The International Review of Multidisciplinary Research
Volume 1, Issue 9, July 2026, pp. 177-187
https://doi.org/10.67167/vertex.658

The International Review of Multidisciplinary Research
Advancing knowledge through quality research

Effect of the 5E Learning Cycle Method of Instruction on the Achievement and Motivation Level of Pre-Service Science Teachers Toward Mechanics

Joseph M. Salvador
Bulacan State University
joseph.salvador@bulsu.edu.ph

Article Details:

Received: 25 June 2026
Revised: 30 June 2026
Accepted: 5 July 2026
Published: 19 July 2026
Corresponding Email:
joseph.salvador@bulsu.edu.ph

Recommended Citation:

Salvador, J. M. (2026). Effect of the 5E Learning Cycle Method of Instruction on the Achievement and Motivation Level of Pre-Service Science Teachers Toward Mechanics. The International Review of Multidisciplinary Research. 1 (9), 177-187. https://doi.org/10.67167/vertex.658

Index Terms:

5E learning cycle method, constructivist approach, achievement, motivation, mechanics

Abstract. Physics is often perceived as a challenging subject among tertiary students, underscoring the need for instructional approaches that enhance both academic achievement and motivation to learn. This mixed-methods study examined the effectiveness of the 5E Learning Cycle Method in improving the achievement, motivation, and learning experiences of 37 pre-service teachers enrolled at Bulacan State University–Bustos Campus. A quasi-experimental one-group pre-test/post-test research design was employed. Quantitative data were collected using the Force Concept Inventory (FCI) to assess achievement in mechanics and the Motivation Scale towards Learning Physics (MSLP) to measure students' motivation. Qualitative data were gathered through focus group discussions to provide deeper insights into participants' learning experiences and to support the quantitative findings. Descriptive and inferential statistical analyses, including paired-samples t-tests and the Wilcoxon signed-rank test, were used to determine significant differences between pre-test and post-test scores, while thematic analysis was applied to the qualitative data. Results revealed statistically significant improvements in both achievement and motivation following the implementation of the 5E Learning Cycle Method. The mean FCI score increased from 14.14 to 21.16 ($t = -8.833$, $p < .001$), demonstrating substantial gains in students' conceptual understanding of mechanics. Likewise, the mean MSLP score increased from 2.37 to 3.65 ($\omega = 0.00$), indicating a significant increase in motivation to learn physics. Qualitative findings further showed that the 5E Learning Cycle Method fostered a supportive, low-pressure learning environment, strengthened collaboration, and increased students' confidence and engagement. The study concludes that the 5E Learning Cycle Method is an effective instructional approach for improving both conceptual understanding and motivation in physics, and recommends integrating it into tertiary physics instruction to enhance teaching effectiveness and student learning outcomes.

Introduction

Science education is important to learn about science, think critically, and make choices based on facts. Traditional, teacher-centered lectures aren't as important in schools today as they once were. Schools are using teaching methods that let students learn by doing things. Students often lose interest when they learn through traditional lectures. This makes them less motivated and makes it harder for them to understand scientific ideas.

These issues are especially clear in physics, where many students struggle with math and abstract ideas, especially in mechanics. Because of this, teachers are always looking for new ways to help students learn that don't just involve memorizing facts.

The 5E Learning Cycle Model is a great way to teach science because it is based on the idea that people learn best when they are actively engaged in hands-on activities. Constructivism holds that learners don't just take in information; they also construct knowledge through experience, reflection, and social interaction (Vygotsky, 1978; Piaget, 1970). The Biological Sciences Curriculum Study (BSCS) developed the 5E model. It has five parts: Engagement, Exploration, Explanation, Elaboration, and Evaluation (Bybee et al., 2006). The goal of each phase is to help students learn by guiding them through a set of questions. Students start the engagement phase by building on what they already know. During the exploration phase, they then do a study in the real world. People then use what they've learned to solve problems, try it out in new situations, and see how well they learned it. This structured approach to teaching helps students understand ideas more clearly and stay engaged. This gives them the power to take charge of their own learning and become better and more independent learners (Bybee, 2015).

The 5E learning cycle helps students learn by making them think. It lets students see real-world examples, make guesses, and back up their claims with evidence. Karthikeyan and Densia (2021) say that the framework encourages inquiry by putting investigation, reasoning, and exploration at the top of the list. A lot of research has shown that this practice makes people more motivated and more successful in school. Researchers Putra et al. (2018) found that the 5E strategy improved conceptual understanding by engaging students.

Research on physics education shows that the paradigm helps students think critically by allowing them to learn through experience before receiving formal explanations. This method works well to combine theoretical knowledge. Even with these benefits, physics remains a very powerful field worldwide. In subjects like mechanics, students need to know how force, motion, and energy are connected. This can cause long-lasting misunderstandings and make it harder for them to learn new things. Pre-service science teachers need to know these things because their knowledge of them will affect how well they teach in the future. When pre-service teachers see good teaching methods during their training, they are more likely to use similar student-centered methods in their own classrooms. This will have a ripple effect in the field of education.

The K to 12 curricula in the Philippines and other Southeast Asian nations underscore the importance of educational inquiry in cultivating logical reasoning skills. Studies in this area have found that the 5E method improves outcomes and engages more people. Paguirigan and Paguirigan (2024) found that using the 5E method to organize teaching materials makes studying more fun. Studies have found that the 5E method fits with the goals of the Philippine school system.

However, there is a lack of research examining the impact of the 5E teaching method on pre-service science teachers, particularly in the context of mechanics instruction. Most of modern literature is about students in elementary and middle school. More research is needed to find out how this method will affect the motivation and academic performance of future science teachers, who will help students learn by asking questions. This study aims to determine how the 5E Learning Cycle Method of Instruction affects the motivation and achievement of pre-service science teachers.

Statement of the Problem

The study aims to determine the effect of the 5E Learning Cycle Method of Instruction on the achievement and motivation level of pre-service teachers toward physics. Specifically, it aims to:
1. To assess the achievement of the pre-service teachers in mechanics before and after the use of the 5E Learning Cycle Method.
2. To determine if there is a significant difference between the pre-test and post-test scores of the pre-service teachers in mechanics.
3. To assess the motivation level of the pre-service teachers before and after the use of the 5E Learning Cycle Method of Instruction.
4. To determine if there is a significant difference in the motivational level of the pre-service teachers before and after the intervention.
5. To identify the learning experiences of the pre-service teachers after the use of the 5E Learning Cycle Method.

Methodology

Research Design.

The study utilized a mixed-methods research design employing a one-group quasi-experimental pretest-posttest framework. This design was selected to determine the effect of the 5E Learning Cycle Method of Instruction on the achievement and motivation level of pre-service science teachers toward Mechanics. The quantitative component measured changes in students' conceptual understanding and motivation before and after the intervention using standardized assessment instruments. Meanwhile, the qualitative component explored students' learning experiences and perceptions regarding the implementation of the 5E Learning Cycle through a Focus Group Discussion (FGD). The integration of quantitative and qualitative data enabled the researcher to gain a comprehensive understanding of the instructional approach's effectiveness in enhancing students' achievement and motivation in Mechanics.

Research Environment

The study was conducted at Bulacan State University – Bustos Campus, located in Bustos, Bulacan, Philippines, during the second semester of Academic Year 2024–2025. The university is a state institution committed to providing quality teacher education programs that prepare future educators to become competent and effective professionals. The study was conducted in the Bachelor of Secondary Education (BSEd) major in science program, in which students are required to take Mechanics as a foundational physics course.

The Mechanics course covers essential topics such as Kinematics, Projectile Motion, and Newton's Laws of Motion, which are fundamental concepts in physics education. These topics often present conceptual difficulties among learners and therefore require instructional approaches that actively engage students in the learning process. The classroom environment provided opportunities for collaborative learning, inquiry-based activities, experimentation, discussion, and reflective thinking, making it well-suited to implementing the 5E Learning Cycle Method of Instruction. The university was selected as the research site because it serves as the institution where the respondents are enrolled and where the intervention could be implemented under authentic classroom conditions.

Research Respondents.

The respondents of this study were thirty-seven (37) second-year Bachelor of Secondary Education major in science students enrolled in the Mechanics course at Bulacan State University – Bustos Campus during the second semester of Academic Year 2024–2025. The participants ranged in age from 18 to 20 years and represented the entire population enrolled in the course during the study. The respondents were selected through purposive sampling, a non-probability sampling technique, because they possessed the specific characteristics required for the investigation. The inclusion criteria required that participants: (a) be officially enrolled in the Mechanics course during the semester of data collection; (b) be enrolled in the Bachelor of Secondary Education major in science program; and (c) participate in all phases of the instructional intervention and data collection process. Since only one Mechanics section was offered during the semester, all enrolled students were included in the study. The respondents were considered appropriate participants because they are pre-service science teachers expected to develop a strong conceptual understanding and positive motivation toward physics. Their experiences and performance provided valuable information regarding the effectiveness of the 5E Learning Cycle Method of Instruction in teaching Mechanics.

Research Instruments.

Three research instruments were utilized in the study to collect both quantitative and qualitative data. The first instrument was the Force Concept Inventory (FCI) developed by Hestenes, Wells, and Swackhamer (1992). The FCI is a standardized multiple-choice diagnostic assessment designed to measure students' conceptual understanding of force and motion concepts. The instrument was administered as both a pretest and a posttest to determine changes in students' achievement after exposure to the 5E Learning Cycle Method of Instruction. The second instrument was the Motivation Scale toward Physics Learning (MSPL), adapted from Ince et al. (2020). The instrument consists of twenty-two (22) items measured using a five-point Likert scale ranging from Strongly Disagree to Strongly Agree. The scale assesses three dimensions of motivation: self-efficacy, appreciation and reward, and perceived value of learning physics. The MSPL was administered before and after the intervention to determine changes in students' motivation levels toward Mechanics.

The third instrument consisted of researcher-prepared Focus Group Discussion (FGD) guide questions used to gather qualitative data regarding students' experiences during the implementation of the 5E Learning Cycle. The discussion questions were designed to encourage participants to share their perceptions, learning experiences, challenges encountered, and insights regarding the effectiveness of the instructional approach. In addition, the instructional intervention was implemented using lesson plans developed according to Bybee's 5E Learning Cycle Model, consisting of the Engagement, Exploration, Explanation, Elaboration, and Evaluation phases. The lesson plans covered Kinematics, Projectile Motion, and Newton's Laws of Motion and were reviewed by experts in science and physics education to ensure content validity and instructional appropriateness.

Ethical Considerations

The study adhered to established ethical standards in educational research. Prior to data collection, permission to conduct the study was obtained from the concerned university authorities and the course instructor. Participants were informed of the study's purpose, objectives, procedures, and significance before their involvement. An informed consent form was provided to all participants, clearly explaining the voluntary nature of participation and their right to withdraw from the study at any time without penalty. Participants were assured that their responses would remain confidential and would be used solely for academic and research purposes. To protect participant privacy, individual responses were coded and anonymized during data analysis and reporting. No identifying information was included in the presentation of findings. All collected data, including questionnaires, assessment results, audio recordings, and transcripts, were securely stored and made accessible only to the researcher. The data will be properly disposed of upon completion of the study, in accordance with university research guidelines. The researcher ensured that the intervention posed no physical, psychological, or academic risk to the participants and that all activities formed part of legitimate instructional practices designed to enhance learning.

Research Procedure

Following the approval of the research proposal, the researcher secured the necessary permissions from the university administration and the course instructor to conduct the study. The selected research instruments were prepared, validated, and organized for administration. During the first phase of data collection, the Force Concept Inventory (FCI) and the Motivation Scale toward Physics Learning (MSPL) were administered to the respondents as pretests. The purpose of the pretest administration was to establish baseline data on students' conceptual understanding of Mechanics and their motivation to learn physics. Following the pretest administration, the researcher implemented the 5E Learning Cycle Method of Instruction over a three-week period covering the topics Kinematics, Projectile Motion, and Newton's Laws of Motion. During the Engagement phase, students' prior knowledge and curiosity were stimulated through demonstrations, questions, and real-life situations. In the Exploration phase, students participated in collaborative investigations and inquiry-based activities. During the Explanation phase, students presented their findings while scientific concepts were clarified and discussed. In the Elaboration phase, students applied their understanding to new situations and problem-solving activities. Finally, the Evaluation phase assessed students' understanding through a range of formative and summative assessments. Upon completion of the instructional intervention, the FCI and MSPL were administered again as posttests to determine changes in students' achievement and motivation. Afterward, a Focus Group Discussion involving all respondents was conducted. The discussion was audio-recorded and later transcribed to capture students' experiences, perceptions, and reflections regarding the implementation of the 5E Learning Cycle. The collected data were organized, coded, analyzed, and interpreted to address the research questions and assess the intervention's effectiveness.

Statistical Treatment of the Data

The data collected in the study were analyzed using appropriate descriptive and inferential statistical tools.

- Weighted Mean and Standard Deviation. These statistical measures were used to assess students' achievement and motivation before and after the implementation of the 5E Learning Cycle Method of Instruction. The weighted mean indicated the average performance and motivation levels, while the standard deviation reflected the variability of responses.
- Paired-Samples t-Test. This statistical test was used to determine whether a significant difference existed between the pretest and posttest Force Concept Inventory (FCI) scores. The test assessed the intervention's effectiveness in improving students' conceptual understanding of Mechanics.
- Wilcoxon Signed-Rank Test. This non-parametric statistical test was used to determine whether a significant difference existed between the pretest and posttest Motivation Scale toward Physics Learning (MSPL) scores. The test was considered appropriate because the data were obtained from a Likert-scale instrument.
- Thematic Analysis. Qualitative data obtained from the Focus Group Discussion were analyzed using thematic analysis. Responses were transcribed, coded, categorized, and organized into themes describing students' experiences and perceptions of the implementation of the 5E Learning Cycle Method of Instruction.
- The level of significance for all inferential statistical analyses was set at 0.05. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), while qualitative data were manually coded and interpreted by the researcher.

The following interpretations were also applied by the researcher to describe the achievement of the students:

Achievement Scale interpretation by Del Siegle

Score Range	Interpretation
25-30	Excellent Poor
19-24	Above Average
13-18	Average
7.00-12	Below
1.00-6.00	Poor

To identify the student's motivation level, motivation-formative assessment was used in this study to describe and interpret the level of students' motivation towards physics.

Motivation level scale interpretation

Mean Range	Interpretation
4.3-5	Very high
4.2-3.5	high
3.4-2.7	motivated
2.6-1.9	Low
1.0-1.8	Very low

Results and Discussion

This section presents the analysis and interpretation of the data gathered to determine the effectiveness of the 5E Learning Cycle Method in improving pre-service teachers' achievement in Mechanics and enhancing their motivation toward learning Physics. The findings are organized into the following areas: (1) pre-service teachers' performance in the pre-test; (2) pre-service teachers' performance in the post-test; (3) comparison of pre-test and post-test scores based on the Force Concept Inventory (FCI); (4) analysis of the significant difference between the pre-test and post-test scores after the implementation of the 5E Learning Cycle Method; (5) pre-service teachers' level of motivation before and after the implementation of the 5E Learning Cycle Method; and (6) analysis of the significant difference in students' motivation following the instructional intervention. The data collected from 37 pre-service teachers are presented in tabular form and accompanied by detailed analyses and interpretations to provide a comprehensive understanding of the instructional intervention's impact on students' conceptual understanding of Mechanics and their motivation to learn the subject.

Table No. 1. Pre-service teachers' scores in the pre-test and post-test in Mechanics after the use of the 5E Learning Cycle Method

Scale	Pre-test		Post-test	
	(f)	(%)	(f)	(%)
25-30	0	0%	11	29.73%
19-24	3	8.10%	17	45.95%
13-18	23	62.20%	9	24.32%
7-12	11	29.72%	0	
1-6	0		0	
Total	37	100%	37	100%
Mean	14.14		21.16	
Standard Deviation	2.898		4.14	
Qualitative Interpretation	**Average**		**Above Average**	

As shown in Table 1, 11 or 29.73 percent of pre-service teachers in the post-test have a score ranging from 25-30, interpreted as excellent. There were 3 or 8.10 percent of pre-service teachers in the pre-test, and 17 or 45.95 percent had a score ranging from 19 -24, interpreted as above average. 23, or 62.20 percent, of pre-service teachers took the pre-test, and 19, or 24.32 percent, scored between 13 and 18, which is considered average. In the pre-test, 11 students, or 29.72 percent of the class, received scores between 7 and 12, which is considered below average. The mean and standard deviation of the pre-test scores in Mechanics were 14.14 and 2.898, respectively, indicating average performance. The mean and standard deviation of the post-test scores were 21.16 and 4.140, respectively, indicating above-average scores. The Pre-test and Post-test scores show that students performed better in Mechanics after using the 5E Learning Cycle Method than before using it. The t-test is used to determine whether pre-service teachers' scores on the Mechanics Pre-test and Post-test differ.

Test	Mean	SD	t-value	df	p-value
Pair Pre-test and Post-test in FCI	-7.027	4.839	-8.833	36	.000

Table 2. The difference between the pre-test and post-test scores of pre-service teachers in mechanics

As shown in Table 2, the t-value for the analysis was -8.833, with a p-value of 0.000 ($p<0.05$). This indicates a significant difference between the pre-test and post-test scores. This increase in means is statistically significant: pre-service teachers achieved higher post-test scores than pre-test scores. It also suggests that the 5E Learning Cycle Method has contributed to this significant increase. This finding is consistent with those of Boakye and Nabie (2022), Nisa (2023), and Jack (2017), who found that students who learned through the 5E learning cycle achieved higher scores than those who learned through conventional teaching. This is because of the strategies and steps followed and observed in students taught using the 5E learning cycle, which includes the phases engage, explore, explain, elaborate, and evaluate. Yonyubon et al. (2022) confirmed the findings by describing the 5E learning cycle as a learning management plan that enhances students' understanding of heat in a scientific class. The participants' learning accomplishments after the treatment were greater than before. The study offers pedagogical implications by demonstrating the impact of a learning management plan based on the 5E inquiry-based teaching approach in a science class. Research by Uswatun (2020) has examined the effects of the 5E learning cycle on student achievement across subjects and grade levels. Studies have found that implementing the 5E learning cycle improves student achievement in science, mathematics, and language arts. These studies suggest that the 5E learning cycle promotes active engagement and deeper understanding of concepts by involving students in the learning process through hands-on activities.

	Pre- Test		Post-Test	
Scale	(f)	(%)	(f)	(%)
4.3-5	0	0%	1	2.7%
3.5-4.2	0	0%	27	72.98%
2.7-3.41	3	8.11%	9	24.34%
1.9-2.6	30	81.08%	0	
1-1.8	4	10.81%	0	
Total	37	100%	37	100%
Mean	2.37		3.65	
Standard Deviation	0.29		0.139	
Qualitative Interpretation	**Low**		**High**	

Table 3. The pre-service teacher's motivation level in mechanics before and after using the 5E Learning Cycle Method

As shown in Table 3, in the post-test, 1 pre-service teacher, or 2.70 percent of the sample, had a mean score between 4.3 and 5, which is considered very high motivation. 27 pre-service teachers, or 72.98 percent of the class, took the post-test and scored between 3.5 and 4.2, indicating they are very motivated. 3 pre-service teachers (8.11 percent of the pre-service teachers in the pre-test) received a score between 2.7 and 3.4, which is regarded as motivated, and 9 (24.324 percent of them in the post-test) did so. In the pre-test, 30 pre-service teachers, or 81.08 percent of the class, earned scores indicating low motivation, ranging from 1.9 to 2.6, while 4, or 10.81 percent, had values indicating very low motivation, ranging from 1.8 to 1.9. As shown in Table 3, the students' MSPL pre-test scores had a mean of 2.37 and a standard deviation of 0.29, indicating low motivation, whereas the post-test scores had a mean of 3.65 and a standard deviation of 0.319, indicating high motivation. Based on the pre- and post-test results, students' motivation for mechanics varied before and after the

Test	Mean	SD	t-value	df	p-value
Pair Pre-test and Post-test in FCI	-7.027	4.839	-8.833	36	.000

application of the 5E Learning Cycle Method. To gain further insight into the students' motivation, levels in sub-factors such as self-efficacy, rewards, and the value of learning are also gathered in the pre-test and post-test.

Motivation Sub-Factors	Pre-test Mean	Interpretation	Post-test Mean	Interpretation
Self-efficacy	2.28	Low	3.35	Motivated
Rewards	2.57	Low	3.67	High
Value of Learning	2.39	Low	3.62	High

Table 4. Pre-service teachers' motivation level in terms of subfactors in pre-test and post-test

As shown in Table 4, the student's motivation level across subfactors. Self-efficacy in the pre-test has a mean of 2.28, interpreted as low motivation, while the post-test mean is 3.35, indicating high motivation. In terms of rewards, the pre-test mean is 2.57 (low motivation), and the post-test mean is 3.67 (high motivation). Lastly, the mean value of learning is 2.39 on the pre-test and 3.62 on the post-test. It has been figured out that students' motivation levels for mechanics differed before and after using the 5E Learning Cycle Method. To gain further insight into differences in students' motivation levels between the Pre-test and Post-test, the Wilcoxon signed-rank test was applied.

Test	Median	Sample size	w- value	Critical value
Pres- test	53			
Post-test	81	37	0.00	221
Difference	28			

Table 5. The difference in pre-service teachers' motivation levels before and after using the 5E Learning Cycle Method.

As seen in Table 5, the Wilcoxon signed-rank test shows a critical value of 221 and a w-value of 0.000 ($p<0.05$), indicating a significant difference in motivation between the pre-test and post-test. The post-test results show that students were more motivated than in the pre-test, and the data also suggest that the increase in means is statistically significant. Additionally, it implies that the 5E Learning Cycle Method is the cause of this substantial growth. Glynn et al. (2015) define motivation as an inherent sense of fulfillment derived from pursuing scientific knowledge for its own sake. The students' increased motivation can be linked to their overall learning experience through the 5E learning cycle and to their association of "fun" and "enjoyment" with science. Manuel (2018) found that students with a strong drive achieve higher marks and exhibit greater tenacity. According to Gottfried and Gottfried (2004), when students have a strong drive, they are more likely to have higher academic success, have a positive impression of their academic abilities, and experience less concern about their academic performance from infancy to adolescence.

Based on the 37 respondents, the 5E learning cycle method has improved their learning experiences through a low-pressure classroom environment, collaborative activities, and heightened confidence in learning. One apparent theme in the 37 responses is an emphasis on the active, positive classroom environment nurtured by the 5E learning cycle.

Codes	Sample Participant Response
Exciting	(1) "The 5E learning cycle method is exciting; there are stages where we do something, and sometimes we just listen. So, the class is excited and happy. It's not dulled and sleepy."
Fun and enjoyable	(4) "The class is not boring because the students have a part, which is fun and motivates me to listen and participate. Especially in the kinematics lesson, it's hard, but I enjoy it."
	(9) "It's interesting to know what the lesson is about at the beginning of class, and it motivates me to keep going because I find out what the main concepts are towards the end of the lesson. In discussions and group activities, I'm having fun and am less nervous."
No Pressure	(7) "The way the lesson was taught was effective for me since it caught my attention and made me feel like we weren't in class because I enjoyed the activities and there wasn't much pressure, which made the lesson motivating even if it was challenging."

	(35) "I didn't feel nervous while in class, so I feel like I learned. Some activities helped me better understand the lesson. No pressure."
Can freely ask questions or clarifications without discrimination	(11) "You can ask questions while doing the group activities, so it helped me understand the lesson better." (31) "There are a variety of parts that make me more engaged in the class. The discussion part is my favorite because that's where we got clarifications during our group activities. With that, I learned a lot."
New and creative teaching approach	(27) "This style is not really boring because it is done differently, so the atmosphere of the class is good. It makes learning easier." (33) "It's not an ordinary lecture-type discussion; there is student participation and phases with specific things to learn, so I didn't have any difficulty in the lesson, which still motivates me. I will use it soon when I become a teacher."

Table 6. Low-pressure classroom environment

According to Table 6, the 5E learning cycle method creates a low-pressure classroom environment that enables pre-service teachers to absorb a challenging topic more effectively while fostering independent thinking. The learning experience with this strategy is perceived as fun, enjoyable, and exciting, with little to no pressure to understand the topic immediately. Hence, it allows difficult topics to be acquired more openly, removing barriers of subject intimidation. The second recurring theme throughout the 37 responses is collaborative activities that stimulate the social and communicative skills of the participant-students.

Codes	Sample Participant Response
Collaboration with classmates	(16) "The lesson style like this is motivating; maybe because we collaborate, there are more thoughts and more information." (22) "The class is fun because there are many activities. Maybe because a lot of people shared the answer during the group activity, I'm no longer nervous. It is also motivating to participate because everyone is making an effort."
Active class participation	(19) "The method makes our class active during the lesson. All of us participate, which makes us more active and motivated." (26) "Teaching in the 5 E Learning Cycle is OK for me; it has a pattern of stages, so it is quite interesting, and we have participation because there is an activity. I think that is the reason why I understood the lesson."
Inclusive learning	(36) "I feel that I am included in the learning, I learned because of my active participation in the class. I am involved in my learning. There is a part of the class that gets my attention, sir, especially when you ask questions at the beginning. I'm curious what that is about. That's why I'm more engaged in making and participating."
Improved communication skills	(5) "We also have time to work together and exchange ideas after that. I think that's a nice approach for me; it helps me communicate more clearly in class."

Table 7. Collaborative Activities

Table 7 shows that the 5E learning cycle method works well to get pre-service teachers to work together. This theme is supported by codes for how to work with classmates in groups, how to participate in class discussions, how to learn in a way that includes everyone, and how to improve students' communication skills. Likewise, this strategy builds a bridge for learners to better understand a topic through their classmates' varied perspectives and to proactively participate in class discussions or activities. Lastly, the 37 responses further reveal a heightened confidence in earning upon engaging with a topic using the 5E learning cycle.

Codes	Sample Participant Response
Raising low self-esteem	(13) "There is collaboration in the class, so the class is not scary or enjoyable. When the classroom atmosphere is like this, it's motivating to go in because you can learn something. I mustered up the courage to answer the board."

Discarding learning anxieties	(2) "It engaged me to listen, and I lost my nervousness in the mechanics. I understood the topics better, especially projectile motion, because we made them real. Also, you gave many examples of the application, so I appreciate the lesson." (20) "This teaching style is effective because I am more able to understand and don't get nervous in class; it gives me positive energy. Then, in the discussion, an example is given, and I understand the lesson better, even though I feel it's difficult. In short, it makes my understanding easier."
Positive outlook toward learning	(28) "It improves my understanding of laws of motion. Maybe because of the example problems we answered during the discussion and group activities". (34) "The learning cycle method helped me analyze and understand the lesson."

Table 8. Heightened Confidence in Learning

Based on Table 8, there is apparent personal development among the students when they engage with a topic through the 5E learning cycle. The data provided suggests that the teaching strategy cultivates a confident learner by gradually raising their low self-esteem, eventually helping them discard learning anxieties, and molding a positive outlook towards learning. Through these personal changes, the participant-students state that they can acquire information and apply concepts more satisfactorily, given their relaxed and optimistic mindset towards the subject, despite its level of difficulty.

Upon conducting a thematic analysis of students' experiences with the 5E learning cycle method, there is an identifiable change in their classroom setup, characterized by a low-pressure environment, participation in activities that reinforce proactive collaboration, and increased confidence in learning, thereby stimulating their academic intelligence. Furthermore, overarched by the theme of an escalated motivation for learning. As stated by one of the respondents, *"The subject is difficult, but because of the 5E Learning Cycle, I understood the lesson better. It is motivating to study when there is collaboration and group work, as more ideas emerge. The tendency is that I understand it more easily"* (37). As such, the 5E learning cycle method can provide creative and effective teaching strategies tailored to students' contemporary learning capabilities and intelligence.

Conclusion and Recommendations

The following inferences were derived based on the findings of the study:

1. The study revealed that pre-service teachers demonstrated an average level of achievement in Mechanics prior to the implementation of the 5E Learning Cycle Method. However, following the intervention, their performance improved to an above-average level, indicating a notable enhancement in conceptual understanding.
2. A statistically significant improvement in achievement scores was observed between the pre-test and post-test results.This finding affirms that implementing the 5E Learning Cycle Method has a positive and meaningful effect on students' academic performance in Mechanics.
3. In terms of motivation, pre-service teachers initially exhibited a low level of motivation toward learning Physics. After implementing the 5E Learning Cycle Method, their motivation increased to a highly motivated level, reflecting a substantial positive shift in learners' affective engagement.
4. The increase in motivation was also found to be statistically significant, suggesting that the 5E Learning Cycle Method not only enhances cognitive achievement but also plays a crucial role in strengthening students' intrinsic motivation toward learning Mechanics.
5. The findings further suggest that the 5E Learning Cycle Method fosters a learner-centered and inquiry-based learning environment, allowing pre-service teachers to actively construct knowledge through exploration, collaboration, and scientific investigation. This interactive approach promotes deeper conceptual understanding and creates a more engaging and meaningful learning experience in Mechanics.

In light of the foregoing, these recommendations are suggested:

1. For Teachers: Given the demonstrated effectiveness of the 5E Learning Cycle Method, teachers are encouraged to integrate this instructional approach into their teaching practices, particularly in Mechanics. Its structured, inquiry-based design can facilitate deeper conceptual understanding and promote meaningful, relational learning among students.

2. For School Administrators: School leaders and administrators are encouraged to support and promote the sustained implementation of the 5E Learning Cycle Method as part of inquiry-based instruction in Physics. Providing institutional support, resources, and instructional flexibility can strengthen its adoption and contribute to continuous improvement in teaching and learning outcomes.
3. For Professional Development Providers: Teachers should be provided with targeted professional development opportunities such as seminars, training programs, and hands-on workshops focused on the effective implementation of the 5E Learning Cycle Method. These capacity-building activities will enhance teachers' instructional competence and confidence in applying the strategy.
4. For Curriculum Planners and Education Stakeholders: It is recommended that curriculum developers and education stakeholders consider integrating the 5E Learning Cycle Method into instructional frameworks and teaching guides in Science education to ensure consistency in its application and maximize its impact on student learning.
5. For Future Researchers: Future studies are encouraged to replicate this research using a larger and more diverse sample to further validate the findings. Researchers may also explore the long-term effects of the 5E Learning Cycle Method on students' achievement and motivation in Physics, as well as its effectiveness across different grade levels and learning contexts.

Acknowledgement

The author is very grateful to the colleagues and institutions who provided advice, constructive suggestions, and constant support throughout this study and the preparation of this manuscript. The authors take full responsibility for any remaining errors or omissions in the work.

Funding

There was no external financial support for this study from public, commercial, or not-for-profit funding agencies. Funding for the design, conduct, authorship, and publication of this research was not provided by any organization.

Competing Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

The data that support the findings of this study are not publicly available due to confidentiality and privacy. However, they are available from the corresponding author on reasonable request and with the permission of the appropriate authority.

References

Boakye, S., & Nabie, M. J. (2022, June 29). The effect of using the 5E instructional model on students' performance in and motivation to learn sine rule and its applications. International Journal of Curriculum and Educational Studies. https://ijces.net/index.php/ijces/article/view/12

Bybee, R. W. (2009). The BSCS 5E instructional model and 21st-century skills. Biological Sciences Curriculum Study. https://bscs.org/resources/reports/the-bscs-5e-instructional-model-and-21st-century-

Bybee, R. W. (2015). The BSCS 5E instructional model: Creating teachable moments. NSTA Press. https://my.nsta.org/resource/101638/the-bscs-5e-instructional-model-creating-teachable-moments

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. M. (2006). The BSCS 5E instructional model: Origins and effectiveness. Biological Sciences Curriculum Study. https://bscs.org/resources/reports/the-bscs-5e-instructional-model-origins-and-effectiveness

Glynn, S. M., Bryan, R. R., Brickman, P., & Armstrong, N. (2015). Intrinsic motivation, self-efficacy, and interest in science. In R. K. Sawyer (Ed.), The Cambridge handbook of the learning sciences (2nd ed.). Cambridge University Press. https://doi.org/10.3102/978-0-935302-42-4_11

Gottfried, A. E., & Gottfried, A. W. (2004). Toward the development of a motivational theory of giftedness. In S. M. Reis (Ed.), Essential readings in gifted education: Programs and services for gifted learners (pp. 121–136). Corwin Press. https://doi.org/10.4135/9781483328680.n9

Jack, G. U. (2017). The effect of learning cycle constructivist-based approach on students' academic achievement and attitude towards chemistry in secondary schools in north-eastern part of Nigeria. Educational Research and Reviews, 12(7), 456–466. https://doi.org/10.5897/ERR2016.3095

Karthikeyan, S., & Densia, S. P. (2021). The effect of 5E learning cycle model in teaching physics on students' academic achievement and the permanence of their knowledge. Elementary Education Online, 20(5), 6324–6330. https://doi.org/10.17051/ilkonline.2021.05.713

Manuel, R. (2018). Attitude and motivation towards learning physics. arXiv. https://doi.org/10.48550/arXiv.1805.02293

Nisa, K., Ramadhan, S., & Thahar, H. E. (2022). 5E learning cycle model on students' learning outcomes. Al-Ishlah: Jurnal Pendidikan, 14(3), 3361–3374. https://doi.org/10.35445/alishlah.v14i3.1868

Paguirigan, E. M., & Paguirigan, M. J. R. (2024). Development of a mathematics module using the 5E learning model. International Journal of Learning, Teaching and Educational Research,23(11), 504–519. https://doi.org/10.26803/ijlter.23.11.26

Piaget, J. (1970). Science of education and the psychology of the child. Orion Press.

Putra, F., Kholifah, I. Y. N., Subali, B., & Rusilowati, A. (2018). 5E-learning cycle strategy: Increasing conceptual understanding and learning motivation. Jurnal Ilmiah Pendidikan Fisika Al-Biruni, 7(2), 171–181. https://doi.org/10.24042/jipfalbiruni.v7i2.2898

Uswatun. (2020). The 5E learning cycle model, in an effort to foster students' mathematical communication skills viewed from an academic level. Journal of Physics: Conference Series, 1657(1), Article 012091. https://doi.org/10.1088/1742-6596/1657/1/012091

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

Yonyubon, S., Khamsong, J., & Worapun, W. (2022, August 24). The effects of 5E inquiry-based learning management on grade 7 students' science learning achievement. Journal of Educational Issues, 8(2). https://doi.org/10.5296/jei.v8i2.20082

Appendices

No appendices are attached to this study.