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IMPACT OF CONTEXTUALIZED TEACHING MODULES ON ENHANCING CONCEPTUAL UNDERSTANDING OF SECONDARY SCHOOL STUDENTS OF MULTAN DISTRICT

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Abstract

This research investigates the disparities in conceptual comprehension between students who are taught using Contextualized Teaching (CT) modules and those taught through direct instruction methods at the secondary school level. The study employs a quasi-experimental approach with a pretest-posttest nonequivalent control group design. Data on concept understanding was gathered using a 19-item reasoned objective test. The collected information was then subjected to descriptive analysis using one-way analysis of variance. Results indicate that students who learned with CT-based modules demonstrated a higher level of concept understanding compared to those who received direct instruction. The findings suggest a significant difference in physics concept comprehension between students exposed to CT-integrated learning modules and those taught through traditional direct instruction techniques.

Key Words: Educational Unit; Contextualized teaching and learning; Conceptual understanding

Introduction

The process of education aims to humanize individuals, enabling them to realize their potential in life. Effective education goes beyond preparing students for careers or positions; it equips them to address everyday challenges. The ideal educational system not only fosters talents aligned with school-acquired knowledge but also strives to enhance human qualities. These qualities include faith and reverence for God Almighty, moral integrity, amiability, self-reliance, progressive character, resilience, intelligence, creativity, skill, discipline, strong work ethic, professionalism, responsibility, productivity, and holistic health (Ashari et al., 2022).

Enhancing educational quality in Pakistan aims to develop more competitive individuals through improved training, critical thinking, and athletic activities to meet global challenges (Rafiq et al., 2024). The focus on increasing educational relevance is designed to produce graduates aligned with the country's natural resource potential. Education is a fundamental human need, crucial for personal growth and societal development. A nation's progress is closely tied to its educational standards, as quality education can help alleviate poverty (Rafiq, Iqbal & Afzal, 2024). By providing high-quality education, Pakistan can cultivate skilled human resources capable of advanced thinking, technological literacy, and the ability to adapt to and benefit from scientific advancements (Kazmi & Quran, 2005).

Educational institutions are expected to mold students' identities based on national values, without seeking new perspectives during modernization, to develop well-rounded individuals (Naim, 2001). Future generations need to master not only subject matter and routine thinking but also communication skills, creativity, clear and critical thinking with moral considerations, civic responsibility, tolerance, global awareness, and diverse interests (Asif et al., 2020). Additionally, they should be prepared for employment, possess intelligence aligned with their aptitudes or interests, and demonstrate environmental stewardship. The goal is to cultivate a broad range of abilities that extend beyond traditional academic focus, encompassing personal, social, and global competencies (Kazmi & Quran, 2005).

Among the natural sciences, physics stands as the most fundamental discipline, offering a foundational and theoretical framework that supports technological advancement and the development of other scientific fields. Consequently, high schools place a strong emphasis on physics education. The main goal of teaching physics is to develop students' reasoning capabilities, which are demonstrated through their ability to think logically, approach problems systematically, maintain objectivity, exhibit honesty, and apply disciplined problem-solving techniques (Safdar, 2010). However, the current state of physics education often falls short of these ideals. Physics courses should provide diverse learning experiences that enable students to grasp scientific concepts and processes while encouraging active and creative engagement (Khan et al., 2017). This approach aims to empower students to discover new knowledge independently by exploring their school environment and local surroundings (Rafiq, Kamran & Afzal, 2024). Educators must go beyond simply conveying information to achieve learning goals; they should create meaningful learning experiences for students. Teachers should strive to maximize opportunities for student engagement within the classroom setting (Rafiq, Kamran & Afzal, 2024). As a subject, physics involves the systematic exploration and understanding of the universe. It encompasses not only the mastery of facts, concepts, and principles but also the process of discovery itself. The study of physics extends beyond the mere accumulation of knowledge, emphasizing the importance of scientific inquiry. Furthermore, character education can be seamlessly integrated into physics instruction, enhancing the overall learning experience (Astra, 2018).

In practice, schools often lack a true understanding of effective learning concepts. Students tend to memorize subject matter without comprehending it, leading to quick forgetting of the learned material (Bozzi et al., 2019). This issue is closely tied to the way teachers present information during lessons. The typical classroom scenario involves teacher-centered instruction, with students passively listening to lectures. In Physics education, many students struggle to connect the theoretical concepts they study with real-world applications. Their grasp of academic concepts often remains abstract. This limited understanding results in suboptimal Physics learning outcomes, preventing students from achieving both individual and class-wide proficiency standards (Fenditasari & Istiyono, 2020).

According to (Etkina et al., 2006) science educators often instruct students to memorize various concepts without fostering true understanding, which hinders students' ability to apply these concepts in novel situations. This lack of comprehension leads to suboptimal Physics learning outcomes, resulting in students failing to achieve individual or class-wide proficiency (Taasoobshirazi & Carr, 2008). Consequently, students tend to quickly forget the subject matter

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they've studied, as they've merely memorized information without grasping its meaning. This underscores the crucial role of understanding in successful physics education. The concept of understanding, which involves the cognitive processes of adapting and modifying knowledge, is intricately linked to educational reform. Consequently, the primary objective of education should be focused on facilitating this depth of comprehension (Hestenes, 1987).

Contextualized Teaching (CT) is an educational approach that can be employed to enhance learning. This approach involves introducing students to authentic, real-world challenges that require solutions, mirroring situations encountered in daily life to accomplish educational goals. The teaching strategy focuses on presenting learning materials through practical problem-solving scenarios that align with everyday experiences (Sears, 2003). Research conducted by (Hudson & Whisler, 2007) supports this approach, stating, "Contextual learning has a significant effect on civic skills because it is meaningful for students and develops meaningful learning to develop student's critical thinking and participative skills in their daily lives." This implies that implementing CT significantly impacts individuals' ability to handle real-life situations, as it provides a natural learning environment for students and fosters meaningful democratic education that enhances their critical thinking and participatory skills in everyday scenarios (Dewi & Primayana, 2019).

According to (Azizah, 2021), the CT approach to learning encompasses seven key elements of effective education: (1) constructivism, (2) questioning, (3) inquiry, (4) learning community, (5) modeling, (6) reflection, and (7) authentic assessment. This approach encourages students to actively construct their own knowledge, develop critical thinking skills, and achieve learning independence. Furthermore, it emphasizes the importance of students acquiring life skills, collaborative abilities, communication proficiency, becoming lifelong learners, and developing the capacity to make sound decisions when addressing real-world challenges. Smith asserts that Contextual Teaching and Learning, as a teaching and learning concept, assists educators in linking subject matter content to real-life situations (Peni, 2018).

The Contextualized Teaching (CT) approach is an educational method that enables instructors to link classroom content with real-world scenarios, prompting students to connect their knowledge to practical applications in their roles as family members and citizens (Afzal & Rafiq, 2024). This approach offers extensive opportunities for students to collaborate in groups, developing and integrating physics problems. Given this background, the researchers aim to investigate "*The Impact of Contextualized Teaching (CT) on Enhancing Concept Comprehension among secondary school students in Multan District".*

Method

This study employs an experimental approach where variables are manipulated in the experimental group and compared with an unaltered control group. Due to the inability to control all variables and conditions, it is classified as quasi-experimental (Maciejewski, 2020). The study employs a non-equivalent control groups design with pretest and posttest measurements, where one group serves as the experimental cohort and another as the control. Statistical analysis involves hypothesis testing using variance analysis through an F test, which solely identifies differences among population means. The hypothesis is evaluated at a 5% significance threshold. To ascertain the magnitude of these differences, a subsequent Least Significant Difference (LSD) test is conducted following the ANOVA, assessing the significance of mean scores between groups. This calculation incorporates the significance level (0.05), total sample size (N), number of groups (a), samples per group (n), and Mean Square Error (MSE). The test criteria consider inter-group mean differences as significant.

Result and Discussions

Examining research results and testing hypotheses involves evaluating how students interact in classroom groups when exposed to educational modules that utilize Contextualized Teaching (CT) and direct learning (DL) methodologies.

3.1 Contextualized Teaching (CT)

CT, an educational methodology, encourages active participation in learning environments. Studies have shown that CT effectively utilizes peer interaction, enhances student involvement, relates to practical situations, and combines scientific subject matter with various disciplines and competencies (Dewi & Primayana, 2019). As a result, CT can be successfully implemented in elementary school math education. Successful learning incorporates strategies that focus on collaborative student activities within the classroom setting (Vaino et al., 2012). The effectiveness of CT implementation depends on the instructor's teaching skills. Educators are essential in all learning processes. The professionalism of teachers is also important, though studies have shown that current educators view their professional identity as encompassing separate areas of expertise (Suryawati & Osman, 2017).

Most educators report that their current professional self-perception differs from their identity as novice teachers. These learning activities aim to cultivate advanced student abilities, fostering creativity and innovation. This involves generating novel and useful ideas, as well as describing, revising, analyzing, and evaluating concepts to enhance problem-solving efforts (Duit et al., 2012). The primary objective is to foster key competencies for the 21st century. Computational Thinking (CT) is anticipated to facilitate Community-Based Learning (CBL). In 2013, CBL was implemented at An-Najah University in Palestine through an initiative spearheaded by the Center for Excellence in Learning. This methodology offers learning experiences in environmental studies that specifically address the requirements of Palestinian community organizations. Furthermore, this engagement is expected to enhance students' critical thinking abilities, promote self-directed learning, improve decision-making skills, and enable the application of theoretical frameworks to community challenges.

3.2 Direct Learning (DL)

Research indicates that direct instructional methods yield a comparable understanding of scientific concepts within similar timeframes (Dewi & Primayana, 2019). The observed differences among learners, educators, and learning environment did not result in statistically significant differences between instructional approaches (Warburton & Volet, 2013). The analysis of research outcomes and hypothesis testing encompasses the conceptual understanding of students in two distinct groups; one utilizing models of learning incorporating, CT, and another employing a model of direct learning. Before implementing these treatments, both the CT and DL groups underwent initial assessments to establish a baseline (Patra et al., 2020).

Table 1

Group	Average Score	
CT (Pretest)	58.84	
DL (Pretest)	41.64	
CT (Posttest)	63.85	
DL (Posttest)	46.32	

The descriptive data analysis revealed disparities in the average pretest scores between student groups using CT-based learning modules and those in MPL groups. The group of learners who engaged with CT-enhanced modules exhibited a marginally higher initial test average in comparison to their DL counterparts, although this variance was not significant. After the implementation of respective interventions for each cohort, both the CT and DL groups participated in a subsequent assessment. The results indicated a variation in mean post-test scores across groups. Specifically, the student group utilizing CT-charged learning modules achieved an average post-test score of 63.85.

The DL group's posttest results yielded an average score of 46.32. When evaluated using guidelines, students who utilized the learning module with CT settings achieved a very high qualification, while the DL group attained a high qualification. The disparity in posttest average scores between these two groups can be attributed to the different learning models employed and the use of CT-based learning modules. An examination of the pretest and posttest outcomes reveals the variation in the improvement of physics concept comprehension between the two groups, as evidenced by the normalized gain average scores, as shown in Table 1.

Table 2

Metric	Value	Interpretation
Normalized Gain Score (CT)	0.71	Higher gain score for CT group
Normalized Gain Score (DL)	0.43	Lower gain score for DL group
ANOVA F-Value	114.989	Significant effect of learning model
ANOVA Significance	0	Statistically significant
LSD Analysis Difference	2.31	Substantial difference between groups
LSD Value	17.535	Exceeds the LSD threshold

The CT-loaded learning module proved more effective than the DL approach, as evidenced by higher normalized gain scores among students. Specifically, the CT setting achieved a normalized gain score of 0.71, surpassing the DL group's 0.43. A one-way ANOVA analysis demonstrated that the learning model significantly impacted students' physics concept understanding, with an F value of 114.989 and a significance of 0.000, well below the 0.05 threshold. This statistical evaluation highlights a notable distinction between DLCT and DL in enhancing physics concept comprehension. To quantify the mean difference between learning groups, researchers employed

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an LSD analysis. The LSD calculations for the DLCT and DL groups resulted in 2.31 with 17.535, exceeding the LSD value. These findings confirm a significant disparity in average physics concept understanding scores between the DLCT and DL groups.

Discussion

The results of descriptive analysis and ANOVA reveal differences in physics concept understanding among student groups. Students who engaged with facilitated learning modules incorporating Contextual Teaching and Learning (CT) approaches exhibited superior comprehension of physics concepts compared to those taught using direct instruction methods. This difference is apparent from the gain score analysis of concept understanding indicators. As illustrated in Tables, learners who used modules with CT settings achieved diverse gain values across various indicators: interpretation (0.38, medium category), giving (0.96, high category), classification (0.30, medium category), summarizing (0.89, high category), concluding (0.68, high category), comparing (0.73, high category), and explaining (1.15, high category). Within the CTL-facilitated group, only the interpretation and classification indicators remained in the medium category, while all others reached the high category.

The performance of students accustomed to multiple-choice tests, along with the aforementioned data, suggests a lack of preparation for expanded multiple-choice examinations. These assessments require students to comprehend and grasp tested concepts, as well as demonstrate proficiency in constructing well-formed, accurate, and logical sentences that support their chosen answers. Evidence from student responses indicates these requirements have not been met, as most students select options without justifying. Classification, which involves recognizing that a specific instance or occurrence belongs to a specific classification (such as an idea or fundamental truth), encompasses identifying relevant characteristics or patterns that align with defined specifications and principles. The limited classification abilities observed in the student group, who were taught using a learning module with a CT approach, can be attributed to insufficient teacher explanation in categorizing material elasticity.

Another factor contributing to students' difficulty in grasping physics concepts is their unfamiliarity with questions that require them to select the correct answer from multiple choices and then provide a rationale. Why do CT models enhance students' comprehension of physics ideas more effectively than direct learning models? This can be clarified by several details. The DL approach treats learners as passive recipients of information, shaping their behavior through repetition and encouraging individual learning through memorization and recording of material. This method emphasizes text reading without allowing learners sufficient Time to contemplate the provided information, relate it to prior information, or put it to real-world scenarios. Teachers rarely provide opportunities for students to develop skills such as 1) interpretation; 2) exemplifying; 3) classifying; 4) summarizing; 5) inferring; 6) comparing; and 7) explaining. Consequently, students' conceptual understanding remains low due to the lack of meaningful engagement in the learning process.

In contrast to students who engage in CT, those who adapt to new learning paradigms tend to do so more rapidly. These students have successfully adjusted their approach from conventional learning models to contextual teaching and learning methods. Before familiarized to teacher

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centered approach, they have transformed into active participants who seek out information during the learning process. This shift is expected to result in more meaningful educational outcomes for students. The implementation of these new learning strategies has proven to be highly beneficial for students, providing them with significant support in their academic pursuits.

CT models enable learners to make themselves before beginning the educational procedure. These modules foster a more dynamic classroom environment by encouraging student participation, rather than passive listening to teacher explanations. Learning occurs naturally through student activities and experiences, instead of mere knowledge transfer from instructor to pupil. The CT model highlights the position of real-world environments in the educational process, making classes more engaging and meaningful as students directly experience the subject matter (Rafiq, Afzal & Kamran, 2022). This contextual approach allows learners to reinforce, broaden, and put on their theoretical facts and abilities in various real-world situations, together within and external school setting. Consequently, learners can grasp concepts more quickly and retain information more effectively. The contextual teaching and learning model, supported by contextual modules and following CTL syntax, leads to a deeper understanding of physics concepts compared to direct instruction methods. In multimedia classrooms lacking school-provided materials, CT can ease the learning procedure for learners.

While the study's treatment method helped students achieve a better understanding of physics concepts compared to the control group, it did not result in uniformly high comprehension across all students. This can be attributed to several factors. Primarily, students remain accustomed to the traditional lecture-based teaching approach that has been employed for an extended period. In this conventional method, students are habituated to simply transcribing the teacher's explanations, including the way the instructor solves example problems for a given topic. Students have grown accustomed to being presented with sample problems before tackling actual assignments.

This situation leads to students becoming dependent when faced with problem-solving tasks. Additionally, learners who are exposed to contextual learning models have limited experience in conducting independent, real-world experiments. As a result, many students are unsure of how to proceed, often wasting a significant portion of the allotted 2x45 minute time frame. To address this issue, researchers provide additional guidance to ensure smooth experiment execution. Furthermore, students are unaccustomed to in-class presentations. When given the opportunity to present, groups often hesitate, with members waiting for others to take the initiative.

This situation negatively affects learning efficiency. To address this issue, the researcher offers an incentive system where students earn points for presenting, encouraging all groups to compete for presentation opportunities. Additionally, students struggle with the unfamiliar format of reasoned multiple-choice tests, finding it challenging to complete all questions with full explanations. In contrast, schools typically use objective tests that require only a single answer without justification, which increases the likelihood of guessing. Furthermore, the limited time allocated for learning sessions poses a challenge. With only 2 hours (2x45 minutes) available for practical activities, which are often time-consuming, it significantly impacts the planning and execution of learning activities, including the assessment of student performance through observation.

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Conclusion

The study's findings and their implications suggest several recommendations. Firstly, the research revealed significant differences in concept comprehension between students who used the contextual learning module and those in contextual learning environments. To enhance students' understanding of physics concepts, educators should implement learning models that prioritize knowledge construction rather than solely focusing on learning outcomes. Specifically, the contextual teaching and learning approach should be employed, as it emphasizes providing students with direct, hands-on experiences. This method allows students to develop a closer connection with nature, potentially increasing their engagement in the learning process.

It is crucial for teachers to assist students in connecting their existing knowledge with real-world applications or to identify relationships between new concepts they will learn and their practical use. Educators are encouraged to optimize learning modules by implementing contextual teaching and learning strategies in physics classes. Additionally, teachers should invest significant effort in the learning process to address understanding indicators that remain in the low category. By employing the CT model, students will be able to link the lessons to real-life situations, thereby enhancing their engagement with the taught material.

Students demonstrated the most significant improvements in skills such as exemplifying, summarizing, inferring, comparing, and explaining, with interpreting and classifying showing moderate progress. These findings indicate that educational approaches should emphasize practical application, personal development, and collaborative learning. Researchers are encouraged to build upon this study by investigating additional variables that could impact the efficacy of CT in improving student understanding within multimedia-based courses. Such variables may include factors like achievement motivation, socioeconomic status, learning environment, individual learning preferences, and other pertinent aspects.

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