



Experimental Time Series Design for Continuous Assessment in Physics Learning: A Qualitative Exploration of Teacher Perspectives

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ABSTRACT

Purpose of the study: This study explored teachers' perspectives on physics learning problems and examined the potential of Experimental Time Series Design for continuous assessment. It also identified opportunities to improve assessment practices through repeated measurements and evidence-based monitoring of students' learning progress.

Methodology: This study employed descriptive qualitative research. Data were collected through observation and semi-structured interviews involving one physics teacher with twenty-one years of teaching experience at Dharmawangsa Private High School Medan. Observation sheets and interview guidelines were used as research instruments. The data were analyzed using the Miles and Huberman interactive model, including data reduction, data display, and conclusion drawing.

Main Findings: The findings indicated that students experienced difficulties in understanding abstract physics concepts and maintaining learning motivation. Existing assessment practices were mainly based on written tests and focused on final achievement rather than continuous learning development. Digital platforms such as Google Forms, Kahoot, and Quizizz had been utilized, but the resulting data were primarily used for documentation purposes. The participant expressed positive perceptions regarding the potential use of Experimental Time Series Design for supporting continuous assessment and monitoring students' progress over time.

Novelty/Originality of this study: This study offers a new perspective by exploring teachers' views on the potential implementation of Experimental Time Series Design for continuous assessment in physics learning. Unlike previous studies emphasizing learning difficulties and instructional media, this study highlights repeated measurements as an alternative framework for monitoring learning development and supporting evidence-based assessment practices in physics education.

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1. INTRODUCTION

Physics education plays an important role in developing students' scientific literacy, analytical thinking, and problem-solving abilities. Through meaningful learning experiences, students are expected to construct conceptual understanding and develop scientific reasoning skills that are essential for understanding natural phenomena [1]-[3]. However, physics is frequently perceived as one of the most challenging subjects at the secondary school level because many concepts are abstract and mathematically demanding. Effective physics

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learning therefore requires not only appropriate instructional strategies but also assessment practices that can continuously monitor students' progress [4]-[6]. Consequently, improving the quality of assessment has become an important issue in contemporary physics education.

Despite its importance, various problems in physics learning remain evident in schools. Students often experience difficulties in understanding concepts, connecting theories with everyday experiences, and maintaining learning motivation throughout the instructional process [7]-[9]. In addition, teachers frequently encounter challenges in identifying students' learning difficulties and monitoring their progress systematically. Assessment practices are still dominated by written tests and summative evaluations that mainly emphasize final achievement rather than learning development [10]-[12]. As a result, important information regarding students' progress over time is often overlooked.

Previous studies have reported that low motivation, inadequate conceptual understanding, and limited instructional innovation contribute significantly to students' difficulties in learning physics. Ady and Warliani found that many students experience considerable difficulties in understanding physics concepts because of low motivation and insufficient intellectual readiness [13]-[15]. Similarly, Amalisholeha et al. [16] revealed that limited interest and weak learning motivation negatively affect students' achievement in physics. Furthermore, previous studies have shown that physics teachers still encounter challenges in developing innovative learning media and designing effective assessment instruments, particularly due to limited technological competence, inadequate training, and difficulties in constructing higher-order thinking assessments [17]. These findings suggest that problems in physics learning are influenced by both student-related and instructional factors.

Although previous studies have provided valuable insights into learning difficulties in physics, most investigations have focused primarily on identifying problems and improving instructional approaches. Relatively little attention has been devoted to the development of continuous assessment frameworks capable of monitoring students' learning progress longitudinally [18], [19]. Existing assessment systems are generally episodic and emphasize end-of-unit achievement rather than developmental changes over time. Consequently, teachers often lack sufficient evidence to evaluate the effectiveness of their instructional practices [20], [21]. This situation indicates the need for alternative approaches that support continuous and data-driven assessment in physics learning.

Experimental Time Series Design offers considerable potential for addressing these limitations through repeated observations conducted before and after instructional interventions. Such an approach enables educators to examine patterns of change and obtain more comprehensive information regarding students' learning development [22]. In addition, continuous assessment can provide teachers with evidence-based information for making instructional decisions and designing appropriate interventions. The implementation of digital assessment platforms further enhances the feasibility of collecting and analyzing learning data systematically [23], [24]. Therefore, exploring the potential application of experimental time series design is important for strengthening assessment practices in physics education.

The novelty of this study lies in its qualitative exploration of teachers' perspectives regarding the use of Experimental Time Series Design as a framework for continuous assessment in physics learning. Unlike previous studies that mainly focused on learning difficulties or instructional media, this study highlights the potential contribution of repeated measurement and longitudinal assessment to improving educational practices [25]. Furthermore, the study provides empirical insights derived from teachers' experiences and perceptions in authentic school settings. The findings are expected to contribute to the growing discourse on evidence-based assessment and continuous monitoring in physics education. Thus, this research offers a new perspective on how Experimental Time Series Design may support more effective and sustainable assessment practices.

2. RESEARCH METHOD

2.1. Research Design

This study employed a descriptive qualitative approach to explore teachers' perspectives regarding physics learning problems and the potential application of Experimental Time Series Design for continuous assessment. A qualitative design was selected because it enables researchers to obtain in-depth information from participants' experiences and perceptions [26], [27]. The study focused on understanding the challenges encountered by physics teachers in instructional and assessment practices [28]. Furthermore, the research emphasized the relevance of repeated measurements as an alternative framework for monitoring students' learning progress. Therefore, qualitative inquiry was considered appropriate for achieving the objectives of this study [29].

2.2. Research Participants and Setting

The study was conducted at Dharmawangsa Private High School Medan, Indonesia. A physics teacher with twenty-one years of teaching experience participated as the key informant in this research. The participant

was selected purposively because of her extensive experience in teaching physics and implementing assessment practices. Data collection was carried out on March 28, 2026. The school context provided valuable information regarding existing problems and the opportunities for implementing continuous assessment in physics learning.

2.3. Data Collection Techniques

Data were collected through direct observation and semi-structured interviews. Observation was conducted to obtain an overview of the learning conditions and assessment practices implemented in physics classrooms. Meanwhile, semi-structured interviews were used to explore teachers' experiences, perceptions, and responses concerning students' learning difficulties and assessment systems. The interview process was guided by a set of predetermined questions to ensure consistency and relevance to the research objectives. These techniques enabled the researchers to gather comprehensive and in-depth qualitative data.

2.4. Data Analysis

The collected data were analyzed using the interactive model proposed by Miles and Huberman, which consists of data reduction, data display, and conclusion drawing. In the first stage, the interview and observation data were organized and categorized according to major themes. Subsequently, the data were presented systematically to facilitate interpretation and identify meaningful patterns. The researchers then interpreted the findings by relating them to previous studies and the concept of Experimental Time Series Design. Finally, conclusions were drawn to explain the potential role of continuous assessment in addressing problems in physics learning.

Table 1. Summary of Research Methodology

Aspect	Description
Research Approach	Qualitative approach
Research Design	Descriptive qualitative research
Research Site	Dharmawangsa Private High School Medan, Indonesia
Participant	One physics teacher with 21 years of teaching experience
Sampling Technique	Purposive sampling
Data Collection Techniques	Observation and semi-structured interview
Research Instrument	Observation sheet and interview guide
Data Analysis Technique	Miles and Huberman interactive model (data reduction, data display, and conclusion drawing)
Focus of the Study	Exploring teachers' perspectives on the potential application of Experimental Time Series Design for continuous assessment in physics learning

3. RESULTS AND DISCUSSION

3.1. Physics Learning Problems Encountered by Students

The interview findings revealed that students still experienced various difficulties in learning physics. According to the participant, topics related to modern physics, particularly relativity and atomic theory, were among the most difficult concepts for students to understand. These difficulties were mainly caused by the abstract nature of the concepts and the mathematical calculations involved. In addition, students tended to memorize formulas without fully understanding their physical meanings and applications. Such conditions indicated that conceptual understanding remained one of the major challenges in physics learning.

3.2. Students' Learning Motivation and Achievement

The participant explained that students' learning motivation generally declined when they encountered topics involving complex calculations and abstract concepts. Although students initially showed enthusiasm at the beginning of instruction, their interest gradually decreased as the level of difficulty increased. The participant also stated that students' achievement often did not correspond to the effort invested in teaching activities. Differences in students' abilities and learning motivation contributed to variations in academic performance. Consequently, some students consistently demonstrated low achievement despite repeated explanations and exercises.

3.3. Existing Assessment Practices and Their Limitations

The results showed that assessment activities were mainly conducted through written tests, quizzes, assignments, and classroom participation. Written tests remained the most frequently used assessment method because they were considered practical and compatible with curriculum requirements. However, the participant

reported that fluctuations in students' scores frequently occurred and were difficult to explain. Monitoring individual students' learning progress continuously was also challenging because of limited instructional time and the large number of students. Therefore, the current assessment system was considered insufficient for identifying long-term patterns of students' learning development.

3.4. Teachers' Perceptions of Digital Assessment and Experimental Time Series Design

The participant reported that digital assessment platforms, such as Google Forms, Kahoot, and Quizizz, had been utilized in classroom assessment activities. These platforms were considered useful for facilitating evaluation and accelerating the scoring process. Nevertheless, the collected data were primarily used for documenting students' achievement rather than analyzing learning progress over time. Furthermore, the participant had never implemented a structured Experimental Time Series Design in assessment practices. Despite this limitation, the participant expressed positive attitudes toward the idea of continuous assessment based on repeated measurements, believing that such an approach could support more effective instructional decision-making.

Table 2. Summary of Research Findings

Category	Main Findings
Physics Learning Problems	Students had difficulties understanding abstract concepts and mathematical aspects of physics.
Learning Motivation	Students' motivation tended to decrease when learning complex topics.
Students' Achievement	Differences in learning abilities resulted in variations in academic performance.
Assessment Practices	Assessment mainly relied on written tests, quizzes, and assignments.
Limitations of Assessment	Learning progress was not monitored continuously and systematically.
Digital Assessment	Google Forms, Kahoot, and Quizizz were used, but data were mainly stored as documentation.
Experimental Time Series Design	Teachers had positive perceptions regarding its potential for continuous assessment.

Physics learning continues to present considerable challenges for students, particularly when dealing with abstract concepts and mathematical representations. Information obtained from the interview revealed that topics such as modern physics and atomic theory are among the most difficult areas for students to comprehend. These difficulties are closely related to students' tendency to memorize formulas without fully understanding the underlying physical principles. Moreover, variations in prior knowledge and learning motivation contribute to differences in students' academic achievement. Such conditions indicate that strengthening conceptual understanding remains an important concern in physics education.

Current assessment practices also appear to be insufficient for capturing students' learning development comprehensively. Assessment activities are predominantly carried out through written tests and other summative evaluations that emphasize final achievement. Although several digital platforms have been introduced to support assessment activities, the resulting data are rarely utilized to examine students' progress over time. Consequently, teachers often encounter difficulties in identifying learning patterns and explaining fluctuations in students' performance. These circumstances highlight the importance of developing more systematic and continuous assessment approaches.

Similar observations have also been reported in previous studies investigating problems in physics learning. Earlier research emphasized the influence of low motivation, conceptual difficulties, and limited instructional innovation on students' learning outcomes [30], [31]. Although these studies successfully identified factors contributing to learning problems, they paid less attention to assessment systems that continuously monitor changes in learning. As a result, empirical evidence regarding long-term learning development remains limited [32], [33]. Therefore, the present study complements existing literature by emphasizing the importance of continuous assessment in physics education.

One distinctive aspect of this research is its emphasis on teachers' perspectives regarding the potential use of Experimental Time Series Design for continuous assessment. Previous studies have mainly focused on instructional strategies, learning difficulties, and digital media integration [34], [35]. In contrast, this study highlights repeated measurements as a mechanism for monitoring students' learning development in a more structured manner. Such an approach provides an alternative perspective to conventional assessment practices that are heavily dependent on final scores [36]. Accordingly, the study contributes to expanding the discussion on evidence-based assessment in physics learning.

Practical implications can be drawn from the positive responses expressed by the participant toward the implementation of continuous assessment. Repeated observations may help teachers identify patterns of learning development and evaluate the effectiveness of instructional strategies more accurately [37]. In addition, the integration of digital assessment platforms with Experimental Time Series Design may facilitate data collection

and support evidence-based decision-making. These advantages are expected to improve the quality of classroom assessment and promote more student-centered learning practices [38], [39]. Therefore, continuous assessment has the potential to become an important component of effective physics instruction.

Several limitations should be acknowledged when interpreting the findings of this study. The research involved only one participant from a single educational institution, thereby limiting the transferability of the results to other contexts [40]. Furthermore, the investigation focused solely on teachers' perspectives and did not include direct implementation of Experimental Time Series Design in classroom settings. Consequently, the conclusions drawn from this study should be considered exploratory in nature. Future research is recommended to involve larger samples and examine the effectiveness of this assessment approach through empirical classroom applications.

4. CONCLUSION

This study revealed that physics learning continues to face various challenges related to students' conceptual understanding, learning motivation, and the limitations of existing assessment practices, thereby confirming the issues identified in the introduction. Findings from the interviews demonstrated that current assessment systems are still predominantly focused on measuring final achievement and have not yet provided sufficient information regarding students' learning development over time. In this context, Experimental Time Series Design was perceived positively by the participant and was considered to have considerable potential as a framework for continuous assessment capable of supporting evidence-based instructional decision-making. The study also contributes to the existing literature by highlighting teachers' perspectives on repeated measurements as an alternative approach for monitoring learning progress in physics education. These findings imply that integrating continuous assessment with digital technologies may strengthen assessment practices and enhance the quality of physics learning. Future studies are recommended to implement Experimental Time Series Design empirically with larger samples and diverse educational settings in order to examine its effectiveness and broaden its application in science education.

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