web application is regarded as helpful, and the incorporation of the 7E Learning Cycle is deemed successful.

The results were supported by the study by Asrizal, A., Amran, A., Ananda, A., Festiyed, F., & Khairani, S. (2018), which states that the use of integrated science instructional material on the pressure in daily life by integrating digital age literacy is effective in a scientific approach to improve knowledge competence, attitudes competence, and digital age literacy skills.

C. Experts' Evaluation of the Level of Acceptability on the Developed Flow with Mechanics: A 7E Instructional Material in General Physics 1 as perceived by the IT Experts

According to the table on the next page, the developed Flow with Mechanics: A 7E Instructional Material in General Physics 1, is Very Highly Acceptable with a grand mean of 4.69, in terms of accuracy with the highest mean of 4.77, followed by portability with a mean of 4.72, user-friendliness with a mean of 4.69, workability and completeness both having a mean of 4.68, and applicability garnering the lowest mean of 4.63.

The results were supported by the study of Jaber, K. M., Abduljawad, M., Ahmad, A., Abdallah, M., Salah, M., & Alhindawi, N. (2021), E-learning Mobile Application Evaluation: Al-Zaytoonah University as a Case Study. This study demonstrates that, in the context of technological innovation, the quality aspects provided by apps used for E-learning objectives have a significant impact on the demand for this kind of app both now and in the future.

Table 2 Composite Table on the Information Technology Experts Evaluation Level of Acceptability on the Developed Flow with Mechanics: A 7E Instructional Material in General Physics 1

OVERALL		
Aspects	Mean	Verbal Interpretation
1. Accuracy	4.77	Very Highly Acceptable
2. Applicability	4.63	Very Highly Acceptable
3. User-Friendliness	4.69	Very Highly Acceptable
4. Workability	4.68	Very Highly Acceptable
5. Completeness	4.68	Very Highly Acceptable
6. Portability	4.72	Very Highly Acceptable
Grand Mean	4.69	Very Highly Acceptable

D.Level of Performance of Each Group of Student Respondents Before and After the Exposure to The Flow with Mechanics: A 7E Instructional Material in General Physics 1

Table 3 presents the Computed Mean and Standard Deviation on the Level of Performance of Experimental Group of Students as Revealed by their Pretest and Posttest Scores with Respect to the Topics in Fluid Mechanics.

Based on the table, the experimental group of students' pre-test scores is observed lowest on Pressure vs. Depth Relation with the mean of 3.44 which deviates to 1.948 and is interpreted as "Fairly Satisfactory."

Meanwhile, their pre-test highest scores are observed on Buoyancy and Archimedes' Principle with the mean of 4.96 which deviates to 1.786 and is interpreted as "Satisfactory". Furthermore, the experimental group of students' post-test scores is observed to be lowest on Pressure with a mean of 8.04 which deviates from 1.344 and is interpreted as "Outstanding".

Concurrently, their post-test scores are observed to be highest on Bernoulli's Principle with the mean of 9.26 which deviates to 0.813 and is interpreted as "Outstanding". Overall, the experimental group of students' total pre-test score is interpreted as "Satisfactory" with a mean of 28.33 which deviates from 4.788, and their total post-test score is interpreted as "Outstanding" with a mean of 61.19 which deviates to 3.114.

The result illustrates that the experimental group of students who used the "Flow with Mechanics application" in learning fluid mechanics has increased their level of performance across all topics within it.

This result was supported by the research conducted by Putri, R. Z. (2020, June). Moodle As E-Learning Media in Physics Class, which states that, in physics courses, e-learning is an important component that supplements the traditional learning method.

Table 3 Computed Mean and Standard Deviation on the Level of Performance of Experimental Group of Students as Revealed by their Pretest and Posttest Scores with Respect to the Topics in Fluid Mechanics

Experimental Group				
Topic		Mean	SD	VI
Specific Gravity	Pretest	4.15	1.231	S
	Post-Test	8.15	1.512	O
Pressure	Pretest	4.07	1.238	S
	Post-Test	8.04	1.344	O
Pressure vs. Depth Relation	Pretest	3.44	1.948	FS
	Post-Test	8.85	0.864	O
Pascal's principle	Pretest	3.93	1.328	FS

	Post-Test	8.78	1.013	O
Buoyancy and Archimedes' Principle	Pretest	4.96	1.786	S
	Post-Test	9.11	1.311	O
Continuity equation	Pretest	3.81	1.075	FS
	Post-Test	9.00	0.877	O
Bernoulli's principle	Pretest	3.96	1.698	FS
	Post Test	9.26	0.813	O
TOTAL	Pretest	28.33	4.788	S
	Post-Test	61.19	3.114	O

Table 4 presents the Computed t-value of the Significant Difference in the Level of Performance of the Experimental Group of Students as Revealed by their Pretest and Posttest Scores with Respect to the Topics in Fluid Mechanics.

In totality, the result shows a significant difference in the performance of the learners between the pre-test and the post-test that are concluded before and after the exposure to the developed Flow with Mechanics: A 7E Instructional Material in General Physics 1. Since the computed p-value of 0.000 is less than the 0.05 level of significance; thus, the null hypothesis is rejected. This finding implies that the learners achieve a better academic performance after utilizing the material since the mean score in pre-test and post-test is 28.33 and 61.19, respectively, which exhibits a mean difference of 32.852.

These findings are also aligned with the study conducted by Ramma, and Bholoa, (2018) which states that the use of web platforms and applications can increase student's motivation, interest, and values; thus, improving their performance in learning physics.

Table 4 Computed t-value of the Significant Difference on the Level of Performance of Experimental Group of Students as Revealed by their Pretest and Posttest Scores with Respect to the Topics in Fluid Mechanics

Experimental Group									
Topics in Fluid Mechanics		Mean	Sd.	Mean Diff	t	df	Sig.	H_O	VI
Specific Gravity	Pretest	4.15	1.231	4.000	11.704	26	0.000	R	S
	Posttest	8.15	1.512						
Pressure	Pretest	4.07	1.238	3.963	11.816	26	0.000	R	S
	Posttest	8.04	1.344						
Pressure vs. Depth Relation	Pretest	3.44	1.948	5.407	13.388	26	0.000	R	S
	Posttest	8.85	0.864						
Pascal's principle	Pretest	3.93	1.328	4.852	15.004	26	0.000	R	S
	Posttest	8.78	1.013						
Buoyancy and Archimedes' Principle	Pretest	4.96	1.786	4.148	10.321	26	0.000	R	S
	Posttest	9.11	1.311						
Continuity equation	Pretest	3.81	1.075	5.185	17.163	26	0.000	R	S
	Posttest	9.00	0.877						
Bernoulli's principle	Pretest	3.96	1.698	5.296	15.345	26	0.000	R	S
	Posttest	9.26	0.813						
Grand Mean	Pretest	28.33	4.788	32.852	32.229	26	0.000	R	S
	Posttest	61.19	3.114						

E. Significant Difference on the Level the Performance of the Experimental and Control Group as Revealed by Their Post-Test Scores

Table 5 on the succeeding page presents the Computed t-value of the Significant Difference on the Level of Performance of the Control and Experimental Groups of Students as Revealed by their Posttest Scores with Respect to the Topics in Fluid Mechanics.

The interpretation of the table implies that the inclusion of Flow with Mechanics: A 7E Instructional Material in General Physics 1 is preferable to attending traditional online class sessions in learning fluid mechanics. Since it can be observed that there is a margin of difference between the post-test mean score of the experimental group of students which acquired a higher mean score than the control group of students

The findings were supported by the research of Asrizal, A., Amran, A., Ananda, A., Festiyed, F., and Khairani, S. (2018). According to the findings, the use of integrated science instructional material on the pressure in daily life by integrating digital age literacy is effective in a scientific approach to improve knowledge competence, attitudes competence, and digital age literacy skills.

F. Level of Effectiveness of the Flow with Mechanics: A 7E Instructional Material in General Physics 1 As Revealed by The Percentage Increase in Mean Scores of the Experimental Group

Table 6 on the next page presents The Level of Effectiveness of the Flow with Mechanics: A 7E Instructional Material in General Physics 1 As Revealed by The Percentage Increase in Mean Scores of the Experimental Group with Respect Fluid Mechanics.

The table shows that the experimental group of students who utilize the Flow with Mechanics: A 7E Instructional Material in General Physics 1 revealed the material is effective because their level of performance increased by 53.70 percent since the mean score of their overall post-test is 61.19 which is greater than their overall pre-test mean score of only 28.33.

It could be gleaned from the table that one out of seven lessons are verbally interpreted as very effective, and six out of seven lessons are verbally interpreted as effective as revealed by the post-test results of the respondents.

Table 5 Computed t-value of the Significant Difference on the Level of Performance of the Control and Experimental Groups of Students as Revealed by their Posttest Scores with Respect to the Topics in Fluid Mechanics

Topics in Fluid Mechanics		Mean	Sd.	Mean Diff	t	df	Sig.	H_O	VI
Specific Gravity	Control	7.30	2.120	0.848	1.722	55	0.91	FR	NS
	Experimental	8.15	1.512						
Pressure	Control	7.13	1.613	0.904	2.283	55	0.026	R	S
	Experimental	8.04	1.344						
Pressure vs. Depth Relation	Control	8.40	1.773	0.452	1.241	55	0.221	FR	NS
	Experimental	8.85	0.863						
Pascal's principle	Control	8.10	1.583	0.678	1.944	55	0.058	FR	NS
	Experimental	8.78	1.013						
Buoyancy and Archimedes' Principle	Control	8.70	1.393	0.411	1.144	55	0.258	FR	NS
	Experimental	9.11	1.311						
Continuity equation	Control	8.27	1.818	0.733	1.969	55	0.055	FR	NS
	Experimental	9.00	0.877						
Bernoulli's principle	Control	8.90	0.885	0.359	1.590	55	0.117	FR	NS
	Experimental	9.26	0.813						

Table 6 Level of Effectiveness of the Flow with Mechanics: A 7E Instructional Material in General Physics 1 As Revealed by The Percentage Increase in Mean Scores of the Experimental Group with Respect Fluid Mechanics

Topic		Mean	Sd.	Mean Diff	% Of Level Increase	VI
Specific Gravity	Pretest	4.15	1.231	4.000	49.08	E
	Posttest	8.15	1.512			
Pressure	Pretest	4.07	1.238	3.963	49.38	E
	Posttest	8.04	1.344			
Pressure vs. Depth Relation	Pretest	3.44	1.948	5.407	61.13	VE
	Posttest	8.85	0.864			
Pascal's principle	Pretest	3.93	1.328	4.852	55.24	E
	Posttest	8.78	1.013			
Buoyancy and Archimedes' Principle	Pretest	4.96	1.786	4.148	45.55	E
	Posttest	9.11	1.311			
Continuity equation	Pretest	3.81	1.075	5.185	57.67	E
	Posttest	9.00	0.877			
Bernoulli's principle	Pretest	3.96	1.698	5.296	57.24	E
	Posttest	9.26	0.813			
Grand Mean	Pretest	28.33	4.788	32.852	53.70	E
	Posttest	61.19	3.114			

The table implies that utilizing the Flow with Mechanics: A 7E Instructional Material in General Physics 1 in learning Fluid Mechanics can positively influence the student's level of performance in the subject as revealed by the percentage increase between their overall pre-test mean score and overall post-test mean score. Furthermore, the Flow with Mechanics: A 7E Instructional Material was labeled "Effective" based on the overall verbal interpretation.

These findings are supported by the research conducted by Ting Lin and Jou (2012), which states that web application is a potential way to engage instructors and students in meaningful teaching and learning activities. In addition, their study revealed that the instructor and students can administer teaching and learning activities efficiently and effectively; thus, improving academic achievement.

REFERENCES

[1] Ekici, E. (2016) "Why Do I Slog Through the Physics?" Understanding High School Students' Difficulties in Learning Physics. Retrieved October 15, 2021 from https://files.eric.ed.gov/fulltext/EJ1095264.pdf

[2] Suarez, A., Kahan, S., Zavala, G., & Marti, A. C. (2017, November 28). Students' Conceptual Difficulties in Hydrodynamics. Physical Review Physics

[3] Rogayan, D., & Dollete, L. (2016). Development and Validation of Physical Science Workbook for Senior High School. Science Education International. Retrieved October 16,2021, from http://www.icaseonline.net/journal/index.php/sei/article/view/138.

[4] Asrizal, A., Amran, A., Ananda, A., & Festiyed, F. (2018, April). Effectiveness of Adaptive Contextual Learning Model of Integrated Science by Integrating Digital Age Literacy on Grade VIII Students. In IOP Conference Series: Materials Science and Engineering (Vol. 335, No. 1, p. 012067). IOP Publishing. Retrieved 2022, from https://iopscience.iop.org/article/10.1088/1757-899X/335/1/012067/pdf

[5] Warliani, R., Muslima, & Setiawan, W. (2017, May 30). Implementation of 7E Learning Cycle Model Using Technology-Based Constructivist Teaching (TBCT) Approach to Improve Students' Understanding Achievment in Mechanical Wave Material. AIP Publishing. Retrieved October 13, 2021, from https://aip.scitation.org/doi/abs/10.1063/1.4983961

[6] Anisah, M., Syukri, & Sulastri. (2020). The Effectiveness of 7e Learning Cycle Model to Improve Student Motivation im Work and Energy Topic. Retrieved October 13, 2021, from https://iopscience.iop.org/article/10.1088/1742-6596/1460/1/012136/pdf

[7] Lubiano, M. L. D., & Magpantay, M. S. (2021). Enhanced 7E Instructional Model towards enriching science inquiry skills. Retrieved October 13, 2021, from International Journal of Research in Education and Science (IJRES), 7(3), 630-658. https://doi.org/10.46328/ijres.1963

[8] Istuningsih, W., Baedhowi, B., & Sangka, K. B. (2018). The Effectiveness of Scientific Approach Using E-Module Based on Learning Cycle 7e To Improve Students' Learning Outcome. International Journal of Educational Research Review, 3(3), 75-85.

[9] Suardana, I. N., Redhana, I. W., Sudiatmika, A. A., & Selamat, I. N. (2018). Students' Critical Thinking Skills in Chemistry Learning Using Local Culture-Based 7E Learning Cycle Model. International Journal of Instruction, 11(2), 399-412.

[10] Primanda, A., Distrik, I. W., & Abdurrahman, A. (2019). The Impact of 7E Learning Cycle-Based Worksheets Toward Students Conceptual Understanding and Problem-Solving Ability on Newton's Law of Motion. Journal of Science Education, 2(19), 95-106.

AUTHORS PROFILE

JOJIMAR S.J. JULIAN successfully completed his Bachelor of Secondary Education with a major in Physics and earned his Master of Arts in Teaching with a major in Science at the University of Rizal System-Morong. Presently, he is in the process of obtaining his Doctor of Philosophy in Science Education at the University of Perpetual Help Delta. Concurrently, he serves as an instructor at the University of Rizal System Morong, where he imparts knowledge in the fields of physics and science.

CARL ADAM ESTACIO has successfully accomplished his Bachelor of Secondary Education with a major in Science at the University of Rizal System-Morong. Currently, he is a dedicated teacher at Child Jesus of Prague School, where he specializes in teaching science and research subjects to senior high school students.

ADRIAN OQUENDO has completed his Bachelor of Secondary Education with a major in Science at the University of Rizal System-Morong. Presently, he serves as a teacher at St. Martin Montessori School Inc., where he is dedicated to instructing junior high school students in the subjects of science and mathematics..

JUSTINE RENNIEL C. BOGATE has successfully completed his Bachelor of Secondary Education with a major in Science at the University of Rizal System-Morong. Currently, he serves as a teacher at Raises Montessori Academe, specializing in instructing junior high school students in the field of science.

WENDYLL G. LISTONES has completed his Bachelor of Secondary Education with a major in Science at the University of Rizal System. Currently, he is a dedicated teacher at Southridge Private High School, specializing in instructing both junior and senior high school students in the field of science..