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JPF | Volume XX | Number X | Year | Page X-X

p - ISSN: 2302-8939
e - ISSN: 2527-4015

Jurnal Pendidikan Fisika

https://journal.unismuh.ac.id/index.php/jpf

DOI: 10.26618/jpf/xxxx

WRITING GUIDELINES FOR JURNAL PENDIDIKAN FISIKA (JPF)

Experience Learning Cycle-Based Classroom Management Prophetic Integrated PhET Virtual Labs to Enhance Students' Understanding of Wave Concepts

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Received: Month XX,20XX; Accepted: Month XX, 20XX; Published: Month XX, 20XX

Abstract – *Wave concept learning in physics is widely recognized as highly abstract, often leading to students' misconceptions, particularly when instruction is conducted through virtual laboratories. On the other hand, classroom management in Virtual Science Labs has not been systematically designed to support meaningful learning experiences while simultaneously fostering students' character development. The urgency of this study lies in the need for a classroom management model that is not only oriented toward improving conceptual understanding but also toward strengthening prophetic character values in physics learning. This study aims to develop and examine the feasibility and effectiveness of classroom management based on the Experiential Learning Cycle (ELC) in Virtual Science Labs (PhET Simulations) integrated with prophetic values to enhance students' understanding of wave concepts. The research employed a Research and Development (R&D) approach using the ADDIE model. The research subjects consisted of 14 fifth-semester students of the Physics Education Study Program at Universitas Muhammadiyah Prof. Dr. Hamka (UHAMKA) in the 2024–2025 academic year. Research instruments included expert validation sheets, conceptual understanding tests (pre-test and post-test), and prophetic character observation sheets. The results of expert validation indicate that the classroom management guide falls into the very feasible category, with an average validation score for content and media of 3.67 and a feasibility percentage of 87.5% for both aspects. Product implementation demonstrated a significant improvement in students' conceptual understanding, with an average N-Gain score of 0.75 (high category). Furthermore, the integration of prophetic values successfully fostered students' character development, as reflected in the achievement of Sidiq (90%) and Amanah (85%) values during the virtual practicum process. The novelty of this study lies in the systematic integration of the ELC framework, interactive PhET visualizations, and the internalization of prophetic values within a single classroom management guide. This study concludes that ELC-based classroom management integrated with prophetic values is effective in enhancing both students' cognitive quality and moral integrity. The findings contribute an alternative holistic virtual*

p - ISSN: 2302-8939
e - ISSN: 2527-4015

classroom management model for physics learning, particularly for wave-related topics in higher education.

Keywords: *Class Management, Experience Learning Cycle, PhET Simulation, Prophetic Values, Understanding the Concept of Waves.*

I. INTRODUCTION

Higher science education in the era of the Industrial Revolution 4.0 and Society 5.0 demands pedagogical transformation that not only emphasizes knowledge transfer but also focuses on the development of digital literacy and character. Education functions as a catalyst in the advancement of a nation (B. A. Habsy et al., 2024). Physics learning in higher education requires students not only to master mathematical formulations but also to construct deep and meaningful conceptual understanding. As one of the major branches of science, physics contributes to the understanding of natural phenomena, technological development, and the solution of practical problems in everyday life (S. Smye, 2018). Wave concepts constitute one of the fundamental yet abstract topics in physics, as they involve mathematical representations, spatial visualization, and the integration of theoretical models with physical phenomena. Based on initial observations and a preliminary study conducted with fifth-semester physics education students at UHAMKA, several critical issues were identified. Pre-test results indicated that only 35% of students were able to surpass the minimum passing threshold on standing wave and interference topics. In addition, perception questionnaires revealed that 65% of students experienced difficulties in visualizing wave phases and the relationships among variables when learning through textual media or static images. Overall, classroom management was still dominated by rigid instructor-centered instruction, resulting in limited student autonomy in experimentation. Consequently, students tended to be less honest in reporting practicum data, as they attempted to align their results with textbook theories. Students continued to experience misconceptions related to wave concepts, such as the relationships among frequency, wavelength, and wave speed, as well as difficulties in interpreting graphical representations and simulations (Tongchai et al., 2011; Wittmann, Steinberg, & Redish, 2003).

Wave phenomena such as interference, diffraction, and the principle of superposition are difficult to visualize through chalk-and-board explanations or one-way lectures alone. Physical laboratories also often face limitations in presenting dynamic visualizations that can be manipulated instantly. As a result, students frequently develop misconceptions. The use of digital technology, particularly virtual laboratories, has therefore emerged as a viable alternative to address these challenges. PhET Virtual Labs / PhET Simulations (Physics Education Technology

Simulations) represent an innovative solution that facilitates students' understanding of physics concepts in a more interactive and accessible manner (R. Darwis et al., 2023). PhET simulation media are freely available to both educators and students through the official website (P. Vogt, T. Wilhelm, & J. Kuhn, 2023). Previous studies have highlighted that the use of PhET simulations can enhance students' conceptual understanding and engagement compared to conventional instructional approaches (Perkins et al., 2006; Wieman, Adams, & Perkins, 2008). However, without structured classroom management, the implementation of PhET simulations risks becoming merely demonstrative, providing limited opportunities for students to engage in reflective thinking processes (Smetana & Bell, 2012).

To ensure meaningful learning processes, an appropriate instructional model is required, namely the Experiential Learning Cycle (ELC), which guides students through a sequence of authentic experiences toward active experimentation. This approach emphasizes learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). A growing body of research indicates that experiential learning–based instruction is effective in enhancing students' conceptual understanding, critical thinking skills, and engagement in science learning (Yardley, Teunissen, & Dornan, 2012; Morris, 2020).

Beyond cognitive aspects, one of the major challenges in contemporary education is the crisis of integrity. Science education should not be detached from theological and humanitarian values. Through the integration of prophetic values such as *Sidiq* (data honesty), *Amanah* (responsibility in task completion), *Tabligh* (scientific communication), and *Fatonah* (solution-oriented intelligence), students are expected to develop not only academic competence but also strong moral commitment. The integration of prophetic values such as honesty in scientific processes, responsibility, collaboration, and awareness of the order of nature is considered relevant for shaping holistic academic individuals. Several studies emphasize the importance of integrating values and character education into science learning to ensure that students remain connected to ethical and spiritual dimensions in the development of scientific knowledge (Lickona, 2012; Nuangchalerm, 2018). However, studies that explicitly integrate prophetic values into technology-based physics learning, particularly within virtual laboratory environments, remain relatively limited.

Research on the use of simulation media in physics education has been widely conducted; however, this study offers a distinct novelty that fundamentally differentiates it from previous investigations. The originality of this research lies in a holistic synthesis of three core elements: instructional classroom management through the Experiential Learning Cycle (ELC), the utilization of Virtual Science Labs (PhET Simulations), and the internalization of prophetic values. Specifically, the first dimension of novelty is found in classroom management. While prior studies have tended to focus classroom management primarily on physical order and time discipline, this study systematically manages students' transitions from free exploration to concept discovery within the PhET platform. This structured management ensures that the use of technology does not degenerate into mere visual play, but instead becomes a purposeful and intellectually guided learning experience. Second, the application of the Experiential Learning Cycle (ELC) to wave-related topics offers a novel approach to bridging mathematical abstraction with physical reality. Through this integration, the study provides a comprehensive solution that not only enhances students' cognitive abilities, particularly conceptual understanding, but also strengthens moral integrity and essential skills within a digital learning environment. Third, this study integrates prophetic values (Sidiq, Amanah, Tabligh, and Fatonah) into virtual laboratory activities. Traditionally, character education has often been treated as separate from the domain of pure science. In this research, however, prophetic values are not taught as abstract concepts but are directly internalized through scientific practice. For instance, Sidiq (honesty) is operationalized through accurate and non-manipulative reporting of simulation data, while Fatonah (intellectual acuity) is reflected in students' ability to solve complex problems related to wave phenomena.

II. METHODS

Research Type and Design

This study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which was selected for its systematic and flexible framework in developing and evaluating instructional products in a staged manner (Branch, 2009; Molenda, 2015). The product developed in this study was a classroom management guide for Virtual Science Labs based on the Experiential Learning Cycle (ELC), integrated with prophetic values specifically *Sidiq, Amanah, Tabligh,* and *Fatonah* for wave-related topics using PhET Simulations.

Research Participants and Setting

The research participants consisted of 14 fifth-semester students from the Physics Education Study Program at Universitas Muhammadiyah Prof. Dr. Hamka (UHAMKA) in the 2024–2025 academic year. The participants were selected using purposive sampling, based on the consideration that the students had completed foundational physics courses and had prior experience using virtual laboratory environments.

Research Procedures / Development Procedures

The product development procedures using the ADDIE model can be seen in the figure.

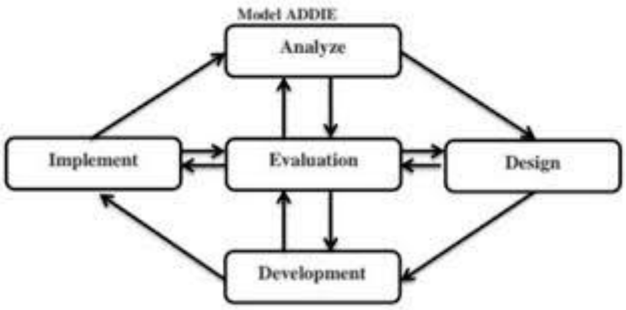

Figure 1. ADDIE Model Stages

a. **Analysis Stage**, The analysis stage involved a needs assessment through curriculum review, analysis of student characteristics, and identification of students' difficulties in understanding abstract wave concepts. This stage also examined the need for utilizing PhET virtual laboratories as visual–interactive learning media, as well as the potential for integrating prophetic values into physics learning (Perkins et al., 2006; Wieman et al., 2008).
b. **Design Stage,** The design stage focused on developing a classroom management model based on the Experiential Learning Cycle (ELC), which includes the stages of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Each ELC stage was aligned with specific PhET simulation activities and integrated with prophetic values encompassing humanization, liberation, and transcendence, as proposed by Kuntowijoyo (2006). At this stage, instructional materials and assessment instruments for measuring students' conceptual understanding of wave topics were also designed.
c. **Development Stage**, The development stage involved producing the initial product in the form of a classroom management guide, PhET virtual lab–based learning scenarios, and instruments for evaluating conceptual understanding. The developed products were subsequently validated by subject-matter experts and instructional design experts to assess content validity, construct validity, and linguistic clarity. This validation process is a critical component of R&D studies to ensure product quality prior to implementation (Branch, 2009).
d. **Implementation Stage** , The implementation stage consisted of applying the developed product in a Wave Physics course. The trial was conducted in a single class using a pre-test and post-test design to obtain data on improvements in students' conceptual understanding of wave concepts. During implementation, observations of learning

implementation were carried out, and students' responses to the use of PhET simulations and the integration of prophetic values were collected.

e. **Evaluation Stage**, The evaluation stage was conducted through both formative and summative evaluation processes. Formative evaluation was used to refine and improve the product at each phase of the ADDIE model, while summative evaluation aimed to assess the effectiveness of the developed product in enhancing students' understanding of wave concepts. Product effectiveness was analyzed using the normalized gain (N-gain) score, which is widely employed to measure improvements in conceptual understanding in physics education (Hake, 1998).

Research Instruments

The instruments used in this study included:

a. Expert validation sheets, which were employed to assess the feasibility of the content, media, and the integration of prophetic values in the developed product;
b. Wave concept understanding tests, consisting of pre-test and post-test items designed to measure improvements in students' conceptual understanding;
c. Prophetic character observation sheets, which were used to evaluate the implementation of learning activities and the integration of prophetic values during PhET-based practicum sessions

Data Collection Techniques

Data were collected through expert validation of the developed product, administration of conceptual understanding tests before and after the implementation, and direct observations conducted during virtual laboratory learning to assess the development of students' prophetic character.

Data Analysis Techniques

a. Product Feasibility Analysis (Expert Validation), Data obtained from expert validation were analyzed using a five-point Likert scale. The results were then calculated in terms of mean scores and feasibility percentages to determine the level of product feasibility.

Table 1. Likert scale (Sugiono,2019)

Mean Score Range	Feasibility Percentage	Feasibility Category
4.21 – 5.00	81% – 100%	Highly Feasible
3.41 – 4.20	61% – 80%	Feasible
2.61 – 3.40	41% – 60%	Moderately Feasible

Mean Score Range	Feasibility Percentage	Feasibility Category
1.81 – 2.60	21% – 40%	Less Feasible
1.00 – 1.80	0% – 20%	Not Feasible

b. **Analysis of Conceptual Understanding Improvement**, The improvement in students' conceptual understanding was analyzed using the normalized gain (N-gain) derived from pre-test and post-test scores. The N-gain analysis was employed to indicate the effectiveness level of the instructional product in enhancing students' conceptual understanding (Hake, 1998).

$$\text{N -Gain} = \frac{(Post-Test\ Score\ )-(Pre-Test\ Score)}{(Maximum\ score)-\ (Pre-Test\ Score)} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots.(1)$$

The N-gain value represents the proportion of the possible improvement in conceptual understanding achieved by students after the implementation of the learning intervention

Table 2. gain score classification

Gain Score	Categori
(g ≥70)	High
(0,30≤ g < 0,70)	Moderate
(g < 0,30)	Low

c. **Analysis of Prophetic Character**, The analysis of prophetic character was conducted using a descriptive quantitative approach based on observational data regarding the achievement of indicators related to *Sidiq*, *Amanah*, *Tabligh,* and *Fatonah* values. Each indicator was scored using an observation rubric, and the obtained scores were converted into percentages to represent the level of character achievement. The percentage scores were then interpreted using predetermined achievement categories (Kuntowijoyo 2006, 2017; Lickona, 2012; Zuchdi, 2011)

Table 3. Prophetic Character Achievement Categories

Percentage Range	Achievement Category
81% – 100%	Highly Feasible
61% – 80%	Feasible
41% – 60%	Moderately Feasible
21% – 40%	Less Feasible
0% – 20%	Not Feasible

III. RESULTS AND DISCUSSION

The results and discussion of this study are presented in an integrated manner based on the stages of the ADDIE model, encompassing the validation of instructional tools and the analysis of students' conceptual understanding.

Analysis Stage, the needs analysis results revealed that 80% of students experienced difficulties in understanding standing wave concepts due to limited visualization. In addition, existing classroom management was found to remain predominantly teacher-centered, resulting in low levels of student autonomy in experimentation. Consequently, students continued to encounter difficulties in comprehending wave concepts that are abstract and dynamic in nature. These findings are consistent with previous studies by Hake (1998) and McDermott and Redish (1999), which indicate that conventional physics instruction often fails to facilitate meaningful conceptual construction. This condition served as the foundation for developing a learning approach that integrates the Experiential Learning Cycle (ELC), PhET Virtual Labs, and prophetic values as an alternative framework emphasizing experiential learning, visual representation, and conceptual reflection.

Design Stage, the instructional model was developed following the stages of the Experiential Learning Cycle (ELC), which were integrated with PhET simulations and reflective activities grounded in prophetic values. This design was intended to guide students through concrete experiences, reflective observation, abstract conceptualization, and active application. This approach aligns with Kolb's experiential learning theory (Kolb, 1984) and is supported by the findings of Wieman et al. (2010), which indicate that interactive simulations are most effective when combined with well-defined pedagogical structures.

Development Stage, The results of the development stage are presented through the expert validation tables for content and media, which indicate that the developed instructional tools fall within the valid to highly valid categories. The expert validation results, including content expert validation and media expert validation, are presented in Table 4 and Table 5, respectively.

Table 4. Results of Content Expert Validation

No	Assessed Aspect	Maximum Score	Obtained Score	Percentage (%)	Category
1	Alignment of wave material with Course Learning Outcomes (CLO)	4	4	100	Highly Feasible
2	Accuracy of wave concepts and definitions	4	3	75	Feasible
3	Alignment of learning materials with the ELC syntax	4	4	100	Highly Feasible
4	Depth of content and contextual examples	4	3	75	Feasible

No	Assessed Aspect	Maximum Score	Obtained Score	Percentage (%)	Category
5	Integration of learning materials with PhET simulations	4	4	100	Highly Feasible
6	Clarity of conceptual understanding indicators	4	4	100	Highly Feasible
Average			3,67	87,5	Highly Feasible

Tabel 5. Results of Media Expert Validation

No	Assessed Aspect	Maximum Score	Obtained Score	Percentage (%)	Category
1	Alignment of PhET visual design with learning objectives	4	4	100	Highly Feasible
2	Clarity of simulation usage instructions	4	3	75	Feasible
3	Interactivity and ease of navigation	4	3	75	Feasible
4	Alignment of PhET simulations with ELC stages	4	3	75	Feasible
5	Integration of media with students' reflective activities	4	3	75	Feasible
6	Media support for understanding wave concepts	4	4	100	Highly Feasible
Average			3,33	83,3	Highly Feasible

The results of both content and media expert validation indicate that the developed instructional product meets a high level of feasibility. Content expert validation yielded an average score of 3.67 with a feasibility percentage of 87.5%, placing the learning materials in the highly feasible category. These results suggest that the wave concepts are conceptually accurate, well aligned with course learning outcomes, structured according to the Experiential Learning Cycle (ELC), and effectively integrated with PhET simulations. Such alignment is essential to ensure that instructional materials support meaningful conceptual construction rather than procedural learning alone (Kolb, 1984; McDermott & Redish, 1999). Similarly, media expert validation produced an average score of 3.33 with a feasibility percentage of 83.3%, which also falls within the highly feasible category. These findings indicate that the PhET-based media are visually appropriate, interactive, and pedagogically aligned with the stages of the ELC, thereby supporting students' engagement and conceptual understanding of wave phenomena. Previous studies have emphasized that interactive simulations are most effective when embedded within a clear instructional structure and guided learning activities (Perkins et al., 2006; Wieman, Adams,

& Perkins, 2008; Wieman et al., 2010). The findings of this study reinforce previous research highlighting that expert validation is a crucial stage in the development of technology-based learning devices to ensure conceptual accuracy, media quality, and the coherence of instructional design prior to broader implementation (Plomp, 2013; Nieveen, 2017).Overall, the convergence of high feasibility ratings from both content and media experts confirms that the developed classroom management guide and PhET-based learning design are suitable for implementation. This finding is consistent with R&D principles, which emphasize expert validation as a critical step to ensure product quality and instructional effectiveness prior to field implementation (Branch, 2009; Molenda, 2015).

Implementation Stage, The implementation stage was conducted to measure the effectiveness of the developed classroom management approach in enhancing students' conceptual understanding of wave topics among fifth-semester Physics Education students in the 2024–2025 academic year. Effectiveness was assessed by comparing students' scores before the intervention (pre-test) and after the intervention (post-test). The results of the data analysis are presented in **Table 6**.

Tabel 6. Nilai Pre-test, Post-test, dan N-Gain

Test	Average Score	Category
Pre-test	42,50	Low
Post-test	85,40	High
N-gain	0,75	High

Based on the data presented in Table 6, there is a significant improvement in students' conceptual understanding. The average student score increased from 42.50 in the pre-test to 85.40 in the post-test. To determine the effectiveness of the learning model more accurately, the N-gain score analysis was employed. The results show an N-gain value of 0.75, which, according to the criteria proposed by Hake (1998), falls into the high category. This improvement can be explained by the characteristics of the Experiential Learning Cycle (ELC), which encourages active student engagement and the gradual construction of knowledge through experience, reflection, conceptualization, and application. The use of PhET Virtual Laboratories played a crucial role in helping students visualize wave phenomena that are difficult to observe directly, as supported by previous studies (Finkelstein et al., 2005; Perkins et al., 2006). Furthermore, the integration of profhetic values strengthened the reflective phase of learning, enabling students not only to develop cognitive understanding but also to connect scientific concepts with meaning and values. Such integration contributes to deeper learning experiences, as emphasized by Lickona (2012), who highlights the importance of value-based reflection in fostering meaningful and holistic learning.

Evaluation Stage, The evaluation stage also examined the effectiveness of the developed product through observations of student behaviors reflecting profhetic values during the learning process. The results of the observation on the integration of profhetic values in PhET-based practicum activities are presented in Table 7.

Table 7. Results of the Validation of Profhetic Values Integration in PhET-Based Practicum

No	Prophetic Value	Indicator in PhET-Based Practicum	Score (%)	Category
1	Scientific Honesty (Shiddiq)	Students accurately record PhET simulation observations without data manipulation	90	Very Feasible
2	Responsibility (Amanah)	Students complete PhET practicum tasks according to established procedures and timelines	85	Very Feasible
3	Openness & Reflection (Tabligh)	Students openly communicate simulation exploration results and reflect on wave concepts	80	Feasible
4	Scientific Accuracy (Fathanah)	Students correctly analyze relationships among wave variables using PhET simulations	88	Very Feasible
5	Collaboration	Students actively collaborate in groups during PhET-based exploration and discussion	85	Very Feasible
6	Spiritual Awareness	Students reflect on the orderliness of wave phenomena as part of divine creation	82	Very Feasible
Average			85,0	Very Feasible

The validation results of prophetic value integration in PhET-based practicums indicate an average percentage of 85.0%, categorized as very feasible. Scientific honesty, responsibility, and scientific accuracy achieved high scores, as PhET practicum activities encouraged students to conduct observations, record data, and perform analyses independently and objectively. In addition, collaboration and openness in communication were fostered through group discussions and presentations of simulation exploration results. These findings should be interpreted with caution due to the limited number of research participants, which involved only 14 students. This limitation restricts the generalizability of the results; therefore, the study is more appropriately positioned as an initial indication or preliminary finding. Comparatively, the results are consistent with previous studies reporting the effectiveness of experiential learning and interactive simulations in enhancing students' conceptual understanding of physics (Hake, 1998; Wieman et al., 2010). The main contribution of this study lies in the integration of prophetic values within the ELC–PhET framework, which enriches the reflective dimension of learning and remains relatively underexplored in similar empirical research.

Based on the findings of this study, it was found that the development of a classroom management guide based on the Experiential Learning Cycle (ELC) integrated with prophetic values in PhET Virtual Labs had a significant impact on students' conceptual understanding of wave phenomena. This result is consistent with the study by Yoan et al. (2021), which reported that PhET simulations provide strong visualizations that help minimize misconceptions in abstract physics topics. However, this study extends previous research by systematically implementing the ELC framework. Through the *Reflective Observation* stage, students were not merely engaged in manipulating simulations, but were guided to critically reflect on the observed phenomena. As emphasized by Abdulwahed and Nagy (2013), Kolb's learning cycle transforms practical experiences into a deep process of knowledge transformation. Furthermore, Emmer and Sabornie (2015) argue that effective classroom management serves as the primary foundation for instructional success. This perspective aligns with Syifa (2022), who highlights that the integration of prophetic values in science education contributes to the formation of scientists with strong moral integrity. The emergence of *Fathanah* (intellectual acumen) was also evident when students were able to solve complex problems related to wave interference phenomena, indicating that intellectual and spiritual intelligence can develop concurrently within well-managed learning environments.

Overall, the results across all ADDIE stages demonstrate a systematic alignment between needs analysis, the quality of instructional design and learning materials, the implementation process, and students' conceptual understanding outcomes, although this study remains limited by the relatively small number of research participants

CONCLUSION AND SUGGESTION

Based on the results of the research and development conducted on prophetic-integrated classroom management based on the Experiential Learning Cycle (ELC) in PhET Virtual Labs, several conclusions can be drawn. (1) **Product Validity**: The developed Classroom Management Guide was evaluated by experts and categorized as *very feasible*. The material validation achieved an average score of 3.67, while the media and instructional design validation obtained an average score of 3.33. These results indicate that the guide meets the standards of physics conceptual accuracy, ELC pedagogical principles, and the integration of prophetic values. (2) **Cognitive Effectiveness**: The implementation of the classroom management guide proved effective in enhancing students' conceptual understanding of wave phenomena. This was evidenced by an increase in the average score from 42.50 in the pre-test to 85.40 in the post-test, with an N-Gain value of 0.75, which falls within the *high* category. (3) **Implementation of Prophetic Character**: The internalization of prophetic values within classroom management successfully fostered students' character development during virtual practicums. The values of *Shiddiq* (90%) and *Amanah* (85%) were consistently reflected in students' honest data reporting and responsible task completion in accordance with the ELC learning cycle.

Based on the research findings, several recommendations are proposed for future studies. Subsequent researchers are encouraged to examine the effectiveness of this classroom management model on other learning variables, such as students' critical thinking skills and digital literacy. In addition, broader field trials involving larger and more diverse student groups are necessary to examine the stability and consistency of the model's effectiveness across different learner characteristics. Although the findings of this study indicate the potential of the implemented learning model to enhance students' conceptual understanding, the involvement of only 14 students limits the strength of effectiveness claims and the generalizability of the results. Therefore, further investigations employing larger sample sizes are required to validate and strengthen the empirical evidence of the model's effectiveness.

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WRITING GUIDELINES FOR JURNAL PENDIDIKAN FISIKA (JPF)

Experience Learning Cycle-Based Classroom Management Prophetic Integrated PhET Virtual Labs to Enhance Students' Understanding of Wave Concepts

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Received: Month XX,20XX; Accepted: Month XX, 20XX; Published: Month XX, 20XX

Abstract *– Wave concept learning in physics is widely recognized as highly abstract, often leading to students' misconceptions, particularly when instruction is conducted through virtual laboratories. On the other hand, classroom management in Virtual Science Labs has not been systematically designed to support meaningful learning experiences while simultaneously fostering students' character development. The urgency of this study lies in the need for a classroom management model that is not only oriented toward improving conceptual understanding but also toward strengthening prophetic character values in physics learning. This study aims to develop and examine the feasibility and effectiveness of classroom management based on the Experiential Learning Cycle (ELC) in Virtual Science Labs (PhET Simulations) integrated with prophetic values to enhance students' understanding of wave concepts. The research employed a Research and Development (R&D) approach using the ADDIE model. The research subjects consisted of 14 fifth-semester students of the Physics Education Study Program at Universitas Muhammadiyah Prof. Dr. Hamka (UHAMKA) in the 2024–2025 academic year. Research instruments included expert validation sheets, conceptual understanding tests (pre-test and post-test), and prophetic character observation sheets. The results of expert validation indicate that the classroom management guide falls into the very feasible category, with an average validation score for content and media of 3.67 and a feasibility percentage of 87.5% for both aspects. Product implementation demonstrated a significant improvement in students' conceptual understanding, with an average N-Gain score of 0.75 (high category). Furthermore, the integration of prophetic values successfully fostered students' character development, as reflected in the achievement of Sidiq (90%) and Amanah (85%) values during the virtual practicum process. The novelty of this study lies in the systematic integration of the ELC framework, interactive PhET visualizations, and the internalization of prophetic values within a single classroom management guide. This study concludes that ELC-based classroom management integrated with prophetic values is effective in enhancing both students' cognitive quality and moral integrity. The findings contribute an alternative holistic virtual*

JPF | Volume XX | Number X | Year | Page X-X
p - ISSN: 2302-8939
e - ISSN: 2527-4015

classroom management model for physics learning, particularly for wave-related topics in higher education.

Keywords: *Class Management, Experience Learning Cycle, PhET Simulation, Prophetic Values, Understanding the Concept of Waves.*

I. INTRODUCTION

14 Higher science education in the era of the Industrial Revolution 4.0 and Society 5.0 demands pedagogical transformation that not only emphasizes knowledge transfer but also focuses on the development of digital literacy and character. Education functions as a catalyst in the advancement of a nation (B. A. Habsy et al., 2024). Physics learning in higher education requires students not only to master mathematical formulations but also to construct deep and meaningful conceptual understanding. As one of the major branches of science, physics contributes to the understanding of natural phenomena, technological development, and the solution of practical problems in everyday life (S. Smye, 2018). Wave concepts constitute one of the fundamental yet abstract topics in physics, as they involve mathematical representations, spatial visualization, and the integration of theoretical models with physical phenomena. Based on initial observations and a preliminary study conducted with fifth-semester physics education students at UHAMKA, several critical issues were identified. Pre-test results indicated that only 35% of students were able to surpass the minimum passing threshold on standing wave and interference topics. In addition, perception questionnaires revealed that 65% of students experienced difficulties in visualizing wave phases and the relationships among variables when learning through textual media or static images. Overall, classroom management was still dominated by rigid instructor-centered instruction, resulting in limited student autonomy in experimentation. Consequently, students tended to be less honest in reporting practicum data, as they attempted to align their results with textbook theories. Students continued to experience misconceptions related to wave concepts, such as the relationships among frequency, wavelength, and wave speed, as well as difficulties in interpreting graphical representations and simulations (Tongchai et al., 2011; Wittmann, Steinberg, & Redish, 2003).

Wave phenomena such as interference, diffraction, and the principle of superposition are difficult to visualize through chalk-and-board explanations or one-way lectures alone. Physical laboratories also often face limitations in presenting dynamic visualizations that can be manipulated instantly. As a result, students frequently develop misconceptions. 21 The use of digital technology, particularly virtual laboratories, has therefore emerged as a viable alternative to address these challenges. PhET Virtual Labs / PhET Simulations (Physics Education Technology

Simulations) represent an innovative solution that facilitates students' understanding of physics concepts in a more interactive and accessible manner (R. Darwis et al., 2023). PhET simulation media are freely available to both educators and students through the official website (P. Vogt, T. Wilhelm, & J. Kuhn, 2023). Previous studies have highlighted that the use of PhET simulations can enhance students' conceptual understanding and engagement compared to conventional instructional approaches (Perkins et al., 2006; Wieman, Adams, & Perkins, 2008). However, without structured classroom management, the implementation of PhET simulations risks becoming merely demonstrative, providing limited opportunities for students to engage in reflective thinking processes (Smetana & Bell, 2012).

To ensure meaningful learning processes, an appropriate instructional model is required, namely the Experiential Learning Cycle (ELC), which guides students through a sequence of authentic experiences toward active experimentation. This approach emphasizes learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). A growing body of research indicates that experiential learning–based instruction is effective in enhancing students' conceptual understanding, critical thinking skills, and engagement in science learning (Yardley, Teunissen, & Dornan, 2012; Morris, 2020).

Beyond cognitive aspects, one of the major challenges in contemporary education is the crisis of integrity. Science education should not be detached from theological and humanitarian values. Through the integration of prophetic values such as *Sidiq* (data honesty), *Amanah* (responsibility in task completion), *Tabligh* (scientific communication), and *Fatonah* (solution-oriented intelligence), students are expected to develop not only academic competence but also strong moral commitment. The integration of prophetic values such as honesty in scientific processes, responsibility, collaboration, and awareness of the order of nature is considered relevant for shaping holistic academic individuals. Several studies emphasize the importance of integrating values and character education into science learning to ensure that students remain connected to ethical and spiritual dimensions in the development of scientific knowledge (Lickona, 2012; Nuangchalerm, 2018). However, studies that explicitly integrate prophetic values into technology-based physics learning, particularly within virtual laboratory environments, remain relatively limited.

Research on the use of simulation media in physics education has been widely conducted; however, this study offers a distinct novelty that fundamentally differentiates it from previous investigations. The originality of this research lies in a holistic synthesis of three core elements: instructional classroom management through the Experiential Learning Cycle (ELC), the utilization of Virtual Science Labs (PhET Simulations), and the internalization of prophetic values. Specifically, the first dimension of novelty is found in classroom management. While prior studies have tended to focus classroom management primarily on physical order and time discipline, this study systematically manages students' transitions from free exploration to concept discovery within the PhET platform. This structured management ensures that the use of technology does not degenerate into mere visual play, but instead becomes a purposeful and intellectually guided learning experience. Second, the application of the Experiential Learning Cycle (ELC) to wave-related topics offers a novel approach to bridging mathematical abstraction with physical reality. Through this integration, the study provides a comprehensive solution that not only enhances students' cognitive abilities, particularly conceptual understanding, but also strengthens moral integrity and essential skills within a digital learning environment. Third, this study integrates prophetic values (Sidiq, Amanah, Tabligh, and Fatonah) into virtual laboratory activities. Traditionally, character education has often been treated as separate from the domain of pure science. In this research, however, prophetic values are not taught as abstract concepts but are directly internalized through scientific practice. For instance, Sidiq (honesty) is operationalized through accurate and non-manipulative reporting of simulation data, while Fatonah (intellectual acuity) is reflected in students' ability to solve complex problems related to wave phenomena.

II. METHODS

Research Type and Design

This study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which was selected for its systematic and flexible framework in developing and evaluating instructional products in a staged manner (Branch, 2009; Molenda, 2015). The product developed in this study was a classroom management guide for Virtual Science Labs based on the Experiential Learning Cycle (ELC), integrated with prophetic values specifically *Sidiq, Amanah, Tabligh,* and *Fatonah* for wave-related topics using PhET Simulations.

Research Participants and Setting

The research participants consisted of 14 fifth-semester students from the Physics Education Study Program at Universitas Muhammadiyah Prof. Dr. Hamka (UHAMKA) in the 2024–2025 academic year. The participants were selected using purposive sampling, based on the consideration that the students had completed foundational physics courses and had prior experience using virtual laboratory environments.

Research Procedures / Development Procedures

The product development procedures using the ADDIE model can be seen in the figure.

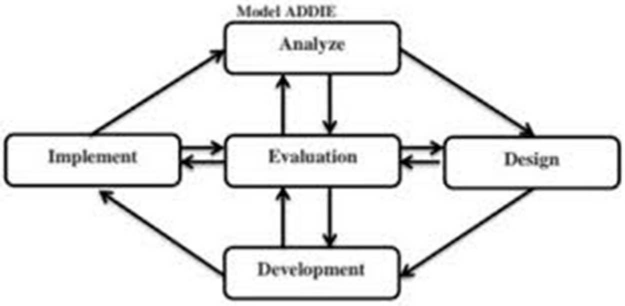

Figure 1. ADDIE Model Stages

a. **Analysis Stage**, The analysis stage involved a needs assessment through curriculum review, analysis of student characteristics, and identification of students' difficulties in understanding abstract wave concepts. This stage also examined the need for utilizing PhET virtual laboratories as visual–interactive learning media, as well as the potential for integrating prophetic values into physics learning (Perkins et al., 2006; Wieman et al., 2008).

b. **Design Stage,** The design stage focused on developing a classroom management model based on the Experiential Learning Cycle (ELC), which includes the stages of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Each ELC stage was aligned with specific PhET simulation activities and integrated with prophetic values encompassing humanization, liberation, and transcendence, as proposed by Kuntowijoyo (2006). At this stage, instructional materials and assessment instruments for measuring students' conceptual understanding of wave topics were also designed.

c. **Development Stage**, The development stage involved producing the initial product in the form of a classroom management guide, PhET virtual lab–based learning scenarios, and instruments for evaluating conceptual understanding. The developed products were subsequently validated by subject-matter experts and instructional design experts to assess content validity, construct validity, and linguistic clarity. This validation process is a critical component of R&D studies to ensure product quality prior to implementation (Branch, 2009).

d. **Implementation Stage** , The implementation stage consisted of applying the developed product in a Wave Physics course. The trial was conducted in a single class using a pre-test and post-test design to obtain data on improvements in students' conceptual understanding of wave concepts. During implementation, observations of learning

48 implementation were carried out, and students' responses to the use of PhET simulations and the integration of prophetic values were collected.

e. **Evaluation Stage**, The evaluation stage was conducted through both formative and summative evaluation processes. Formative evaluation was used to refine and improve the product at each phase of the ADDIE model, while summative evaluation aimed to assess the effectiveness of the developed product in enhancing students' understanding of wave concepts. Product effectiveness was analyzed using the normalized gain (N-gain) score, which is widely employed to measure improvements in conceptual understanding in physics education (Hake, 1998).

Research Instruments

The instruments used in this study included:

a. Expert validation sheets, which were employed to assess the feasibility of the content, media, and the integration of prophetic values in the developed product;
b. Wave concept understanding tests, consisting of pre-test and post-test items designed to measure improvements in students' conceptual understanding;
c. Prophetic character observation sheets, which were used to evaluate the implementation of learning activities and the integration of prophetic values during PhET-based practicum sessions

Data Collection Techniques

Data were collected through expert validation of the developed product, administration of conceptual understanding tests before and after the implementation, and direct observations conducted during virtual laboratory learning to assess the development of students' prophetic character.

Data Analysis Techniques

a. Product Feasibility Analysis (Expert Validation), Data obtained from expert validation were analyzed using a five-point Likert scale. The results were then calculated in terms of mean scores and feasibility percentages to determine the level of product feasibility.

Table 1. Likert scale (Sugiono,2019)

Mean Score Range	Feasibility Percentage	Feasibility Category
4.21 – 5.00	81% – 100%	Highly Feasible
3.41 – 4.20	61% – 80%	Feasible
2.61 – 3.40	41% – 60%	Moderately Feasible

Mean Score Range	Feasibility Percentage	Feasibility Category
1.81 – 2.60	21% – 40%	Less Feasible
1.00 – 1.80	0% – 20%	Not Feasible

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b. **Analysis of Conceptual Understanding Improvement**, The improvement in students' conceptual understanding was analyzed using the normalized gain (N-gain) derived from
4
pre-test and post-test scores. The N-gain analysis was employed to indicate the effectiveness level of the instructional product in enhancing students' conceptual understanding (Hake, 1998).

$$\text{N -Gain} = \frac{(Post-Test\ Score\ )-(Pre-Test\ Score)}{(Maximum\ score)-\ (Pre-Test\ Score)} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

59
The N-gain value represents the proportion of the possible improvement in conceptual understanding achieved by students after the implementation of the learning intervention
26
Table 2. gain score classification

Gain Score	Categori
(g ≥70)	High
(0,30≤ g < 0,70)	Moderate
(g < 0,30)	Low

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c. **Analysis of Prophetic Character**, The analysis of prophetic character was conducted using a descriptive quantitative approach based on observational data regarding the achievement of indicators related to *Sidiq, Amanah, Tabligh,* and *Fatonah* values. Each indicator was scored using an observation rubric, and the obtained scores were converted into percentages to represent the level of character achievement. The percentage scores were then interpreted using predetermined achievement categories (Kuntowijoyo 2006, 2017; Lickona, 2012; Zuchdi, 2011)

Table 3. Prophetic Character Achievement Categories

Percentage Range	Achievement Category
81% – 100%	Highly Feasible
61% – 80%	Feasible
41% – 60%	Moderately Feasible
21% – 40%	Less Feasible
0% – 20%	Not Feasible

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III. RESULTS AND DISCUSSION

The results and discussion of this study are presented in an integrated manner based on the stages of the ADDIE model, encompassing the validation of instructional tools and the analysis of students' conceptual understanding.

Analysis Stage, the needs analysis results revealed that 80% of students experienced difficulties in understanding standing wave concepts due to limited visualization. In addition, existing classroom management was found to remain predominantly teacher-centered, resulting in low levels of student autonomy in experimentation. Consequently, students continued to encounter difficulties in comprehending wave concepts that are abstract and dynamic in nature. These findings are consistent with previous studies by Hake (1998) and McDermott and Redish (1999), which indicate that conventional physics instruction often fails to facilitate meaningful conceptual construction. This condition served as the foundation for developing a learning approach that integrates the Experiential Learning Cycle (ELC), PhET Virtual Labs, and prophetic values as an alternative framework emphasizing experiential learning, visual representation, and conceptual reflection.

Design Stage, the instructional model was developed following the stages of the Experiential Learning Cycle (ELC), which were integrated with PhET simulations and reflective activities grounded in prophetic values. This design was intended to guide students through concrete experiences, reflective observation, abstract conceptualization, and active application. This approach aligns with Kolb's experiential learning theory (Kolb, 1984) and is supported by the findings of Wieman et al. (2010), which indicate that interactive simulations are most effective when combined with well-defined pedagogical structures.

Development Stage, The results of the development stage are presented through the expert validation tables for content and media, which indicate that the developed instructional tools fall within the valid to highly valid categories. The expert validation results, including content expert validation and media expert validation, are presented in Table 4 and Table 5, respectively.

Table 4. Results of Content Expert Validation

No	Assessed Aspect	Maximum Score	Obtained Score	Percentage (%)	Category
1	Alignment of wave material with Course Learning Outcomes (CLO)	4	4	100	Highly Feasible
2	Accuracy of wave concepts and definitions	4	3	75	Feasible
3	Alignment of learning materials with the ELC syntax	4	4	100	Highly Feasible
4	Depth of content and contextual examples	4	3	75	Feasible

No	Assessed Aspect	Maximum Score	Obtained Score	Percentage (%)	Category
5	Integration of learning materials with PhET simulations	4	4	100	Highly Feasible
6	Clarity of conceptual understanding indicators	4	4	100	Highly Feasible
Average			3,67	87,5	Highly Feasible

Tabel 5. Results of Media Expert Validation

No	Assessed Aspect	Maximum Score	Obtained Score	Percentage (%)	Category
1	Alignment of PhET visual design with learning objectives	4	4	100	Highly Feasible
2	Clarity of simulation usage instructions	4	3	75	Feasible
3	Interactivity and ease of navigation	4	3	75	Feasible
4	Alignment of PhET simulations with ELC stages	4	3	75	Feasible
5	Integration of media with students' reflective activities	4	3	75	Feasible
6	Media support for understanding wave concepts	4	4	100	Highly Feasible
Average			3,33	83,3	Highly Feasible

The results of both content and media expert validation indicate that the developed instructional product meets a high level of feasibility. Content expert validation yielded an average score of 3.67 with a feasibility percentage of 87.5%, placing the learning materials in the highly feasible category. These results suggest that the wave concepts are conceptually accurate, well aligned with course learning outcomes, structured according to the Experiential Learning Cycle (ELC), and effectively integrated with PhET simulations. Such alignment is essential to ensure that instructional materials support meaningful conceptual construction rather than procedural learning alone (Kolb, 1984; McDermott & Redish, 1999). Similarly, media expert validation produced an average score of 3.33 with a feasibility percentage of 83.3%, which also falls within the highly feasible category. These findings indicate that the PhET-based media are visually appropriate, interactive, and pedagogically aligned with the stages of the ELC, thereby supporting students' engagement and conceptual understanding of wave phenomena. Previous studies have emphasized that interactive simulations are most effective when embedded within a clear instructional structure and guided learning activities (Perkins et al., 2006; Wieman, Adams,

& Perkins, 2008; Wieman et al., 2010). The findings of this study reinforce previous research highlighting that expert validation is a crucial stage in the development of technology-based learning devices to ensure conceptual accuracy, media quality, and the coherence of instructional design prior to broader implementation (Plomp, 2013; Nieveen, 2017).Overall, the convergence of high feasibility ratings from both content and media experts confirms that the developed classroom management guide and PhET-based learning design are suitable for implementation. This finding is consistent with R&D principles, which emphasize expert validation as a critical step to ensure product quality and instructional effectiveness prior to field implementation (Branch, 2009; Molenda, 2015).

Implementation Stage, The implementation stage was conducted to measure the effectiveness of the developed classroom management approach in enhancing students' conceptual understanding of wave topics among fifth-semester Physics Education students in the 2024–2025 academic year. Effectiveness was assessed by comparing students' scores before the intervention (pre-test) and after the intervention (post-test). The results of the data analysis are presented in **Table 6**.

Tabel 6. Nilai Pre-test, Post-test, dan N-Gain

Test	Average Score	Category
Pre-test	42,50	Low
Post-test	85,40	High
N-gain	0,75	High

Based on the data presented in Table 6, there is a significant improvement in students' conceptual understanding. The average student score increased from 42.50 in the pre-test to 85.40 in the post-test. To determine the effectiveness of the learning model more accurately, the N-gain score analysis was employed. The results show an N-gain value of 0.75, which, according to the criteria proposed by Hake (1998), falls into the high category. This improvement can be explained by the characteristics of the Experiential Learning Cycle (ELC), which encourages active student engagement and the gradual construction of knowledge through experience, reflection, conceptualization, and application. The use of PhET Virtual Laboratories played a crucial role in helping students visualize wave phenomena that are difficult to observe directly, as supported by previous studies (Finkelstein et al., 2005; Perkins et al., 2006). Furthermore, the integration of profhetic values strengthened the reflective phase of learning, enabling students not only to develop cognitive understanding but also to connect scientific concepts with meaning and values. Such integration contributes to deeper learning experiences, as emphasized by Lickona (2012), who highlights the importance of value-based reflection in fostering meaningful and holistic learning.

Evaluation Stage, The evaluation stage also examined the effectiveness of the developed product through observations of student behaviors reflecting profhetic values during the learning process. The results of the observation on the integration of profhetic values in PhET-based practicum activities are presented in Table 7.

Table 7. Results of the Validation of Profhetic Values Integration in PhET-Based Practicum

No	Prophetic Value	Indicator in PhET-Based Practicum	Score (%)	Category
1	Scientific Honesty (Shiddiq)	Students accurately record PhET simulation observations without data manipulation	90	Very Feasible
2	Responsibility (Amanah)	Students complete PhET practicum tasks according to established procedures and timelines	85	Very Feasible
3	Openness & Reflection (Tabligh)	Students openly communicate simulation exploration results and reflect on wave concepts	80	Feasible
4	Scientific Accuracy (Fathanah)	Students correctly analyze relationships among wave variables using PhET simulations	88	Very Feasible
5	Collaboration	Students actively collaborate in groups during PhET-based exploration and discussion	85	Very Feasible
6	Spiritual Awareness	Students reflect on the orderliness of wave phenomena as part of divine creation	82	Very Feasible
Average			85,0	Very Feasible

The validation results of prophetic value integration in PhET-based practicums indicate an average percentage of 85.0%, categorized as very feasible. Scientific honesty, responsibility, and scientific accuracy achieved high scores, as PhET practicum activities encouraged students to conduct observations, record data, and perform analyses independently and objectively. In addition, collaboration and openness in communication were fostered through group discussions and presentations of simulation exploration results. These findings should be interpreted with caution due to the limited number of research participants, which involved only 14 students. This limitation restricts the generalizability of the results; therefore, the study is more appropriately positioned as an initial indication or preliminary finding. Comparatively, the results are consistent with previous studies reporting the effectiveness of experiential learning and interactive simulations in enhancing students' conceptual understanding of physics (Hake, 1998; Wieman et al., 2010). The main contribution of this study lies in the integration of prophetic values within the ELC–PhET framework, which enriches the reflective dimension of learning and remains relatively underexplored in similar empirical research.

Based on the findings of this study, it was found that the development of a classroom management guide based on the Experiential Learning Cycle (ELC) integrated with prophetic values in PhET Virtual Labs had a significant impact on students' conceptual understanding of wave phenomena. This result is consistent with the study by Yoan et al. (2021), which reported that PhET simulations provide strong visualizations that help minimize misconceptions in abstract physics topics. However, this study extends previous research by systematically implementing the ELC framework. Through the *Reflective Observation* stage, students were not merely engaged in manipulating simulations, but were guided to critically reflect on the observed phenomena. As emphasized by Abdulwahed and Nagy (2013), Kolb's learning cycle transforms practical experiences into a deep process of knowledge transformation. Furthermore, Emmer and Sabornie (2015) argue that effective classroom management serves as the primary foundation for instructional success. This perspective aligns with Syifa (2022), who highlights that the integration of prophetic values in science education contributes to the formation of scientists with strong moral integrity. The emergence of *Fathanah* (intellectual acumen) was also evident when students were able to solve complex problems related to wave interference phenomena, indicating that intellectual and spiritual intelligence can develop concurrently within well-managed learning environments.

Overall, the results across all ADDIE stages demonstrate a systematic alignment between needs analysis, the quality of instructional design and learning materials, the implementation process, and students' conceptual understanding outcomes, although this study remains limited by the relatively small number of research participants

CONCLUSION AND SUGGESTION

Based on the results of the research and development conducted on prophetic-integrated classroom management based on the Experiential Learning Cycle (ELC) in PhET Virtual Labs, several conclusions can be drawn. (1) **Product Validity**: The developed Classroom Management Guide was evaluated by experts and categorized as *very feasible*. The material validation achieved an average score of 3.67, while the media and instructional design validation obtained an average score of 3.33. These results indicate that the guide meets the standards of physics conceptual accuracy, ELC pedagogical principles, and the integration of prophetic values. (2) **Cognitive Effectiveness**: The implementation of the classroom management guide proved effective in enhancing students' conceptual understanding of wave phenomena. This was evidenced by an increase in the average score from 42.50 in the pre-test to 85.40 in the post-test, with an N-Gain value of 0.75, which falls within the *high* category. (3) **Implementation of Prophetic Character**: The internalization of prophetic values within classroom management successfully fostered students' character development during virtual practicums. The values of *Shiddiq* (90%) and *Amanah* (85%) were consistently reflected in students' honest data reporting and responsible task completion in accordance with the ELC learning cycle.

63 Based on the research findings, several recommendations are proposed for future studies. Subsequent researchers are encouraged to examine the effectiveness of this classroom management model on other learning variables, such as students' critical thinking skills and digital literacy. In addition, broader field trials involving larger and more diverse student groups are necessary to examine the stability and consistency of the model's effectiveness across different learner characteristics. Although the findings of this study indicate the potential of the implemented learning model to enhance students' conceptual understanding, the involvement of only 14 students limits the strength of effectiveness claims and the generalizability of the results. Therefore, further investigations employing larger sample sizes are required to validate and strengthen the empirical evidence of the model's effectiveness.

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