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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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Abstract – *This study aims to develop and test the feasibility and effectiveness of a product in the form of a classroom management guide based on Experience Learning Cycle (ELC) in Virtual Science Labs (PhET Simulation) that integrates Prophetic values to improve students' understanding of the concept of wave. The research method used is Research and Development (R&D) with the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The research subjects consisted of 14 fifth semester students in the 2024-2025 Physics Education study program at Uhamka. Data collection instruments included expert validation sheets, concept understanding tests (pre-test and post-test), and prophetic character observation sheets. The results of expert validation showed that the classroom management guide was in the very Feasible category with an average material and media validation score of 3.67 with a presentation of 87.5% for both material and media. Product implementation showed a significant increase in conceptual understanding with an average N-Gain score of 0.75 (High Category). Furthermore, the integration of prophetic values successfully fostered student character, with the achievement of Sidiq (90%) and Amanah (85%) values during the virtual practicum process. This study concluded that classroom management that orchestrated the ELC cycle, PhET visualization, and internalization of prophetic values holistically was effective in improving students' cognitive quality and moral integrity in the Wave material.*

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 a pedagogical transformation that focuses not only on knowledge transfer but also on digital literacy and character development. Learning physics in higher education requires students not only to master mathematical formulations but also to develop deep and meaningful conceptual understanding. The concept of waves is a fundamental topic in physics that is abstract because it involves mathematical representation, spatial visualization, and the relationship between theoretical models and physical phenomena. Students still experience misconceptions about the concept of waves, such as the relationship between frequency, wavelength, and speed of propagation, as well as difficulties in interpreting graphic representations and simulations. (Tongchai et al., 2011; Wittmann, Steinberg, & Redish, 2003).

Education is a fundamental component for the progress of a nation. The role of education is very important because it has the ability to shape individuals. Education functions as a catalyst in the development of a nation (B. A. Habsy, et.al., 2024). One relevant learning approach to optimize the use of virtual laboratories is the Experiential Learning Cycle (ELC) proposed by Kolb. This approach emphasizes learning as a cyclical process involving concrete experience, reflection, abstract conceptualization, and active experimentation (Kolb, 1984). Several studies have shown that experiential learning-based learning can improve conceptual understanding. Several studies have shown that experiential learning-based learning can improve conceptual understanding, critical thinking skills, and student engagement in science learning (Yardley, Teunissen, & Dornan, 2012; Morris, 2020).

In this digital era, internet access has become a fundamental need, especially for students who require various online learning resources, both to meet academic demands and to broaden their horizons. The use of digital technology, particularly virtual laboratories, is one alternative to overcome these challenges. PhET Virtual Labs have been widely used in physics learning because they provide interactive visualizations and allow students to explore concepts independently. In this context, PhET Simulations (Physics Education Technology Simulations) are an innovative solution to help students understand physics concepts more easily and interactively (R. Darwis, et al., 2023). PhET Simulations is a technology-based platform that provides interactive virtual simulations for various Physics concepts, such as mechanics, thermodynamics, waves, and electromagnetism. PhET simulation media can be obtained free of charge by both educators and students through the website http://phet.colorado.edu/en/get-phet/full-insta (P. Vogt, T. Wilhelm, and J. Kuhn, 2023). Previous research highlights that the use of PhET can improve conceptual understanding and student engagement compared to conventional learning (Perkins et al., 2006; Wieman, Adams, & Perkins, 2008). This is in line with recommendations from various reviews that emphasize the effectiveness of PhET is highly dependent on classroom management and accompanying pedagogical strategies. Without structured classroom management, the use of PhET has the potential to become only a demonstrative activity that does not encourage students' reflective thinking processes (Smetana & Bell, 2012).

Physics courses, especially at the tertiary level, play a crucial role in the development of science and technology. As a major branch of science, Physics contributes to the understanding of natural phenomena, technological development, and the resolution of practical problems in everyday life (S. Smye, 2018). Physics courses are often considered challenging because of the many abstract concepts that are difficult to grasp without direct experience. On the other hand, physics learning in higher education is not only oriented towards cognitive achievement but also towards character and value formation. The integration of prophetic values such as honesty in the scientific process, responsibility, cooperation, and awareness of the regularity of nature is considered relevant to forming a well-rounded academic person. Several studies emphasize the importance of integrating values and character in science learning so that students are not separated from the ethical and spiritual dimensions in scientific development (Lickona, 2012; Nuangchalerm, 2018). However, those that explicitly integrate prophetic values in technology-based physics learning, particularly virtual laboratories, are still relatively limited.

Based on the novelty of this research lies in the simultaneous integration of three main aspects, namely classroom management, Experiential Learning Cycle, and PhET Virtual Labs, which have generally been studied partially, the internalization of prophetic values in each phase of the Experiential Learning Cycle in virtual laboratory-based physics learning, which is still rarely raised in previous research. While the focus is on understanding the concept of student waves as a conceptual achievement that is systematically studied through classroom management, not only through the use of media or learning models alone.

II. METHODS

This study uses a Research and Development (R&D) approach with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, which was chosen because it is systematic and flexible in developing and evaluating learning products in stages (Branch, 2009; Molenda, 2015). This study aims to develop and test the effectiveness of a classroom management model based on the Experience Learning Cycle (ELC) in PhET Virtual Labs integrated with prophetic values to improve students' understanding of wave concepts. In the analysis stage, an analysis of learning needs was conducted through a review of the curriculum, student characteristics, and identification of students' difficulties in understanding abstract wave concepts. This analysis also includes the need to use PhET virtual laboratories as visual-interactive media and opportunities for integrating prophetic values in physics learning (Perkins et al., 2006; Wieman et al., 2008).

The design stage includes designing a classroom management model based on the Experience Learning Cycle, which includes concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Each ELC stage is mapped with PhET simulation activities and integrated with prophetic values including humanization, liberation, and transcendence, as proposed by Kuntowijoyo (2006). At this stage, learning tools and assessment instruments for understanding the concept of waves are also designed.

The development phase includes the development of initial products in the form of classroom management guides, PhET Virtual Labs-based learning scenarios, and conceptual understanding assessment instruments. The developed products are then validated by subject matter and learning experts to assess the appropriateness of the content, construction, and language. This validation process is a crucial part of development research to ensure product quality before implementation (Branch, 2009).

The implementation phase involved applying the product to a Wave Physics course. A pretest-posttest design was used in one class to obtain data on improvements in understanding of wave concepts. During implementation, observations were made on the learning process and student responses to the use of PhET and the integration of prophetic values were collected.

The evaluation phase was conducted both formatively and summatively. Formative evaluation was used to refine the product at each ADDIE stage, while summative evaluation aimed to assess the product's effectiveness in improving students' understanding of wave concepts. Product effectiveness was analyzed using the N-gain value, which is commonly used to measure improvements in conceptual understanding in physics learning (Hake, 1998).

The research subjects consisted of validators and trial subjects. Validators included physics subject matter experts, learning media experts, and physics practitioners/lecturers. The trial subjects were 14 fifth-semester students of the UHAMKA Physics Education study program taking the Wave course, in the 2024-2025 academic year. Subject selection was purposive, considering the suitability of the material and learning needs.

The instruments used in this study include; Expert validation sheet, which is used to assess the feasibility of the material, media, and integration of prophetic values in the developed product, Wave concept understanding test, in the form of pretest and posttest questions to measure the improvement in students' conceptual understanding, Observation sheet, to assess the implementation of learning and integration of prophetic values during PhET-based practicum. And Student response questionnaire, to obtain data regarding the practicality and acceptability of the product in learning.

Data Analysis Techniques: The results of expert validation were analyzed using quantitative descriptive analysis in the form of a feasibility percentage, then categorized into very feasible, feasible, quite feasible, or not feasible criteria. Data on understanding the concept of waves were analyzed by comparing pretest and posttest scores and calculated using N-gain to determine the level of improvement in students' conceptual understanding. Observation data and student response questionnaires were analyzed descriptively qualitatively and quantitatively to strengthen quantitative findings and provide an overview of the implementation and practicality of the product. The effectiveness of the learning product was analyzed based on the increase in students' understanding of the concept of waves after the implementation of the Experience Learning Cycle-based classroom management model in the PhET Virtual Labs integrated prophetic. Analysis of the increase in conceptual understanding was carried out using normalized gain (N-gain) (Hake, 1998).

The N-gain value is used to indicate the level of effectiveness of learning products in improving students' conceptual understanding.

Tabel 1. gain score classification

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

III. RESULTS AND DISCUSSION

This research aims to develop Experiential Learning Cycle (ELC)-based classroom management in PhET Virtual Labs integrated with prophetic values in wave courses through expert validation processes and limited trials with students.

In the analysis phase, the results of the needs analysis showed that 80% of students found it difficult to understand the concept of stationary waves due to limited visualization. In addition, it was found that the existing classroom management was still teacher-centered, so that students were very low in experimenting. Meanwhile, in the Design Phase, the researcher designed a draft of a wave practicum guidebook that integrates the ELC flow with the PhET feature. This design inserts prophetic messages (Sidiq, Amanah, Tabligh, Fatonah) in each student worksheet.

Development Stage (Development and Validation), expert validation was obtained, namely material expert validation and media expert validation, which can be seen in Table 2 and Table 3.

Table 2. Material Expert Validation Results

No	Rated aspect	Score Maks	Score Obtained	Percentage (%)	Category
1	Compliance of wave material with CPMK	4	4	100	Very Worthy
2	Accuracy of wave concepts and definitions	4	3	75	Worthy

No	Rated aspect	Score Maks	Score Obtained	Percentage (%)	Category
3	Alignment of material with ELC syntax	4	4	100	Very Worthy
4	Depth of material and contextual examples	4	3	75	Worthy
5	Integration of material with PhET simulations	4	4	100	Very Worthy
6	Clarity of conceptual understanding indicators	4	4	100	Very Worthy
Average			3,67	87,5	Very Worthy

Table 3. Media Expert Validation Results

No	Rated aspect	Score Maks	Score Obtained	Percentage (%)	Category
1	The PhET display aligns with learning objectives	4	4	100	Very Worthy
2	The clarity of the simulation instructions	4	3	75	Worthy
3	The interactivity and ease of navigation	4	3	75	Worthy
4	The PhET aligns with the ELC stages	4	3	75	Worthy
5	The integration of media with student reflection activities	4	3	75	Worthy
6	The media support for understanding wave concepts	4	4	100	Very Worthy
Average			3,33	83,3	Very Worthy

The results of the validation by material experts showed that the Experiential Learning Cycle-based classroom management in PhET Virtual Labs obtained an average percentage of 87.5%, categorized as very feasible. This indicates that the wave material presented is in accordance with learning outcomes, conceptually accurate, and integrated with the Experiential Learning Cycle syntax. Meanwhile, the results of the validation by media experts showed that the use of PhET Virtual Labs in classroom management obtained an average percentage of 83.3%, categorized as very feasible. The media used was considered interactive, easy to access, and supports the implementation of the Experiential Learning Cycle in wave learning.

After the product was declared feasible by the experts, the next stage was implementation, to measure the effectiveness of the developed classroom management on students' conceptual understanding of Waves in the 5th semester of Physics Education class in the 2024-2025 academic year. Effectiveness was measured by comparing pre-test and post-test scores. The results of the data processing are presented in Table 4 below.

Table 4. Pre-test, Post-test, and N-Gain Scores

Test	Average Score	Category
Pretest	42,50	Low
Posttest	85,40	High
N-gain	0,75	High

Based on the data in Table 4, there is a significant increase in students' conceptual understanding. The average student score increased from 42.50 to 85.40. To determine the effectiveness of the model more accurately, the researcher used an N-Gain Score analysis. The calculation results show an N-Gain value of 0.75, which according to Hake's (1999) criteria is included in the high category.

The evaluation stage, to test the product's effectiveness, is also evident in observations of student behavior that reflects prophetic values during the learning process, as shown in Table 5.

Table 5. Validation Results of Prophetic Value Integration in PhET-Based Practicums

No	Prophetic Value	Indicators in PhET Practicum	Score (%)	Category
1	Scientific Honesty (Shiddiq)	Students record the results of PhET simulation observations based on the data obtained without manipulation.	90	Very Worthy
2	Responsibility (Amanah)	Students complete PhET practicum assignments according to the established procedures and timeframe.	85	Very Worthy
3	Openness & Reflection (Tabligh)	Students communicate the results of simulation explorations and reflect on wave concepts openly.	80	Layak
4	Scientific Accuracy (Fathanah)	Students analyze the relationships between wave variables through PhET simulations accurately.	88	Very Worthy
5	Cooperation	Students collaborate in groups during PhET-based explorations and discussions.	85	Very Worthy
6	Divine Awareness	Students reflect on the regularity of wave phenomena as part of God's creation.	82	Very Worthy
Average			85,0	Very Worthy

The validation results of the integration of prophetic values in PhET-based practicums showed an average percentage of 85.0 %, categorized as very feasible. The values of scientific honesty, responsibility, and scientific accuracy obtained high scores because PhET practicum activities encouraged students to observe, record, and analyze data independently and objectively. In addition, the values of cooperation and open communication developed through group discussions and presentations of simulation exploration results. The integration of prophetic values in PhET-based practicums was considered relevant and applicable in supporting physics learning that is not only oriented towards conceptual understanding, but also the formation of student character.

Based on the research findings presented, it was found that the development of a classroom management guide based on the Experience Learning Cycle (ELC) in PhET Virtual Labs integrated with Prophetic had a significant impact on students' understanding of the wave concept. This is in line with research by Yoan.et.al (2021) which stated that PhET provides strong visualizations to minimize misconceptions in abstract physics material. However, this study goes further by implementing the ELC cycle. Through the Reflective Observation stage, students do not simply play with simulations but are guided to reflect on the phenomena that occur. As emphasized by Abdulwahed & Nagy (2013), the Kolb learning cycle (ELC) transforms practical experiences into a process of profound knowledge transformation. According to Emmer & Sabornie (2015), effective classroom management is the main foundation of instructional success. This aligns with Syifa's (2022) idea that the integration of prophetic values in science can shape scientists with high moral integrity. The nature of Fatonah (intelligence) also appears when students are able to solve complex problems in the phenomenon of wave interference, which shows that intellectual and spiritual intelligence can grow side by side in proper classroom management.

CONCLUSION AND SUGGESTION

This research resulted in an Experiential Learning Cycle-based classroom management in PhET Virtual Labs that integrates prophetic values for wave concept learning for students and has met the criteria of being very feasible based on validation by material experts, media, and practitioners. Product implementation shows an increase in students' understanding of the wave concept as indicated by an increase in pretest and posttest scores and an N-gain value in the high category, so that experiential learning through PhET is effective in helping concept construction. In addition, the integration of prophetic values in virtual practicum activities is considered relevant and applicable in fostering scientific honesty, responsibility, careful thinking, open communication, and students' divine awareness, so that the developed classroom management is not only oriented towards cognitive aspects, but also towards holistic character formation.

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JURNAL PENDIDIKAN FISIKA

Response to Reviewers' Form

Title of Paper: ***The Past and Present of Thought Experiments' Research. . . . .***

Thank you very much for your informative and constructive comments on our submitted manuscript. We strongly believe that the comments are invaluable for the improvement of the quality of the manuscript. We do agree with most of the comments and tried to reflect them in revising the manuscript as far as we could.

The following are our revisions in response to reviewers' comments. To make clear the changes we have made in the manuscript, we used ***blue text*** *to denote our direct responses to reviewers' comments. The* ***black text*** *denotes original text and* ***red text*** *denotes revisions in the original manuscript.*

Reviewer 1			
No	**Reviewer's comments**	**Response**	**Page No.**
1	The introduction is relevant, the author is active on the field. The analyst is also an actor: ranking himself second in the field he provides a bibliometric analysis of. The topic is interesting, but its significance is not well argued for (some growth in the publications over 20 years is true of most topics not dropping out miserably from researcher focus), so to argue for significance some comparisons could be added.	Thank you for your insightful comments. We appreciate your recognition of the relevance of the introduction and the author's active involvement in the field. We also acknowledge your concern regarding the significance of the topic and agree that adding comparisons would strengthen the argument. We have revised the manuscript to better emphasize the significance of the study by including comparisons with other research topics in physics education. These comparisons highlight the unique growth and sustained interest in TEs relative to other scientific topics over the past 20 years. **Before** Although a number of studies on TEs from various perspectives have been conducted, no study has yet completely studied this field to look at the trend of this topic in recent years. Therefore, it becomes essential to conduct a bibliometric study of TEs over time based on authoritative databases like Scopus. Because of Scopus's comprehensive coverage of scholarly articles in the field of education (Irwanto et al., 2023; Prahanı et al., 2022; Supriadi et al., 2022), it was chosen as the database for this study. Scopus is also a popular resource for bibliometric research (Irwanto et al., 2023; Pranckutė, 2021). For this reason, we use data sources from the Scopus database to carry out the bibliometric method. Our study covers journal articles, conference papers, and book chapters from the last 20 years to provide a more complete view. Therefore, this study aims to provide an up-to-date overview of trends in TEs research. The research questions in this study are as follows: . . . . . **After** Although a number of studies on TEs from various perspectives have been conducted, no study has yet	P.2, L.26-32

		completely studied this field to look at the trend of this topic in recent years. Therefore, it becomes essential to conduct a bibliometric study of TEs over time based on authoritative databases like Scopus. Because of Scopus's comprehensive coverage of scholarly articles in the field of education (Irwanto et al., 2023; Prahanı et al., 2022; Supriadi et al., 2022), it was chosen as the database for this study. Scopus is also a popular resource for bibliometric research (Irwanto et al., 2023; Pranckutė, 2021). For this reason, we use data sources from the Scopus database to carry out the bibliometric method. Our study covers journal articles, conference papers, and book chapters from the last 20 years to provide a more complete view. To highlight the significance of TEs research, we compare its growth to other scientific topics. While many scientific fields have seen growth over the past two decades, TEs research has also shown a unique and sustained increase in interest and publications. This trend contrasts sharply with the decline in research focus on traditional physics experiments (Yun, 2020). Similarly, other topics in physics education, such as methodological issues, textbook analysis and pre-service physics teacher, are also experiencing reduced research interest (Nurazmi & Bancong, 2024). Additionally, the integration of TEs with emerging technologies, such as artificial intelligence, underscores their evolving relevance and potential for future research (Hallsworth et al., 2023) Therefore, this study aims to provide an up-to-date overview of trends in TEs research. The research questions in this study are as follows:	
2	The data suggest that the topic has lost most of its significance where it originally came from: HPS, but there is little discussion of disciplinary shifts, an understanding whether some positions "won" or a consensus emerged in HPS or in other fields.	Thank you for your insightful comments. We recognize the importance of discussing the disciplinary shifts and the evolution of consensus within the fields of history and philosophy of science (HPS) and other disciplines. To address this, we have revised the manuscript to include a detailed discussion on how the significance of thought experiments (TEs) has evolved within HPS and their impact on other fields. This revised section highlights the emergence of new research areas and the shift in focus from traditional HPS to other interdisciplinary applications. **Before** If we look at the authors who have made the greatest contributions to the topic of TEs in the previous 20 years (2003-2022), Stuart is the most significant author with 7 articles (51 citations)…….. Meanwhile, Halkia and Velentzas from the University of Athens, Greece, discussed TEs from an educational perspective, such as using TEs from 'Newton's Cannon' for teaching satellite physics (Velentzas & Halkia, 2013a) and using TEs from the theory of relativity for teaching the relativity theories (Velentzas & Halkia, 2013b). In	P.13, L.3-12

		general, the top 10 authors in the last 20 years have examined TEs from different perspectives. Many of them study TEs through the lenses of history and philosophy, education, and religion. Based on the most commonly used keywords in the last 20 years, research on TEs has mostly focused on understanding what TEs are like from a philosophical perspective in the first five years (2003-2007). . . . **After** If we look at the authors who have made the greatest contributions to the topic of TEs in the previous 20 years (2003-2022), Stuart is the most significant author with 7 articles (51 citations)…….. Meanwhile, Halkia and Velentzas from the University of Athens, Greece, discussed TEs from an educational perspective, such as using TEs from 'Newton's Cannon' for teaching satellite physics (Velentzas & Halkia, 2013a) and using TEs from the theory of relativity for teaching the relativity theories (Velentzas & Halkia, 2013b). Over the past two decades, authors have examined TEs from diverse perspectives, including history, philosophy, education, and religion. This variety highlights a significant shift in the disciplinary landscape of TE research, which is historically rooted in the philosophy of science (Galili, 2009; Norton, 2004). The true strength of TEs lies in their adaptability across disciplines, rather than in resolving philosophical disputes. Although TEs were traditionally centered in history and philosophy of science (HPS), recent trends show a growing application in education and technology, particularly in artificial intelligence and speculative design. This shift indicates that TEs have not lost their significance but have instead found new areas of relevance. In HPS, the focus has moved towards understanding the methodological and epistemological implications of TEs, confirming their essential role in scientific reasoning (Brown, 2019; Schindler & Saint-Germier, 2020). Additionally, in fields such as physics education, TEs are increasingly utilized to explore complex theoretical concepts and enhance educational methodologies (Bancong et al., 2023; El Skaf & Palacios, 2022). Based on the most commonly used keywords in the last 20 years, research on TEs has mostly focused on understanding what TEs are like from a philosophical perspective in the first five years (2003-2007). . . .	
3			
4			
5			

Reviewer 2			
#	**Reviewer's comments**	**Response**	**Page No.**
1	Authors set the publication period as twenty years i.e. 2003 - 2022. Please explain this criteria.	Thank you for your insightful comments. We appreciate the opportunity to clarify and improve our work based on your feedback. We selected the 20-year period from 2003 to 2022 to ensure a comprehensive analysis of recent trends and developments in TEs' research. The methods section has been updated to reflect the rationale behind the chosen publication period: **Before** This study aims to analyze the trend of studies on TEs in the last 20 years, and therefore, this study uses a bibliometric mapping method. Bibliometric analysis is a well-known statistical method for examining and analyzing a large amount of scientific data on a certain topic (Pan et al., 2018; Visser et al., 2021). . . . . . **After** This study aims to analyze the trends in TEs research over the past 20 years by using a bibliometric mapping method. To ensure a thorough analysis of recent trends and developments, this study focused on studies published between 2003 and 2022. This period was chosen because of significant advancements in research methodologies and bibliometric analysis tools in the early 2000s, as well as the consistent growth and comprehensive coverage of the Scopus database since that time. Bibliometric analysis is a well-known statistical method for examining and analyzing a large amount of scientific data on a certain topic (Pan et al., 2018; Visser et al., 2021).	P.3, L.5-9
2	Source titles has been written as publishers (refer the table 1).	Yes, you are correct. In Table 1, the titles listed are indeed source titles (journals and conference proceedings) and not publishers. We apologize for the oversight. The table has been revised to reflect that these are source titles. **Before** Table 1. Top 20 publishers contributing to TEs **After** Table 1. Top 20 source titles contributing to TEs	P.6-7

3	Table 1 has been cited in the text as table 3 mistakenly.	We acknowledge the error in referencing Table 1 as Table 3 within the text. The correct references have been updated throughout the manuscript. **Before** As seen in Table 3, 95% of the publishers contributing to the TEs topic are journals, with only one publishing conference proceedings. **After** As seen in Table 1, 95% of the publishers contributing to the TEs topic are journals, with only one publishing conference proceedings.	P.7, L.2

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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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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*

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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. 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
9 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
55 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
6 Fatonah (intellectual acuity) is reflected in students' ability to solve complex problems related to wave phenomena.

II. METHODS

Research Type and Design

10 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
23 systematic and flexible framework in developing and evaluating instructional products in a staged
65 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

5 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
27 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.

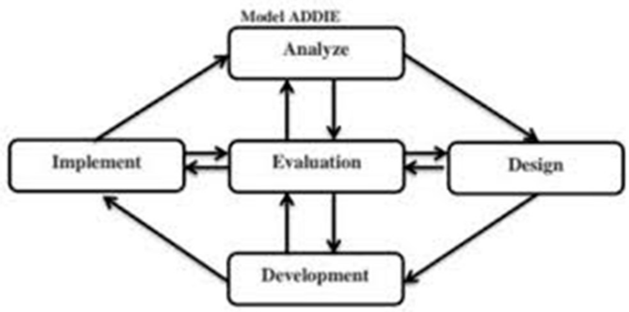

Figure 1. ADDIE Model Stages

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

74

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).

4

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

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

39

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

7

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

69 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.

12 **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.

62 **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 52 grounded in prophetic values. This design was intended to guide students through concrete experiences, reflective observation, abstract conceptualization, and active application. This 23 64 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 32 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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