THE IMPACT OF DIFFERENTIATED AND PRACTICE-ORIENTED HOMEWORK ON ACADEMIC ACHIEVEMENT IN PHYSICS IN KAZAKHSTAN

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ABSTRACT:

This study explores the impact of differentiated and practice-oriented homework assignments on the academic achievements of 8th and 9th-grade students in physics in secondary schools of Kazakhstan.

The research combines a theoretical review with an experimental approach involving control and experimental groups. Differentiated homework was implemented for 9th-grade students, while practice-oriented tasks were introduced for 8th-grade students.

The results demonstrated significant improvements in the academic performance of students in the experimental groups compared to the control groups, confirming the effectiveness of the applied homework strategies.

Further statistical analysis (see Table 3.30) revealed that both approaches had a statistically significant impact; however, the practice-oriented homework showed a stronger effect, as evidenced by a higher F-value (14.3) and a lower p-value ($< .001$), compared to the differentiated approach ($F = 6.31$, $p = 0.016$). These findings highlight the value of incorporating real-life applications into physics homework to foster greater learning gains.

The study provides practical recommendations for integrating differentiated and practice-oriented assignments into physics education to enhance student engagement, understanding, and achievement.

KEYWORDS:

Differentiation, Practice-Oriented Learning, Homework Assignments, Physics Education, Academic Achievement, Secondary School Students, Educational Strategies, Kazakhstan.

АННОТАЦИЯ

Бұл зерттеуде Қазақстандағы жалпы білім беретін мектептердің 8- және 9-сынып оқушыларының физика пәні бойынша оқу жетістіктеріне дифференциацияланған және практикалық бағытталған үй тапсырмаларының әсері қарастырылады.

Зерттеу теориялық шолуды бақылау және эксперименттік топтарды қамтитын эксперименттік тәсілмен ұштастырады. 9-сынып оқушыларына дифференциацияланған үй тапсырмалары, ал 8-сынып оқушыларына практикалық бағыттағы тапсырмалар енгізілді.

Нәтижелер көрсеткендей, эксперименттік топтардың оқушыларының оқу жетістіктері бақылау топтарына қарағанда айтарлықтай жақсарған, бұл қолданылған үй тапсырмалары стратегияларының тиімділігін растайды.

Қосымша статистикалық талдау (3.30-кестені қараңыз) екі тәсілдің де статистикалық тұрғыдан маңызды әсері болғанын көрсетті. Алайда практикалық бағыттағы үй тапсырмасы анағұрлым күшті әсер көрсетті: бұл F мәнінің жоғары болуымен (14.3) және p мәнінің төмен болуымен ($< .001$) дәлелденеді, ал дифференциацияланған тәсіл үшін бұл көрсеткіштер $F = 6.31$, $p = 0.016$ болды. Бұл нәтижелер физика бойынша үй тапсырмаларына шынайы өмірмен байланысты тапсырмаларды енгізудің оқу жетістіктерін арттырудағы маңыздылығын көрсетеді.

Зерттеу оқушылардың қызығушылығын, түсінігін және оқу жетістігін арттыру мақсатында физика сабағына дифференциацияланған және практикалық бағытталған тапсырмаларды біріктіру бойынша практикалық ұсынымдар ұсынады.

АННОТАЦИЯ

В данном исследовании рассматривается влияние дифференцированных и практико-ориентированных домашних заданий на академические достижения учащихся 8-х и 9-х классов по физике в общеобразовательных школах Казахстана.

Исследование сочетает теоретический обзор с экспериментальным подходом, включающим контрольные и экспериментальные группы. Для учащихся 9-х классов были внедрены дифференцированные домашние задания, а для 8-х классов — практико-ориентированные задания.

Результаты показали значительное улучшение учебных достижений учащихся экспериментальных групп по сравнению с контрольными, что подтверждает эффективность использованных стратегий домашних заданий.

Дополнительный статистический анализ (см. таблицу 3.30) показал, что оба подхода оказали статистически значимое влияние. Однако практико-ориентированные задания оказали более выраженное воздействие: значение F составило 14,3 при уровне значимости $p < .001$, тогда как для дифференцированного подхода — $F = 6.31$, $p = 0.016$. Эти данные подчеркивают важность включения заданий, связанных с реальными жизненными ситуациями, в структуру домашних заданий по физике для повышения эффективности обучения.

Исследование предлагает практические рекомендации по интеграции дифференцированных и практико-ориентированных заданий в преподавание физики с целью повышения вовлечённости, понимания и учебных достижений учащихся.

INTRODUCTION

Relevance of the Research

The quality and effectiveness of homework assignments play a crucial role in enhancing students' academic achievement, particularly in subjects such as physics, where the development of both theoretical understanding and practical application skills is fundamental to success (Salar & Turgut, 2021, p. 11).

Homework serves not only as a mechanism for reinforcing classroom instruction but also as a means of promoting independent learning, critical thinking, and the ability to apply concepts in diverse contexts.

In recent years, the differentiation of homework-adapting tasks to meet the varying levels of students’ readiness, learning styles, and interests-along with the introduction of practice-oriented assignments-linking theoretical content to real-world applications-have emerged as important pedagogical strategies. These approaches aim to individualize the learning experience, making it more engaging and meaningful for students.

Differentiation addresses the diverse needs of learners, ensuring that every student encounters homework that is appropriately challenging and motivating. Practice-oriented tasks, on the other hand, bridge the gap between abstract concepts and everyday experiences, fostering deeper understanding, increased relevance, and higher intrinsic motivation (Keane & Heinz, 2019, p.15).

The integration of these strategies into homework practices is particularly relevant in physics education, where abstract theoretical principles often require concrete, observable examples to be fully comprehended and retained.

Recognizing the critical role of effective homework design, this study addresses the urgent need to optimize homework practices for 8th- and 9th-grade students in secondary schools of Kazakhstan.

The primary objective is to improve students’ academic outcomes in physics by developing and implementing differentiated and practice-oriented homework strategies that promote individualized learning pathways, foster deeper engagement, and enhance overall performance.

By examining the impact of these innovative approaches, the research seeks to contribute to the ongoing efforts to modernize science education in Kazakhstan and to support the creation of more student-centered, dynamic, and effective learning environments that prepare students for future academic and professional success in scientific fields.

Research Problem and Degree of Study

Although numerous studies have explored various methods for improving academic performance, particularly in the fields of science and physics education, there remains a noticeable lack of comprehensive research specifically focusing on the role of differentiated and practice-oriented homework strategies within the context of Kazakhstani secondary education (Kontur & Terry, 2015, p.7).

Existing studies often address general approaches to homework effectiveness or emphasize broader pedagogical reforms, but few have systematically investigated how adapting homework tasks to individual student needs or linking academic content to real-world applications can influence learning outcomes in Kazakhstan’s unique educational setting.

This dissertation seeks to fill this important research gap by providing a focused analysis and empirical evaluation of two targeted approaches aimed at enhancing students' academic achievements in physics.

The first approach involves the differentiation of homework assignments for 9th-grade students, tailoring tasks to match students' diverse readiness levels, learning preferences, and interests, thereby promoting more equitable and effective learning experiences.

The second approach emphasizes the use of practice-oriented homework for 8th-grade students, engaging learners through activities that connect theoretical physics concepts to practical, observable phenomena encountered in everyday life.

By implementing and testing these two strategies within controlled experimental settings, this study aims not only to evaluate their immediate impact on academic performance but also to contribute to the broader discourse on homework optimization in science education.

The research aspires to offer evidence-based recommendations for physics teachers, curriculum developers, and policymakers seeking to modernize homework practices and to foster deeper, more sustainable learning among secondary school students in Kazakhstan.

Research Purpose and Objectives

The purpose of this research is to evaluate the effectiveness of differentiated and practice-oriented homework assignments in improving students' academic achievements in physics.

To achieve this purpose, the following objectives were set:

- To analyze theoretical foundations related to differentiation and practice-oriented learning in physics education.
- To develop differentiated homework assignments for 9th-grade students.
- To develop practice-oriented homework assignments for 8th-grade students.
- To organize and conduct pedagogical experiments based on these homework methods.
- To assess and compare the academic achievements of students before and after the intervention.
- To formulate practical recommendations based on the findings.

Object And Subject Of The Research

Object: The process of teaching physics in secondary schools.
Subject: The impact of differentiated and practice-oriented homework on the academic achievements of 8th and 9th-grade students.

Hypothesis Of The Research

The hypothesis of the study is that the use of differentiated homework for 9th-grade students and practice-oriented homework for 8th-grade students will significantly improve their academic achievements in physics compared to traditional homework methods.

Research Methods

The following methods were used in the study:

- Theoretical analysis of scientific literature;
- Development and implementation of experimental homework assignments;
- Empirical methods, including pedagogical experiments;
- Statistical analysis and interpretation of the results.

Scientific Novelty

The scientific novelty of this research lies in the comprehensive and systematic comparison of two innovative approaches to homework design-differentiated and practice-oriented assignments-specifically within the context of Kazakhstan's secondary education system in the subject of physics.

While differentiated instruction and practice-oriented learning have been individually explored in international educational research, there has been a notable absence of studies that simultaneously examine the comparative effectiveness of these two approaches in the context of physics homework, particularly in Kazakhstan.

This study not only introduces a dual-focused experimental framework that evaluates the academic impact of both strategies but also adapts and tests them in accordance with the specific educational, cultural, and curricular conditions of Kazakhstani secondary schools.

The research advances existing knowledge by providing empirical evidence on how differentiated homework-designed to align with students' readiness levels, interests, and learning profiles-and practice-oriented homework-focused on applying theoretical knowledge to real-world contexts-affect students' engagement, motivation, conceptual understanding, and academic performance in physics (Rosário, et al., 2015, p.386).

Additionally, the study offers new insights into how tailored homework strategies can be effectively integrated into national education practices to address diverse student needs, promote personalized learning, and enhance science education outcomes.

Thus, the scientific novelty of this dissertation is reflected not only in its experimental design and focus on dual strategies but also in its contribution to the modernization of homework practices in Kazakhstan's secondary education system.

Thus, both the theoretical and practical contributions of this study are significant.

The research expands the scientific understanding of differentiated and practice-oriented homework strategies in physics education, while simultaneously offering practical tools and methodologies that teachers can apply to enhance student engagement, personalize learning, and improve academic outcomes.

This dual impact underscores the relevance of the study for both educational theory and everyday teaching practice, particularly within the evolving context of secondary education in Kazakhstan.

Practical Significance

The findings of this research can be effectively utilized by physics teachers to significantly enhance the quality and effectiveness of homework assignments, personalize the learning process, and ultimately contribute to improving students' academic performance in physics.

By applying differentiated homework strategies, teachers can better address the individual learning needs, readiness levels, and interests of their students, thereby creating more inclusive and supportive educational environments.

Differentiated assignments enable educators to offer appropriately challenging tasks to all learners, reducing frustration among struggling students and preventing disengagement among more advanced learners.

In addition, the implementation of practice-oriented homework allows teachers to bridge the gap between theoretical knowledge and real-world applications. This approach not only deepens students' understanding of physics concepts but also increases their motivation by demonstrating the relevance of academic learning to everyday life and future professional activities (Wyss, V. L., et al., 2007, p.49).

Practical, inquiry-based tasks encourage students to develop essential scientific skills such as critical thinking, problem-solving, hypothesis testing, and data analysis, which are fundamental for success in both academic and real-world contexts.

Moreover, the research provides physics teachers with evidence-based guidance for modernizing their homework practices in alignment with contemporary educational standards that emphasize student-centered learning and the development of higher-order cognitive skills.

By incorporating the differentiated and practice-oriented strategies examined in this study, educators can foster greater student engagement, autonomy, and responsibility for learning, which in turn leads to more sustained academic success and a stronger interest in the sciences.

Therefore, the practical significance of this study lies in its direct applicability to everyday teaching practice, offering teachers actionable strategies to enhance physics education in Kazakhstan’s secondary schools and to support the broader goal of developing a scientifically literate and motivated student population.

Structure of the Dissertation

The dissertation consists of an introduction, three chapters, a conclusion, a list of references, and appendices.

- Chapter 1 presents a theoretical review of differentiation and practice-oriented learning.

- Chapter 2 describes the research design, methodology, and development of the homework assignments.
- Chapter 3 discusses the results of the experiments and provides practical recommendations.
- Chapter 4 practical recommendations for physics teachers

1. THEORETICAL FOUNDATIONS OF DIFFERENTIATION AND PRACTICE-ORIENTED HOMEWORK IN PHYSICS

1.1. The Concept of Differentiation in Education

In modern educational theory and practice, differentiation is widely regarded as a fundamental and essential approach aimed at addressing the diverse learning needs of students within increasingly heterogeneous classrooms.

Differentiation refers to the process of thoughtfully adapting various elements of instruction-such as content, process, product, or the learning environment-based on students’ readiness levels, personal interests, and learning profiles (Tomlinson, 2014).

This approach acknowledges that no two students are exactly alike in terms of their backgrounds, abilities, experiences, motivations, and preferred ways of learning, and it emphasizes the need for instructional flexibility to accommodate these individual differences effectively.

The main goal of differentiated instruction is to maximize each student's growth and individual academic success by recognizing their starting points and designing educational experiences that enable them to progress toward achieving their full potential.

Rather than adhering to a one-size-fits-all model, differentiation seeks to provide multiple pathways for students to access content, engage with material meaningfully, and demonstrate their understanding.

It can involve a variety of strategies, such as modifying the level of complexity or abstraction of assignments, offering students different modes of demonstrating their knowledge (e.g., written reports, presentations, creative projects), and utilizing diverse teaching methods and learning activities to cater to different learning modalities and intelligences.

In the context of physics education, the importance of differentiation becomes even more pronounced due to the inherently abstract and sometimes highly theoretical nature of many physics concepts.

Students often enter physics courses with differing levels of mathematical preparedness, logical reasoning ability, and prior exposure to scientific thinking, all of which can significantly affect their ability to grasp complex ideas.

As a result, physics teachers must be particularly attentive to the varied needs of their students, carefully designing homework tasks that are appropriately challenging yet accessible.

Assignments should be structured in a way that supports struggling learners by building foundational skills and conceptual understanding, while also offering opportunities for advanced students to explore topics more deeply, apply knowledge in novel situations, and engage in higher-order problem-solving.

Differentiated homework in physics not only helps to bridge gaps in understanding but also promotes a classroom culture where all students feel capable, valued, and motivated to succeed.

By providing tasks that are aligned with individual learning profiles, teachers can foster greater engagement, encourage persistence through academic challenges, and ultimately facilitate the development of a deeper, more enduring comprehension of physical phenomena.

Through thoughtful differentiation, physics education can become more inclusive, equitable, and effective, enabling a broader range of students to experience success and develop the skills necessary for future scientific inquiry and problem-solving.

Thus, differentiation serves as a critical pedagogical strategy for meeting the diverse learning needs of students, particularly in subjects such as physics that demand both conceptual understanding and the ability to apply abstract principles.

By implementing differentiated homework practices, educators can create more inclusive, motivating, and effective learning environments that support the academic growth of all students, regardless of their initial levels of readiness or preferred learning styles.

Building on this foundation, it is important to explore how differentiated homework strategies can be practically designed and implemented within the framework of physics education.

1.2. Practice-Oriented Approaches to Homework in Physics

Practice-oriented learning focuses on the development of students' practical skills, emphasizing their ability to apply theoretical knowledge to real-world contexts and situations.

Unlike traditional approaches that often prioritize abstract knowledge acquisition, practice-oriented learning places a strong emphasis on experiential engagement, hands-on activities, and problem-solving tasks that mirror the complexities and challenges encountered outside the classroom.

In physics education, a practice-oriented approach is particularly significant because physics, as a natural science, is fundamentally rooted in experimentation, empirical observation, and the systematic application of scientific principles to analyze, interpret, and solve real-life problems (Oliveira & Bonito, 2023).

Mastery of physics not only requires understanding theoretical constructs but also demands the ability to use these constructs to make sense of the physical world. Therefore, a practice-oriented methodology ensures that students are not merely passive recipients of information but active participants in the process of scientific discovery and application.

Practice-oriented homework assignments are intentionally designed to bridge the traditional gap between theoretical instruction and practical application.

Such tasks may involve conducting simple experiments at home using everyday materials, systematically observing physical phenomena such as the effects of friction or buoyancy, solving real-world physics problems that require thoughtful application of learned concepts, or participating in small-scale projects that integrate creativity, engineering design, and critical thinking.

These assignments aim to reinforce classroom learning by encouraging students to test theories, formulate hypotheses, gather and interpret data, and draw evidence-based conclusions from their investigations.

The benefits of practice-oriented homework are numerous.

It leads to increased student engagement by making learning more relevant and connected to their daily lives. Students often find greater motivation when they see the tangible applications of their knowledge.

Additionally, practice-oriented tasks contribute to the development of scientific inquiry skills, fostering abilities such as observation, measurement, experimentation, logical reasoning, and evidence-based decision-making.

Moreover, this approach promotes a deeper and more durable understanding of fundamental physical laws and principles, as students move beyond rote memorization toward active exploration and application.

However, the implementation of practice-oriented homework also presents several challenges that must be carefully managed.

One major concern is ensuring the accessibility of necessary materials and resources for all students, regardless of their home environments or socio-economic backgrounds.

Teachers must design experiments and tasks that are achievable with commonly available materials to ensure equitable participation (Raharjo, Sudarmin, & Dwiningsih, 2016).

Another challenge involves providing adequate guidance and scaffolding to support students' independent learning outside the classroom.

Without clear instructions, support structures, and opportunities for feedback, students may struggle to engage meaningfully with complex tasks or may misinterpret physical phenomena, leading to misconceptions rather than learning.

Therefore, while practice-oriented homework holds significant promise for enhancing physics education, its effective implementation requires careful planning, thoughtful task design, and a commitment to supporting diverse learners in developing both theoretical knowledge and practical scientific competencies.

1.3. Influence of Homework on Students' Academic Achievement

To ensure equitable participation among all students, physics teachers should design experiments and tasks that can be completed using readily available or low-cost materials and tools. This approach is particularly important in resource-limited settings, as it enables every student to actively engage in the learning process on equal terms. A recent study demonstrated that the implementation of remote physics laboratories using simple technologies can significantly expand access to practical physics education, especially in underserved or rural areas (Ishafit et al., 2025).

The effectiveness of homework largely depends on several factors: the quality and clarity of assignments, the appropriate amount of workload, the feedback provided by teachers, and the extent to which tasks are tailored to students' individual needs. Differentiated and practice-oriented homework strategies, when applied thoughtfully, have the potential to significantly boost students' academic achievement by addressing their diverse learning styles and enhancing motivation.

Moreover, the psychological and motivational aspects of homework cannot be overlooked. Students who perceive homework as meaningful and achievable are more likely to complete assignments diligently, which in turn positively influences their academic success.

Thus, practice-oriented homework serves as a vital link between theoretical instruction and real-world application, helping students to internalize scientific concepts more deeply and develop essential inquiry and problem-solving skills.

When thoughtfully designed and appropriately supported, practice-oriented assignments can significantly enhance students' engagement, motivation, and understanding in physics education.

Building upon this foundation, it is important to explore effective strategies for designing and implementing practice-oriented homework tasks that are accessible, meaningful, and aligned with educational objectives.

1.4. Analysis of Previous Research Related to Homework Differentiation and Practice Orientation

In recent decades, numerous studies have explored the role of differentiated and practice-oriented homework in improving students' academic performance across various educational contexts.

Research conducted by Tomlinson (2014) highlights the effectiveness of differentiated instruction in addressing students' diverse learning needs and fostering higher achievement levels.

Differentiation, when thoughtfully applied to homework tasks, enables the creation of assignments that vary in complexity, format, and the degree of support offered, thereby providing each student with an appropriate level of challenge and opportunity for academic growth.

By allowing students to work at their own readiness level and according to their preferred learning styles, differentiated homework can lead to improved engagement, greater academic confidence, and enhanced performance.

In the field of practice-oriented homework, studies such as those by (Oliveira & Bonito, 2023) emphasize the crucial role of connecting homework tasks with real-world experiences and practical applications.

Practice-oriented assignments are shown to increase students' intrinsic interest in the subject matter, enhance their motivation to learn, and improve essential problem-solving skills, particularly in science education where conceptual understanding must often be linked to observable phenomena.

Engaging students with real-world tasks helps bridge the gap between theoretical knowledge and its practical relevance, making learning more meaningful and applicable to everyday life.

In the context of Kazakhstan, research related to differentiated instruction and practice-oriented approaches is steadily emerging but still remains relatively limited compared to international literature.

Studies conducted underline the growing recognition of the need to adapt and integrate international best practices into the Kazakhstani secondary education system.

These studies highlight the importance of considering the specific cultural, social, and institutional contexts of Kazakhstan when applying differentiated and practice-oriented teaching strategies.

Nevertheless, the implementation of such approaches in everyday school practice remains at an early stage, requiring further empirical validation and contextual adaptation.

Despite the positive findings reported by both international and local researchers, noticeable gaps remain in the existing body of research.

There is a clear need for more experimental studies that focus specifically on the differentiation and practice orientation of homework tasks in physics classes, particularly at the lower secondary school level where foundational scientific understanding is formed.

Most existing research tends to address differentiation and practice-oriented approaches in a general educational context, without sufficient emphasis on subject-specific applications in the sciences or on the unique challenges faced by Kazakhstani educators and students.

This dissertation seeks to address these identified gaps by systematically investigating the impact of differentiated and practice-oriented homework assignments on the academic achievement of 8th and 9th grade students in Kazakhstan.

Through the design, implementation, and analysis of experimental interventions, this study aims to provide evidence-based insights into the effectiveness of these homework strategies in enhancing physics education outcomes and to contribute to the ongoing development of more inclusive, effective, and student-centered educational practices in Kazakhstan’s secondary schools.

1.5. Conclusion to Chapter 1

The theoretical analysis conducted in this chapter highlights the critical and multifaceted role of differentiated and practice-oriented homework assignments in enhancing students' academic performance, particularly within the domain of physics education.

Differentiation in education is essential for ensuring that the diverse needs, varying levels of ability, and individual interests of students are systematically addressed through carefully tailored instructional strategies.

By acknowledging the inherent differences among learners, differentiation promotes equitable access to education, providing all students with the appropriate level of challenge and support needed to maximize their potential.

In the context of physics education, where students often face difficulties in mastering abstract and complex scientific concepts, differentiation plays an especially important role.

By adjusting the complexity, format, and focus of homework assignments, teachers can facilitate more effective learning, enabling students to better comprehend challenging theoretical ideas and to build robust analytical and problem-solving skills.

Differentiated homework tasks not only support knowledge acquisition but also nurture independent thinking, adaptability, and perseverance in solving scientific problems.

Practice-oriented homework, on the other hand, serves as a vital bridge between theoretical knowledge and its application in real-world contexts.

By engaging students in meaningful, hands-on activities-such as conducting simple experiments, analyzing physical phenomena in everyday life, or applying theoretical principles to solve practical challenges-practice-oriented assignments make learning more relevant, tangible, and motivating.

Through such activities, students are encouraged to deepen their understanding, to develop scientific inquiry skills, and to foster critical thinking abilities that are essential for success not only in physics but across all scientific disciplines.

The review of previous research reveals that, internationally, there is substantial empirical evidence supporting the effectiveness of both differentiated and practice-oriented approaches in improving student learning outcomes, engagement, and motivation.

Studies conducted in various educational systems demonstrate the positive impacts of these methods on student achievement and attitudes toward learning, particularly in science education.

However, a noticeable gap remains in the body of research concerning the application of these strategies within the specific context of Kazakhstan's secondary education system.

In particular, there is a scarcity of experimental studies focused on how differentiated and practice-oriented homework can be effectively implemented in physics classes at the lower secondary school level, where foundational scientific skills and understandings are formed.

Thus, the findings and conclusions drawn from the theoretical analysis in this chapter form a strong and necessary foundation for the present research.

This study seeks to contribute to filling the identified research gap by experimentally testing the effectiveness of differentiated homework assignments for 9th-grade students and practice-oriented homework tasks for 8th-grade students in secondary schools across Kazakhstan.

By investigating the impact of these innovative homework strategies on academic performance, the study aims to provide empirical evidence to support the modernization and enhancement of physics education practices in Kazakhstan, aligning them more closely with contemporary pedagogical trends and the evolving needs of diverse student populations.

2. METHODOLOGY OF THE RESEARCH

2.1. Research Design and Methods

In educational research, several models of research design are widely recognized, including experimental, quasi-experimental, descriptive, correlational, and qualitative designs.

Each model serves specific research purposes and is selected based on the nature of the research questions, the degree of control over variables, and the desired type of data.

Experimental designs are primarily used when the researcher seeks to establish cause-and-effect relationships by manipulating one or more independent variables and observing their effects on a dependent variable under controlled conditions.

“**Quasi-experimental designs** share similarities with experimental models but typically lack full random assignment to groups, making them suitable when randomization is impractical (Pranata, O. D. (2024).”.

Descriptive designs aim to systematically describe characteristics or phenomena without manipulating variables, while correlational studies investigate relationships between variables without establishing causality.

Qualitative designs focus on understanding participants’ experiences, perspectives, and meanings through in-depth, non-numerical data collection and analysis.

In this study, an experimental research design was selected as the most appropriate model.

The primary objective of the research was to determine the causal impact of differentiated and practice-oriented homework assignments on students' academic achievements in physics.

The experimental model was particularly suitable because it enabled the random assignment of students into control and experimental groups, thereby ensuring the comparability of groups at the beginning of the intervention and minimizing the influence of confounding variables.

By implementing a true experimental design, the study achieved a high degree of internal validity, allowing observed differences in academic performance to be confidently attributed to the specific homework strategies applied, rather than to external factors.

Furthermore, the experimental approach provided a robust methodological framework for testing the formulated hypotheses under controlled conditions, offering strong empirical support for the study’s conclusions.

The choice of an experimental design was additionally motivated by the need to contribute credible, rigorous, and generalizable findings to the limited body of research on differentiated and practice-oriented homework strategies in Kazakhstan’s secondary education context.

Through this methodological approach, the study aimed to generate practical insights and recommendations that could be confidently applied to improve homework practices and enhance physics education outcomes.

This study employed an experimental research design to systematically investigate the effects of differentiated and practice-oriented homework assignments on students' academic achievements in physics education at the secondary school level.

The experimental approach was chosen as it allows for the establishment of cause-and-effect relationships between the independent variables-the differentiated and practice-oriented homework interventions-and the dependent variable, which is the academic performance of students.

The research was conducted using a comparative framework, wherein experimental groups were provided with innovative homework interventions specifically designed to address students' individual learning needs and to connect theoretical knowledge to practical applications.

In contrast, control groups continued to engage with traditional homework assignments that did not explicitly incorporate differentiation or real-world relevance.

This comparative setup enabled a direct analysis of the differences in academic progress between students exposed to the new homework strategies and those following conventional homework practices.

Quantitative research methods were primarily employed to collect and analyze data, ensuring objectivity and the possibility of statistical validation of the findings.

Pre-tests were administered to both experimental and control groups at the beginning of the intervention period to assess the baseline academic levels of the participants.

Following the intervention, post-tests were conducted to evaluate the extent of students' academic growth and to measure the effectiveness of the differentiated and practice-oriented homework strategies.

Statistical analyses, including measures of central tendency, dispersion, and inferential tests such as Welch's ANOVA, were utilized to identify significant differences between the groups and to validate the research hypotheses.

In addition to the quantitative component, qualitative methods were incorporated to enrich the data and provide a more comprehensive understanding of the interventions' impact.

Student questionnaires were used to gather information about students' perceptions of the homework tasks, their levels of engagement and motivation, and any perceived benefits or challenges associated with the new homework approaches.

Classroom observations were also conducted to capture real-time insights into students' behavior, interactions, and attitudes during physics lessons following the implementation of the interventions.

By combining experimental and descriptive research methods, this study aimed to obtain a holistic view of the influence of differentiated and practice-oriented homework strategies on students' learning outcomes.

The mixed-methods approach allowed for the triangulation of data, strengthening the validity and reliability of the findings and offering a richer, more nuanced perspective on how innovative homework designs can enhance academic achievement and foster greater motivation in secondary school physics education.

The following sections provide a detailed description of the research setting, participants, intervention procedures, and methods used for data collection and analysis.

This comprehensive overview aims to ensure transparency, reproducibility, and a clear understanding of how the study was conducted in order to evaluate the effectiveness of differentiated and practice-oriented homework strategies in secondary school physics education.

2.2. Organization and Stages of the Research

At the preparatory stage, the foundational work necessary for the successful implementation of the experiment was conducted.

Differentiated and practice-oriented homework assignments were meticulously developed based on the pedagogical principles and theoretical considerations outlined in the literature review.

These tasks were crafted to align with the goals of differentiation and practice orientation, ensuring that they catered to varying levels of student readiness and promoted real-world application of physics concepts.

In addition to the development of homework materials, diagnostic tools were created to assess the baseline academic levels and characteristics of the participating students.

This included the design of pre-test questionnaires aimed at gathering data on students' prior knowledge, learning preferences, and attitudes toward physics homework, as well as standardized achievement tests to quantitatively measure their initial understanding of key physics concepts and skills.

The preparatory stage also involved logistical planning, selection of participating schools and classes, and training of the teachers involved in the experimental groups to ensure consistency in the intervention's application.

The experimental stage marked the active phase of the study, during which the differentiated and practice-oriented homework assignments were implemented in real classroom settings.

In the experimental groups, 9th-grade students received differentiated homework tasks that varied in complexity, support, and format, tailored to meet their individual learning needs and profiles.

Meanwhile, 8th-grade students in the experimental groups engaged with practice-oriented homework tasks that emphasized the application of theoretical physics knowledge to everyday experiences and practical problems.

The control groups, in contrast, continued to complete standard, non-differentiated homework assignments that reflected traditional approaches without specific attention to individual differences or real-world application.

Throughout the experimental stage, continuous classroom observations were conducted to monitor students' levels of engagement, participation, and responsiveness to the homework interventions.

Additionally, regular formative assessments and feedback sessions provided further insight into the evolving academic performance and motivation of students during the intervention period.

The final stage involved the comprehensive evaluation of the impact of the interventions.

Post-tests identical in structure and content to the pre-tests were administered to both experimental and control groups to ensure comparability of results.

The data collected were subjected to comparative statistical analysis, including the calculation of mean scores, standard deviations, and inferential tests to determine the significance of observed differences.

The comparison between pre-test and post-test results enabled the identification of academic improvements attributable to the differentiated and practice-oriented homework strategies.

Furthermore, qualitative data from student questionnaires and teacher observations were analyzed to gain a deeper understanding of the interventions' influence on student motivation, attitudes toward physics, and perceived learning gains.

Together, the three stages of the research provided a comprehensive framework for evaluating the effectiveness of differentiated and practice-oriented homework practices in enhancing the academic achievements of secondary school students in physics.

The research was systematically carried out in three main stages: the preparatory stage, the experimental stage, and the final (concluding) stage.

Each stage was carefully designed to ensure the validity, reliability, and comprehensiveness of the study, following the principles of experimental research methodology applied in the context of educational sciences.

The next section presents a detailed description of the participants involved in the study, including information about the schools, grade levels, group composition, and criteria used for assigning students to experimental and control groups.

Understanding the characteristics of the study population is essential for interpreting the results and evaluating the generalizability of the research findings.

2.3. Participants and Research Base

The study was conducted in two general education secondary schools located in Kazakhstan, selected based on their willingness to participate and their provision of suitable conditions for conducting educational research.

These schools were chosen because they represented typical features of urban educational institutions in Kazakhstan, ensuring that the findings of the study could be generalized to similar educational settings.

A total of 100 students took part in the research, comprising 52 students from the 8th grade and 48 students from the 9th grade.

The participants were distributed between experimental and control groups to allow a systematic investigation of the effects of differentiated and practice-oriented homework assignments on academic achievement in physics.

The division of participants was organized as follows:

- 24 students from the 9th grade were assigned to the experimental group, where they received differentiated homework tasks designed to match their individual readiness levels, interests, and learning profiles;
- 24 students from the 9th grade constituted the control group, continuing to work with traditional, non-differentiated homework assignments;
- 26 students from the 8th grade were included in the experimental group, receiving practice-oriented homework tasks aimed at connecting theoretical knowledge to real-world applications;
- 26 students from the 8th grade formed the control group, completing traditional homework assignments that did not emphasize practical application or inquiry-based learning.

The selection and assignment of participants were carried out using the principle of random assignment, which helped to ensure the comparability of the groups.

Special attention was paid to balancing the groups in terms of academic performance levels, gender distribution, and other demographic characteristics, such as age and previous exposure to physics content, to minimize the influence of extraneous variables on the study's outcomes.

Before the commencement of the study, all participating students and their legal guardians provided informed consent.

Students and parents were informed about the purpose of the research, the nature of their participation, and their right to withdraw from the study at any time without any negative consequences. Ethical considerations were strictly adhered to, ensuring confidentiality, voluntary participation, and respect for participants' rights.

The research setting offered an adequate and supportive environment for conducting the experimental intervention.

Both schools provided access to necessary educational resources, such as textbooks, laboratory equipment for simple experiments, and internet facilities.

The administrative support from school leadership and the active collaboration with physics teachers were critical in facilitating the smooth organization of the study, ensuring consistent application of the homework interventions, monitoring student progress, and collecting the required data throughout the research process.

Overall, the characteristics of the research base and the careful organization of participant selection contributed to the reliability and validity of the experimental study, laying a strong foundation for analyzing the impact of differentiated and practice-oriented homework strategies on students' academic achievements in physics.

The next section describes the development and structure of the homework interventions applied in the experimental groups.

Particular attention is given to the principles guiding the design of differentiated and practice-oriented homework assignments, as well as to the ways these tasks were adapted to meet the educational objectives of secondary school physics instruction.

2.4. Development of Differentiated Homework Assignments for 9th Grade Students

In developing differentiated homework assignments for 9th-grade students, several key pedagogical principles were taken into careful consideration, including the principles of student-centered learning, gradual progression of task complexity, and instructional flexibility to accommodate diverse student needs. The differentiation strategy was guided primarily by three essential criteria: the students' academic readiness, their preferred learning styles, and their specific interests in the study of physics.

Recognizing that students exhibit a wide range of prior knowledge, cognitive abilities, and motivations, the design of homework assignments aimed to create multiple entry points into the learning process, ensuring that each student could engage meaningfully with the material at a level appropriate to their capabilities.

Homework tasks were systematically structured into three distinct levels of difficulty to provide both support and challenge:

- **Basic Level Tasks:** These assignments focused on reinforcing fundamental physics concepts and ensuring mastery of basic problem-solving skills. Students at this level worked with standard formulas and familiar contexts, solving straightforward problems that required direct application of classroom knowledge. The goal was to build a strong conceptual foundation and boost the confidence of learners who needed more practice with essential skills.
- **Intermediate Level Tasks:** At this level, students were expected to demonstrate a deeper understanding of physical principles. Tasks involved multi-step problem-solving, qualitative explanations of physical phenomena, and basic experimental analysis. Assignments at this level required students to connect different concepts, interpret results, and engage in more complex reasoning processes, fostering critical thinking and analytical skills.
- **Advanced Level Tasks:** These assignments challenged students to apply their theoretical knowledge in creative and non-standard ways. Tasks included solving complex or open-ended problems, designing and conducting simple experiments at home, and analyzing real-world applications of physical laws. Students were encouraged to think independently, make predictions, interpret data, and reflect on the implications of their findings, promoting a higher level of scientific inquiry and innovation.

Examples of differentiated tasks designed for the homework assignments included:

- Solving progressively more complex problems based on Newton’s Laws of motion, where students could choose the level of difficulty suited to their current understanding;

- Conducting simple home experiments, such as using a spring scale to measure forces, followed by comparing theoretical predictions with practical outcomes and analyzing any discrepancies;
- Creating short presentations, posters, or written reports exploring the application of physical principles in everyday technologies, such as explaining how refrigerators work based on thermodynamic laws or how seatbelts function according to Newton's first law.

In order to promote autonomy and self-directed learning, students were often given the opportunity to choose homework assignments that corresponded to their perceived readiness level.

Alternatively, in cases where additional guidance was necessary, the teacher used the results of diagnostic assessments and classroom observations to recommend appropriate task levels for individual students.
This flexible approach allowed for greater personalization of learning, encouraging students to take ownership of their educational progress while ensuring that all learners were adequately supported and appropriately challenged.

Overall, the differentiated homework strategy aimed not only to enhance students' academic achievement in physics but also to foster key educational outcomes such as increased motivation, stronger engagement with scientific material, development of critical thinking skills, and greater self-confidence in tackling complex learning tasks.

In parallel with the development of differentiated homework assignments for 9th-grade students, practice-oriented homework tasks were specifically designed for 8th-grade students.

These tasks aimed to bridge theoretical knowledge with real-world applications, fostering greater engagement, scientific inquiry skills, and deeper understanding of fundamental physics concepts among younger learners.

2.5. Development of Practice-Oriented Homework Assignments for 8th Grade Students

The development of practice-oriented homework assignments for 8th-grade students was carefully guided by the principles of activity-based learning, experiential engagement, and the purposeful integration of theoretical physics knowledge with real-life contexts.

Recognizing that younger learners benefit greatly from hands-on experiences that link abstract concepts to observable phenomena, the primary objective was to design tasks that would actively engage students in the practical application of physics principles, thereby deepening their conceptual understanding and enhancing their motivation to learn.

Practice-oriented homework tasks were constructed to encourage exploration, experimentation, and critical analysis.

Students were not only expected to recall theoretical knowledge but also to apply it in authentic situations, observe outcomes, interpret results, and reflect on the broader significance of the physical laws governing the world around them.

The types of practice-oriented homework activities developed included:

- Conducting simple home experiments to observe and analyze physical phenomena.
- For example, students measured the time of free fall of everyday objects such as a pencil or ball from a known height, compared their experimental results with theoretical calculations using the formula for free fall, and discussed possible sources of error.
- Analyzing everyday situations where physical laws are at work.
- Assignments asked students to investigate how friction influences motion on different surfaces in their homes by sliding objects over wood, tile, and carpet, and recording differences in movement and resistance, followed by explanations based on the concepts of force and friction.
- Designing and constructing simple devices or models to demonstrate basic mechanical principles.
- Students were tasked with building simple lever systems using household materials (e.g., rulers, pencils, erasers) and calculating the forces involved based on the principles of moments and mechanical advantage.
- Recording observations and reflecting on how physics concepts explain everyday experiences.

Students kept brief logs or journals describing physical phenomena they encountered daily-such as why a cup of tea cools faster when stirred-and connected these observations to theoretical explanations, thus practicing scientific reasoning in an informal context.

Each assignment was purposefully structured to foster independent inquiry, critical thinking, and problem-solving skills.

Tasks were accompanied by guiding questions designed to scaffold students' thinking processes. These questions helped students plan their experiments systematically, collect and organize data effectively, analyze results thoughtfully, and draw evidence-based conclusions.

In designing these assignments, particular care was taken to ensure accessibility and feasibility for all students.

Experiments were based on materials commonly available in most households to minimize barriers to participation.

Where necessary, alternative task options were provided, allowing students who might lack certain resources to engage with equivalent investigative activities, thus maintaining inclusivity and fairness within the experimental framework.

Through the incorporation of real-life relevance and active practical engagement, these homework tasks aimed not only to make the study of physics more meaningful for 8th-grade students but also to support the broader development of scientific literacy, encouraging students to view physics not as an abstract academic subject but as a dynamic and essential part of everyday life.

Ultimately, practice-oriented homework was designed to promote curiosity, nurture a scientific mindset, and lay the groundwork for the continued development of inquiry skills that are critical for future academic and personal success in science education.

Thus, the practice-oriented homework assignments provided 8th-grade students with valuable opportunities to actively engage in the learning process, apply theoretical concepts to real-life situations, and develop essential scientific inquiry skills.

By fostering hands-on experimentation, critical thinking, and meaningful reflection, these tasks not only enhanced students' understanding of physics but also contributed to the formation of positive attitudes toward scientific learning and increased motivation to explore physical phenomena beyond the classroom setting.

2.6. Data Collection and Analysis Methods

To thoroughly assess the effectiveness of the differentiated and practice-oriented homework assignments implemented in this study, a combination of quantitative and qualitative data collection methods was employed.

This mixed-methods approach was chosen to ensure a comprehensive evaluation that captured not only measurable academic outcomes but also students' subjective experiences, levels of engagement, and motivational changes associated with the interventions.

Quantitative methods were used as the primary means of evaluating changes in students' academic performance, providing objective, numerical data that could be subjected to rigorous statistical analysis.

The quantitative component included the following:

- **Pre-tests and post-tests:**

Standardized physics achievement tests were administered to both control and experimental groups at two points-before (pre-test) and after (post-test) the intervention period.

The tests were carefully designed to assess students' understanding of key physics concepts, their ability to solve problems of varying complexity, and their capacity to apply theoretical knowledge to practical situations.

The pre-test provided baseline data on students' academic levels prior to the intervention, while the post-test measured their progress following the completion of the differentiated and practice-oriented homework tasks.

- **Statistical analysis:**

The scores obtained from the pre- and post-tests were subjected to detailed statistical processing.

Descriptive statistics, including the calculation of mean values, standard deviations, and standard errors, were used to summarize the overall performance trends within each group.

Inferential statistical methods, particularly Welch's ANOVA (Analysis of Variance), were employed to determine whether the observed differences between the control and experimental groups were statistically significant, taking into account potential inequalities in group variances.

Additionally, the effect size (Cohen's d) was calculated to assess the magnitude of the observed differences and to provide a practical interpretation of the interventions' impact on students' academic achievements.

Qualitative methods complemented the quantitative findings by offering insights into students' subjective perceptions and behaviors throughout the study.

The qualitative component included the following tools:

- **Student questionnaires:**

Surveys were administered to all participants at the end of the intervention period.

The questionnaires were designed to gather students' feedback regarding their experiences with the homework tasks, their perceived difficulty and relevance, their levels of motivation and engagement, and their overall satisfaction with the learning process.

Both closed-ended questions (rated on Likert scales) and open-ended questions (allowing free-text responses) were used to capture a broad spectrum of student opinions and reflections.

- **Classroom observations:**

Systematic observations were conducted by the researcher and collaborating teachers during physics lessons throughout the experimental period.

Observation protocols focused on documenting students' participation, attentiveness, collaboration with peers, willingness to engage in discussions related to homework assignments, and general behavioral indicators of interest or disengagement.

These observations provided important contextual information, helping to interpret test results and student questionnaire data within the broader dynamics of the classroom environment.

By combining these quantitative and qualitative methods, the study achieved a comprehensive evaluation of the differentiated and practice-oriented homework interventions.

The use of multiple sources of evidence allowed for data triangulation, strengthening the validity and reliability of the findings and offering a deeper and more nuanced understanding of how different homework strategies influence students' academic outcomes, motivation, and attitudes toward learning physics.

The next section presents the procedures followed for data analysis, including the specific statistical techniques applied to evaluate the quantitative results and the approaches used to interpret the qualitative data.

This detailed overview ensures transparency and rigor in assessing the effectiveness of the differentiated and practice-oriented homework interventions.

Data Analysis Methods:

In educational research, a range of statistical methods is commonly used to analyze students' academic performance, depending on the nature of the data and the research

questions.
Among the most frequently applied techniques are:

- **t-tests**, which are used to compare the means of two independent groups;
- **one-way and multi-way analysis of variance (ANOVA)**, which allow for comparison of means across more than two groups or across multiple variables;
- **correlation and regression analysis**, which help identify relationships between variables and predict outcomes;
- as well as **non-parametric methods**, applied when data do not meet the assumptions of normal distribution or homogeneity of variance.

For the purposes of this study, **one-way analysis of variance (Welch's ANOVA)** was selected as the primary statistical tool for evaluating the effectiveness of the interventions.
This method was appropriate because the study involved comparing the mean performance of two groups (control and experimental) across different grade levels and conditions.
Welch's ANOVA was specifically chosen over the traditional ANOVA due to its robustness in situations where the assumption of equal variances between groups (homoscedasticity) may not be fully satisfied-a common occurrence in educational field settings with relatively small and unequal group sizes.

Welch's ANOVA allowed for the identification of statistically significant differences between group means while reducing the risk of Type I errors associated with variance inequality.
It provided a reliable basis for testing the research hypotheses by determining whether the observed changes in academic performance were due to the differentiated and practice-oriented homework strategies rather than to chance or uncontrolled external factors.

In addition to testing for significance, the **effect size (Cohen's d)** was calculated to assess the magnitude of the observed effects, offering a more complete interpretation of the practical impact of the interventions.
This approach ensured that the findings of the study were not only statistically valid but also educationally meaningful.

Thus, the selected statistical procedures, including Welch's ANOVA and effect size calculations, allowed for a rigorous and comprehensive evaluation of the research hypotheses.

The use of these methods ensured the accuracy, validity, and educational relevance of the findings, providing a strong empirical basis for assessing the impact of differentiated and practice-oriented homework strategies on students' academic achievements in physics.

2.7. Ethical Considerations

Ethical principles were strictly and consistently observed throughout all stages of the research process in order to ensure the protection of participants' rights, dignity, and well-being.

Adherence to ethical standards was a fundamental priority, reflecting the commitment to responsible and respectful conduct of educational research involving minors.

- **Informed consent** was obtained from all participants and their parents or legal guardians prior to the commencement of the study. Clear and comprehensive information was provided regarding the aims, scope, and procedures of the research. Participants were informed about the nature of their involvement, the types of tasks they would complete, the duration of the study, and the methods of data collection. Special emphasis was placed on communicating that participation in the study was entirely voluntary and that students, as well as their parents, had the right to decline participation or to withdraw from the study at any point without any negative consequences or penalties.
- **Confidentiality and anonymity** were strictly maintained to protect the privacy of all participants. All data collected, including test results, questionnaires, and observation notes, were anonymized by assigning codes to individual participants instead of using personal identifiers such as names or school ID numbers. Data were securely stored and accessed only by authorized research personnel. In reporting the findings, aggregated data were used to prevent the identification of any individual participant or school, thereby upholding the ethical obligation to protect participant confidentiality.
- **Voluntary participation** was explicitly emphasized during the consent process and throughout the research activities. Students were reassured that their participation was not obligatory and that choosing not to participate, or choosing to withdraw at any stage, would not affect their academic standing, grades, or relationships with teachers and school administration. This approach fostered an environment of trust and respect, encouraging genuine and willing participation.
- **Minimization of risk** was another critical ethical consideration. All homework assignments and experimental activities designed for the study were carefully vetted to ensure that they were safe, age-appropriate, and within the physical, cognitive, and emotional capabilities of 8th- and 9th-grade students. Tasks were designed to involve minimal risk, avoiding any physical, psychological, or social harm. In addition, students were provided with clear instructions and guidelines for any experimental activities conducted at home to further reduce the likelihood of accidents or misunderstandings.
- **Institutional approval** for conducting the research was obtained from the relevant school administrations prior to the start of the study. School leaders were briefed on the research objectives, methodologies, and ethical safeguards in place.

Their approval and support ensured that the research activities were integrated smoothly into the school environment and were aligned with institutional policies and ethical standards for educational research.

In sum, all procedures undertaken in this study were conducted in full compliance with recognized ethical guidelines for research involving human participants,

particularly minors.
This careful attention to ethical principles contributed to the credibility, trustworthiness, and integrity of the research process and its outcomes.

Thus, the ethical integrity of the study was ensured at every stage of the research process, from participant recruitment and informed consent to data collection, analysis, and reporting.

Maintaining high ethical standards contributed to creating a respectful and supportive research environment, ensuring the validity of the findings and the overall credibility of the study.

3. RESULTS AND DISCUSSION

Introduction to Chapter 3

This chapter presents the results of the pedagogical experiment conducted to assess the impact of differentiated and practice-oriented homework assignments on students' academic achievements in physics at the secondary school level. The findings are systematically organized according to the two primary areas of investigation: the effectiveness of differentiated homework strategies implemented with 9th-grade students and the effectiveness of practice-oriented homework strategies applied to 8th-grade students.

The analysis carried out in this chapter encompasses several key components:

- **Comparison of pre-test and post-test results** for both control and experimental groups, enabling the evaluation of academic progress over the course of the intervention;
- **Statistical evaluation** of the effectiveness of the interventions using Welch's ANOVA and effect size calculations, to determine the significance and magnitude of differences observed between groups;
- **Interpretation of the quantitative findings** within the context of the theoretical framework discussed in Chapter 1, linking empirical results to the conceptual principles of differentiated and practice-oriented learning strategies.

Special attention is given to analyzing the **dynamics of students' academic achievements**, highlighting trends and patterns in learning outcomes across different groups and grade levels. Differences between the experimental and control groups are explored in depth to identify how the innovative homework approaches influenced students' academic performance compared to traditional homework practices.

Furthermore, the chapter discusses **students' perceptions and attitudes** toward the homework interventions based on data collected through post-intervention questionnaires.
Students' feedback provides valuable qualitative insights into their levels of engagement, motivation, and satisfaction with the differentiated and practice-oriented tasks, offering an important dimension to the interpretation of the results.

The outcomes of the study are analyzed using a **mixed-methods approach**, integrating both quantitative data from standardized tests and qualitative data from surveys and classroom observations. This comprehensive evaluation ensures a holistic understanding of the ways in which differentiated and practice-oriented homework strategies contribute to enhancing students' learning experiences, academic achievements, and attitudes toward physics.

Through the detailed analysis presented in this chapter, the study aims to provide empirical evidence supporting the effectiveness of innovative homework practices and to draw meaningful conclusions about their implications for the improvement of physics education in Kazakhstan's secondary schools.

The first section presents the comparative analysis of the academic results of 9th-grade students, focusing on the impact of differentiated homework assignments.

The analysis includes a comparison of pre-test and post-test scores between the experimental and control groups, supported by statistical evaluation and interpretation of the findings within the broader theoretical framework.

3.1. Results of the Study on Differentiated Homework (9th Grade)

The first part of the pedagogical experiment focused on evaluating the effectiveness of differentiated homework assignments in improving the academic achievements of 9th-grade students in the subject of physics.

This stage of the study was designed to test the hypothesis that differentiated homework, tailored to students' individual readiness levels, learning preferences, and interests, would lead to higher academic performance compared to traditional, uniform homework assignments that do not account for individual differences.

In the experimental group, students received homework tasks that were systematically differentiated based on the principles outlined during the preparatory phase of the study.

Assignments were structured across three levels of complexity: basic, intermediate, and advanced.

Students were either given the autonomy to select tasks according to their self-assessed readiness levels or were guided by the teacher based on diagnostic assessments of their prior knowledge and skills.

This approach aimed to ensure that each student engaged with physics content at a level that was appropriately challenging, thereby promoting deeper understanding, stronger engagement, and higher motivation to learn.

In contrast, the control group continued to receive traditional homework assignments characterized by a uniform level of difficulty and a standard format.

These tasks were the same for all students, regardless of their individual learning needs or academic abilities.

The traditional approach reflected common practice in many educational settings, where homework is assigned without explicit differentiation, assuming a relatively homogenous level of student preparedness and capability.

The differentiation in the experimental group was designed not only to enhance students' conceptual understanding of physics but also to develop critical skills such as problem-solving, analytical thinking, and independent inquiry.

Basic-level tasks reinforced fundamental concepts and basic applications of physical laws, intermediate tasks required multi-step reasoning and qualitative explanations, and advanced tasks encouraged creative problem-solving, experimental design, and the exploration of real-world applications of physics principles.

Throughout the intervention period, students' engagement with homework assignments was carefully monitored through classroom observations, informal discussions, and regular formative assessments.

Teachers documented students' attitudes toward the differentiated tasks, noting levels of interest, persistence in problem-solving, willingness to attempt more challenging tasks, and overall responsiveness to the differentiated approach.

The comparison of pre-test and post-test results between the experimental and control groups served as the primary quantitative measure of the effectiveness of the differentiated homework strategy.

By analyzing the changes in academic performance over the course of the intervention, the study sought to determine whether differentiated homework assignments could be empirically validated as an effective pedagogical tool for improving learning outcomes in physics education.

In addition to quantitative data, qualitative feedback gathered from student questionnaires provided important insights into how students perceived the differentiated homework tasks, how they assessed their own learning experiences, and whether they felt that differentiated homework contributed to a deeper understanding of physics concepts.

Overall, this first part of the pedagogical experiment was integral to exploring the broader research question of how individualized approaches to homework design can support the academic development of secondary school students and contribute to more effective and inclusive physics education practices.

The analysis of the pre-test and post-test results for 9th-grade students is presented below.

This analysis focuses on comparing the academic achievements of the experimental group, which received differentiated homework assignments, with those of the control group, which continued with traditional homework practices.

Statistical evaluation and interpretation of the findings are provided to assess the effectiveness of the differentiated homework strategy.

3.1.1. Pre-test Results: Comparison between Control and Experimental Groups

Before the introduction of differentiated homework assignments, both the experimental and control groups underwent a pre-test designed to assess their initial level of knowledge, understanding, and problem-solving skills related to the selected topics in the physics curriculum (Table 3.1).

The purpose of administering the pre-test was to establish a reliable baseline for comparing subsequent academic progress and to ensure the initial academic comparability of the groups involved in the study.

The pre-test included a range of tasks assessing students' mastery of fundamental physics concepts, their ability to apply theoretical knowledge to problem-solving situations, and their capacity for basic analytical reasoning.

The test was constructed in alignment with the learning objectives specified for the corresponding grade level, ensuring that it was both valid and representative of the curriculum content.

Upon analyzing the results of the pre-test, it was found that there were no statistically significant differences between the control and experimental groups in terms of their mean scores.

This finding was confirmed through the application of Welch's ANOVA, which is appropriate for comparing group means, particularly when assumptions of equal variance may not be strictly met.

The p-value obtained exceeded the commonly accepted threshold of significance ($p > 0.05$), indicating that any observed differences in mean scores were not statistically meaningful and could be attributed to random variation rather than to systematic differences between the groups.

The absence of statistically significant differences at the pre-test stage is an important methodological strength of the study.

It confirms that the groups were academically comparable at the outset of the experiment, thus enhancing the internal validity of the research design.

This comparability ensures that any differences observed in the post-test phase can be more confidently attributed to the intervention itself-the differentiated homework strategy-rather than to pre-existing disparities in students' academic abilities.

Establishing baseline equivalence between groups is a crucial step in experimental research, as it provides the foundation for fair and unbiased evaluation of the effects of educational interventions.

In this study, the comparability of the experimental and control groups at the pre-test stage supports the integrity of the experimental procedure and strengthens the reliability of the conclusions drawn from the subsequent data analysis.

Таблица 3.1 Entrance test results

Control group		**Experimental group**	
Student	Maximum score 30	Student	Maximum score 30
1	20	1	9
2	15	2	10
3	15	3	13
4	19	4	20
5	18	5	15
6	11	6	15
7	21	7	13
8	15	8	19
9	21	9	13
10	13	10	15
11	12	11	13
12	12	12	18
13	14	13	15
14	15	14	18
15	16	15	14
16	20	16	12
17	12	17	13

Control group		Experimental group	
Student	Maximum score 30	Student	Maximum score 30
18	11	18	20
19	16	19	14
20	14	20	23
21	15	21	18
22	13	22	12
23	14	23	16
24	11	24	10

In the control and experimental groups, there is a strong scatter of results: in the control group, the minimum score is 11, the maximum score is 21, in the experimental group, the minimum score is 9, the maximum score is 23. The results of the preliminary analysis are included in Table 3.2.

Results of the Preliminary Analysis

Table 3.2 Results of the Preliminary Analysis

	Control group	Experimental group
Minimum score	11	9
Maximum score	21	23
Average score	15,13	14,9
Range of values	10	14
Quantity estimate «5» (Great)	0	0
Quantity estimate «4» (Fine)	5	5
Quantity estimate «3» (satisfactorily)	18	16
Quantity estimate «2» (not satisfactory)	1	3

Analysis of the entrance testing shows that the difference in results is insignificant; overall, the picture of academic performance in both classes is similar.

Statistical Analysis of Pre-test Group Results

To ensure the initial equivalence between the control and experimental groups, a Welch's one-way analysis of variance (ANOVA) was conducted on the pre-test scores. This statistical test was chosen due to its robustness against violations of homogeneity of variances. The results indicated no statistically significant difference between the groups:

F(1, 45.6) = 0.0462, p = 0.831.

These findings suggest that the groups were comparable at the outset of the study, providing a valid foundation for subsequent comparisons in the post-test phase.

Table 3.3 Descriptive Statistics for Pre-test Scores

	Class	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Initial test	Control	24	15.1	3.19	0.652
	Experimental	24	14.9	3.51	0.717

Table 3.3 presents the descriptive statistics for the pre-test scores in both the control and experimental groups. The control group (N = 24) had a mean score of 15.1 (SD = 3.19), with a standard error (SE) of 0.652. The experimental group (N = 24) had a mean score of 14.9 (SD = 3.51), with a standard error (SE) of 0.717.

These results suggest that both groups have similar average scores prior to the intervention, with only a slight difference in the means (0.2), which is not statistically significant based on the previous ANOVA results. The standard deviations (SD) for both groups are relatively similar, indicating that the spread of scores within each group is comparable.

Figure 3.1 Pre-test result of groups

As shown in the graph (Figure 3.1), the mean values and confidence intervals for the pre-test are nearly identical, confirming the absence of significant differences between the groups at the initial stage.

Final academic performance of students before the start of the study.

To ensure the baseline equivalence between the control and experimental groups, a one-way Welch's Analysis of Variance (ANOVA) was performed on the students' final academic performance data collected prior to the commencement of the intervention phase of the study (Table 3.4, Table 3.5, Table 3.6, Figure 3.2). This statistical approach was selected due to its robustness in handling unequal variances between groups, which is a common concern in educational field research involving naturally occurring student populations.

Table 3.4 Final academic performance of students before the start of the study

Control group		Experimental group	
Student	Maximum value 100%	Student	Maximum value 100%
1	77	1	63
2	60	2	52
3	67	3	50
4	78	4	59
5	70	5	70
6	53	6	63
7	83	7	65
8	65	8	49
9	74	9	61
10	61	10	73
11	70	11	59
12	64	12	57
13	65	13	62
14	74	14	51
15	62	15	64
16	86	16	69
17	57	17	66
18	55	18	67
19	74	19	84
20	69	20	86
21	71	21	79
22	68	22	54
23	68	23	83
24	58	24	49

Table 3.5 Comparison of Students' Academic Achievement Before the Study Using Welch's One-Way ANOVA

Test Stage	F-value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p-value
Before the Study	1.90	1	43.2	0.175

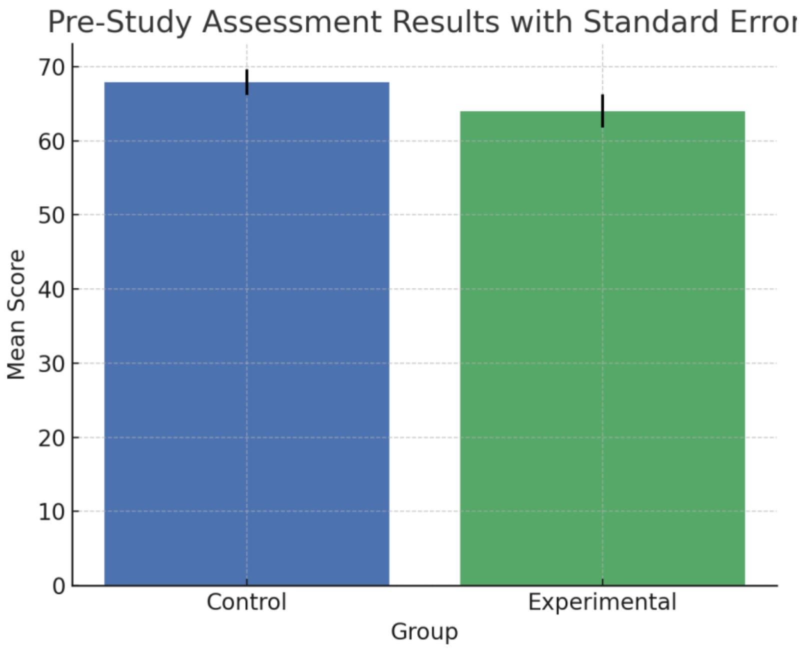


Figure 3.2 Baseline Academic Performance and Descriptive Characteristics of the Groups

Table 3.6 Baseline Academic Performance and Descriptive Characteristics of the Groups

Test Stage	Group	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Before the Study	Control	24	67.9	8.48	1.73
Before the Study	Experimental	24	64.0	11.03	2.25

The results of the Welch's ANOVA revealed no statistically significant difference in the average academic performance between the two groups at the pre-intervention stage, $F(1, 43.2) = 1.90$, $p = .175$. Given that the p-value exceeds the conventional threshold of significance ($p < .05$), the observed differences in mean scores can be considered as statistically non-significant.

This outcome suggests that the experimental and control groups were academically comparable at the start of the study. The lack of significant differences strengthens the internal validity of the research by confirming that any changes observed in academic performance during or after the intervention can be attributed with greater confidence to the implemented strategies, rather than to pre-existing disparities between the groups. Therefore, the results of this preliminary analysis provide a solid foundation for conducting valid and unbiased comparisons in the subsequent stages of the research.

Description of the Phase Between the Initial test and Final test

Following the administration of the pre-test, which served to determine the students' initial level of understanding, the core phase of the study was initiated. This phase spanned the period between the pre-test and the post-test and involved the implementation of distinct instructional approaches in the experimental and control groups, particularly in relation to homework assignments.

In the experimental group, a system of differentiated homework tasks was introduced. These tasks were tailored to the individual learning needs, abilities, and interests of the students. The assignments varied in terms of complexity (basic, intermediate, and advanced), and included practical problem-solving tasks, research-based mini-projects, and activities designed to foster critical thinking and independent learning. The teacher played an active role in monitoring students' progress, providing ongoing feedback, and adjusting the level and type of tasks as necessary to maintain engagement and ensure accessibility.

In contrast, the control group continued learning through the traditional method, in which all students received identical homework assignments, regardless of their individual performance levels or learning preferences. The tasks were predominantly reproductive in nature, focusing on the repetition and reinforcement of classroom content without significant variation.

Throughout this phase, data collection was conducted systematically, including observations of students' engagement levels, task completion quality, and overall participation. Difficulties encountered by students in both groups were also recorded to allow for a more comprehensive analysis of the instructional strategies employed.

This phase concluded with the post-test, which was designed to assess the development of students' academic performance over the course of the intervention. The post-test was aligned with the same content areas as the pre-test, enabling a direct comparison of learning outcomes and providing insights into the effectiveness of differentiated homework assignments as a pedagogical intervention.

3.1.2. Post-test Results: Comparison between Control and Experimental Groups

After the implementation of differentiated homework over the course of the study period, students completed a post-test. The post-test results demonstrated an improvement in both groups; however, the experimental group showed a more substantial gain compared to the control group.

To assess the effectiveness of the applied instructional strategies, a post-test was conducted in both the experimental and control groups. This section presents the outcomes of the post-test, highlighting key trends, differences, and patterns in students' performance that emerged as a result of the intervention.

Table 3.7 The results of the Final test

Control group		Experimental group	
Student	Maximum score 30	Student	Maximum score 30
1	21	1	15
2	16	2	14
3	14	3	17
4	20	4	23
5	18	5	20
6	14	6	19
7	22	7	17
8	16	8	24
9	23	9	16
10	13	10	19
11	14	11	16
12	14	12	24
13	13	13	16
14	16	14	21
15	17	15	18
16	21	16	15
17	14	17	16
18	12	18	26
19	18	19	15
20	15	20	26
21	16	21	22
22	15	22	14
23	15	23	23
24	10	24	15

In both groups, the control and the experimental, there is a spread of post-test results: in the control group, the minimum score is 10, the maximum score is 23, in the experimental group, the minimum score is 14, the maximum score is 26. The results of the preliminary analysis are presented in Table 3.7, Table 3.8, Table 3.9, Table 3.10, Figure 3.3.

Results of the Preliminary Analysis

Table 3.8 Results of the Preliminary Analysis

	Control group	Experimental group
Minimum score	23	26
Maximum score	10	14
Average score	16,13	18,79
Range of values	13	12
Quantity estimate «5» (Great)	0	2
Quantity estimate «4» (Fine)	5	7
Quantity estimate «3» (satisfactorily)	18	15
Quantity estimate «2» (not satisfactory)	1	0

Table 3.9 One-Way Analysis of Variance (Welch's ANOVA) of Post-Test Results

	F-value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p-value
Final test	6.49	1	44.8	0.014

Table 3.10 Descriptive statistics of the group

	class	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Final test	control	24	16.1	3.31	0.677
	experimental	24	18.8	3.91	0.799

Figure 3.3 The results of the Final test

To evaluate the effectiveness of differentiated homework tasks, a one-way analysis of variance (Welch's ANOVA) was conducted, accounting for potential heterogeneity of variances between the groups.

The analysis yielded the following result: $F(1, 44.8) = 6.49$, $p = 0.014$.

Since the p-value is less than 0.05, the result indicates a statistically significant difference in post-test scores between the experimental and control groups. This finding suggests that differentiated homework had a positive impact on students' academic performance.

Therefore, it can be concluded that assigning homework tailored to students' individual readiness levels and learning needs contributed to improved learning outcomes.

3.1.3. Analysis of Changes in Academic Achievements

To better understand the progress, the differences between pre-test and post-test scores within each group were analyzed. The experimental group showed a higher mean gain in test scores than the control group.

Upon completion of the study, a summative assessment was administered to both the experimental and control groups. The results of this assessment were used as a tool to track changes in students' academic performance compared to the data obtained during the pre-test phase. The statistical analysis presented in this section aims to identify differences in results between the groups and evaluate the potential impact of the implemented intervention on students' learning outcomes.

The results of the students’ final work completed after the intervention are presented in Table 3.11, Table 3.12, Table 3.13, Figure 3.4.

Table 3.11 Results of the final assessment of the groups after the research intervention

Control group		**Experimental group**	
Student	Maximum value 100%	Student	Maximum value 100%
1	78	1	66
2	59	2	53
3	66	3	52
4	76	4	62
5	75	5	72
6	56	6	66
7	83	7	68
8	66	8	51
9	73	9	66
10	63	10	76
11	70	11	63
12	65	12	66
13	66	13	66
14	73	14	52
15	65	15	66
16	89	16	70
17	60	17	66
18	61	18	69
19	76	19	87
20	69	20	89
21	69	21	81
22	67	22	57
23	67	23	86
24	60	24	51

Table 3.12 Statistical Analysis of Summative Assessment Results Using Welch's One-Way ANOVA

	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	P value
Difference in summative scores	10.22	1	44.1	0.003
Difference in test scores	6.31	1	46.0	0.016

Table 3.13 Descriptive Statistics of the Control and Experimental Groups

	class	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Difference in test scores	Control	24	0.958	2.14	0.436
	Experimental	24	2.750	1.73	0.352
Difference in test scores	Control	24	2.208	1.64	0.335
	Experimental	24	3.417	1.69	0.345

Figure 3.4 Statistical Analysis of Summative Assessment Results

Results of Welch's One-Way ANOVA

A one-way Welch's analysis of variance (ANOVA) was conducted to assess differences in students' academic performance after the intervention (after_study%)

between the experimental and control groups. The results indicated no statistically significant differences between the groups, as shown below:

F value = 0.579, Degrees of Freedom 1 (df_1) = 1,
Degrees of Freedom 2 (df_2) = 41.5, p value = 0.451

The obtained p-value (0.451) is greater than the conventional significance level of .05, suggesting that the intervention had no significant effect on students' task performance after the instructional period. The F-statistic of 0.579 also reflects minimal variance between the groups.

Therefore, the null hypothesis-which assumes no differences in outcomes between the experimental and control groups after the intervention-cannot be rejected. These results suggest that the intervention did not lead to a statistically significant improvement in students' performance, as measured by the variable after_study%.

Additionally, one-way Welch's ANOVA was conducted to analyze the dynamics of students' results in summative assessment before and after the intervention, as well as the changes in Pre-test and Post-test performance in both the experimental and control groups (Table 3.14, Table 3.15, Figure 3.5, Figure 3.6).

Table 3.14 Analysis of Changes in Academic Achievement Using Welch's One-Way ANOVA

	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p value
Difference in summative scores	10.22	1	44.1	0.003
Difference in test scores	6.31	1	46.0	0.016

Table 3.15 Descriptive Statistics and Analysis of Changes in Academic Achievements

	class	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Difference in summative scores	control	24	0.958	2.14	0.436
	experimental	24	2.750	1.73	0.352
Difference in test scores	control	24	2.208	1.64	0.335
	experimental	24	3.417	1.69	0.345

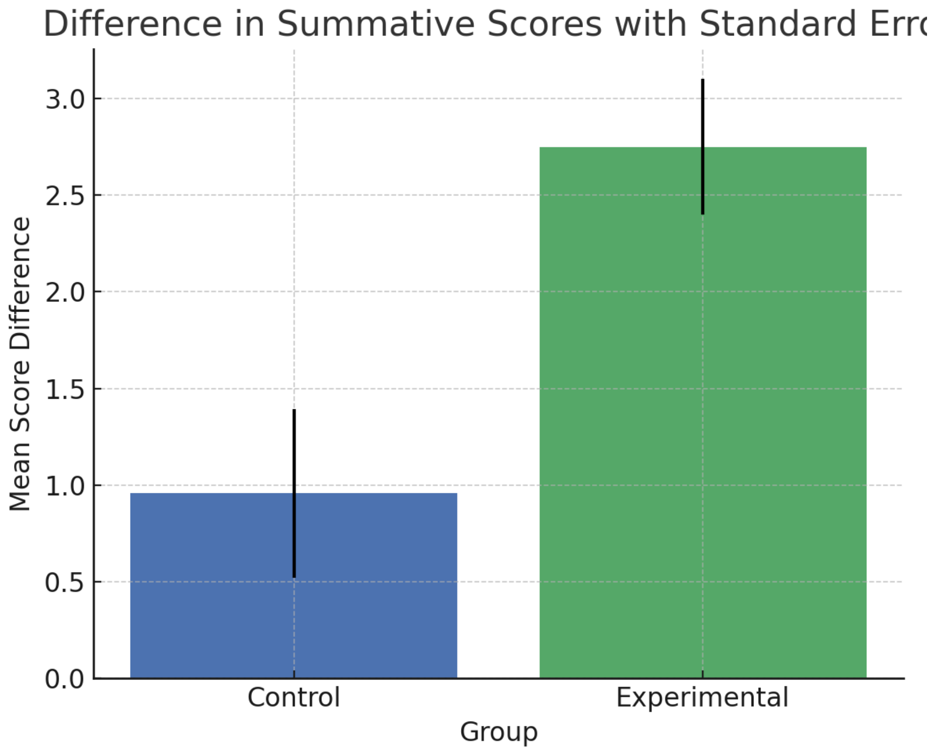


Figure 3.5 Analysis of Changes in Summative Academic Achievement Between Control and Experimental Groups

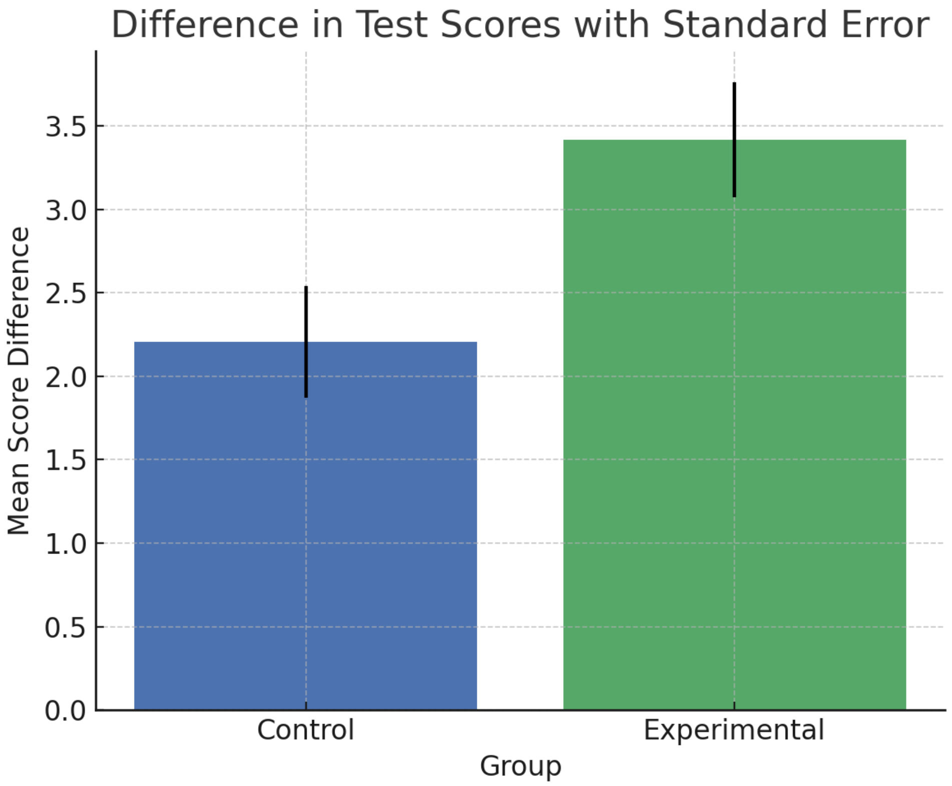


Figure 3.6 Analysis of Changes in Test-Based Academic Achievement Between Control and Experimental Groups

The results of Welch's one-way ANOVA revealed statistically significant differences between the experimental and control groups in both the dynamics of summative assessment performance ($F(1, 44.1) = 10.22$, $p = .003$) and in Pre-test to Post-test performance ($F(1, 46.0) = 6.31$, $p = .016$). These findings indicate the effectiveness of the intervention and confirm the positive impact of differentiated assignments on students' academic achievement.

3.1.4. Interpretation of the Results for Differentiated Homework

In the present study, the hypothesis regarding the existence of statistically significant differences between the participants of the experimental and control groups was tested in terms of task performance indicators (i.e., the dynamics of students' results in summative assessments before and after the intervention) and academic performance levels (i.e., the dynamics of students' results in pre-test and post-test assessments). Welch's one-way analysis of variance (ANOVA) was used to analyze the data, as preliminary testing using Levene's test revealed a violation of the homogeneity of variances assumption (where a p-value $< .05$ indicates statistically significant differences in variances between groups, meaning that the variability within the groups is unequal, thus violating the assumption of homogeneity of variances required for classical ANOVA).

The results of the analysis showed statistically significant differences between the groups for both variables under investigation. For the variable measuring the dynamics of students' results in summative assessments before and after the intervention, a significant difference was observed: $F(1, 44.1) = 10.22$, $p = .003$. This indicates a substantial impact of differentiated homework assignments on academic achievement. Additionally, for the variable reflecting the dynamics of students' results in pre-test and post-test assessments, a statistically significant difference was found: $F(1, 46.0) = 6.31$, $p = .016$, suggesting that the intervention had a positive influence on final test outcomes.

Thus, the results support the proposed hypothesis: the implementation of the suggested methodology has a positive impact on students' academic performance. The most pronounced effect was observed in the dynamics of students' summative assessment results before and after the intervention, which may indicate increased engagement and improved quality in task completion within the experimental group. These findings highlight the importance of integrating pedagogical strategies aimed at individualizing instruction to enhance students' academic success.

3.2. Results of the Study on Practice-Oriented Homework (8th Grade)

The second part of the pedagogical experiment focused on examining the impact of practice-oriented homework assignments on the academic achievements of 8th-grade students in the field of physics.

This phase of the study aimed to test the hypothesis that practice-oriented homework, which emphasizes the application of theoretical concepts to real-life contexts and encourages active, inquiry-based learning, would lead to improved student engagement, deeper understanding, and higher academic performance compared to traditional, theory-based homework approaches.

In the experimental group, students were provided with carefully designed homework tasks that explicitly connected classroom learning with everyday phenomena.

These tasks included simple experiments using household materials, observational activities related to common physical processes, problem-solving tasks rooted in real-world contexts, and reflective exercises aimed at encouraging students to apply scientific reasoning outside of the classroom environment.

The design of these tasks was informed by the principles of experiential and practice-oriented learning, which advocate that students learn more effectively when they are able to see the relevance and applicability of theoretical knowledge in their daily lives.

In contrast, students in the control group continued to work with traditional homework assignments, which were predominantly focused on theoretical exercises drawn directly from the textbook or classroom instruction.

These tasks emphasized rote memorization of formulas, completion of standard problem sets, and reproduction of theoretical content, without necessarily requiring students to apply knowledge to new or practical situations.

While traditional assignments provided opportunities for reinforcing theoretical understanding, they lacked the experiential dimension that the practice-oriented tasks were specifically designed to offer.

The introduction of practice-oriented homework for the experimental group was intended not only to strengthen students’ grasp of physics concepts but also to develop critical 21st-century skills such as problem-solving, analytical thinking, creativity, and the ability to transfer knowledge to novel contexts.

By engaging students in activities that mirrored real-world challenges and phenomena, the practice-oriented approach aimed to enhance their intrinsic motivation, stimulate curiosity, and foster a deeper and more lasting understanding of physical principles.

During the intervention period, students' participation, enthusiasm, and engagement with homework tasks were closely monitored through classroom observations and informal discussions.

Teachers noted students’ willingness to perform experiments, their ability to articulate observations and findings, and their interest in discussing how physics concepts explained everyday experiences.

Special attention was given to documenting differences in learning behaviors between the experimental and control groups, particularly regarding students' initiative, critical thinking skills, and ability to connect theory to practice.

Quantitative evaluation of the impact of the intervention was conducted by comparing the pre-test and post-test results of the experimental and control groups.

The statistical analysis focused on determining whether students who engaged with practice-oriented homework demonstrated greater academic improvement compared to their peers following traditional homework practices.

In addition to quantitative measures, qualitative feedback from student questionnaires provided important insights into students' perceptions of the homework assignments, their levels of enjoyment and engagement, and the perceived relevance of physics to their everyday lives as a result of the intervention.

Overall, the second part of the pedagogical experiment played a critical role in exploring the broader research question concerning the effectiveness of innovative, student-centered approaches to homework design in promoting higher academic achievement and a more meaningful learning experience in physics education.

The analysis of the pre-test and post-test results for 8th-grade students is presented below.

This section compares the academic achievements of the experimental group, which completed practice-oriented homework assignments, with those of the control group, which continued with traditional theory-based homework.

Statistical evaluation and interpretation are provided to assess the effectiveness of the practice-oriented homework strategy in enhancing students' understanding and performance in physics.

3.2.1. Initial test Results: Comparison between Control and Experimental Groups

At the beginning of the study, both the control and experimental groups took a pre-test to assess their initial knowledge and skills in physics. The pre-test analysis indicated that there were no statistically significant differences between the groups, ensuring comparability for the subsequent evaluation.

At the diagnostic stage, an assessment was carried out to determine the initial level of academic preparation of students from the two 8th-grade classes selected to participate in the study. To establish the homogeneity of the groups, an analysis was conducted (Table 3.16) of the results from a summative assessment administered prior to the implementation of the practice-oriented approach. This made it possible to determine whether there were any significant differences in the level of content mastery between the experimental and control groups before the start of the pedagogical intervention (Table 3.17, Table 3.18, Figure 3.6).

Table 3.16 Results of summative assessments for the control and experimental groups before the start of the study (8th Grade)

	Control group		**Experimental group**
№	Maximum score 25	№	Maximum score 25
1	21	1	23
2	13	2	15
3	23	3	23
4	13	4	14
5	16	5	18
6	14	6	15

№	**Control group** Maximum score 25	№	Experimental group Maximum score 25
7	18	7	19
8	13	8	15
9	12	9	13
10	18	10	20
11	15	11	15
12	16	12	17
13	16	13	17
14	22	14	23
15	20	15	23
16	14	16	15
17	16	17	17
18	18	18	19
19	17	19	17
20	22	20	23
21	14	21	15
22	15	22	17
23	16	23	18
24	15	24	18
25	17	25	18
26	14	26	15

To statistically test the hypothesis of no significant differences between the groups, a one-way Welch ANOVA was conducted.

Table 3.17 Comparison of Initial test Results Between Control and Experimental Groups (8th Grade) Using Welch's One-Way ANOVA

	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p value
Before the study	1.67	1	43.0	0.203

Table 3.28 Descriptive Statistics and Initial test Comparison of Control and Experimental Groups (8th Grade)

	groups	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Before the study	Control	26	16.5	3.05	0.598
	Experimental	26	15.5	1.98	0.389

The results of the analysis showed that the differences in the summative assessment scores were statistically insignificant: $F(1, 43) = 1.67$, $p = 0.203$. Therefore, it can be concluded that at the start of the study, the groups were comparable in terms of preparation level, which ensures appropriate conditions for conducting the further experiment.

The administration of the pre-test, specifically developed for this study, was planned for the next stage-prior to the implementation of practice-oriented tasks into the learning process.

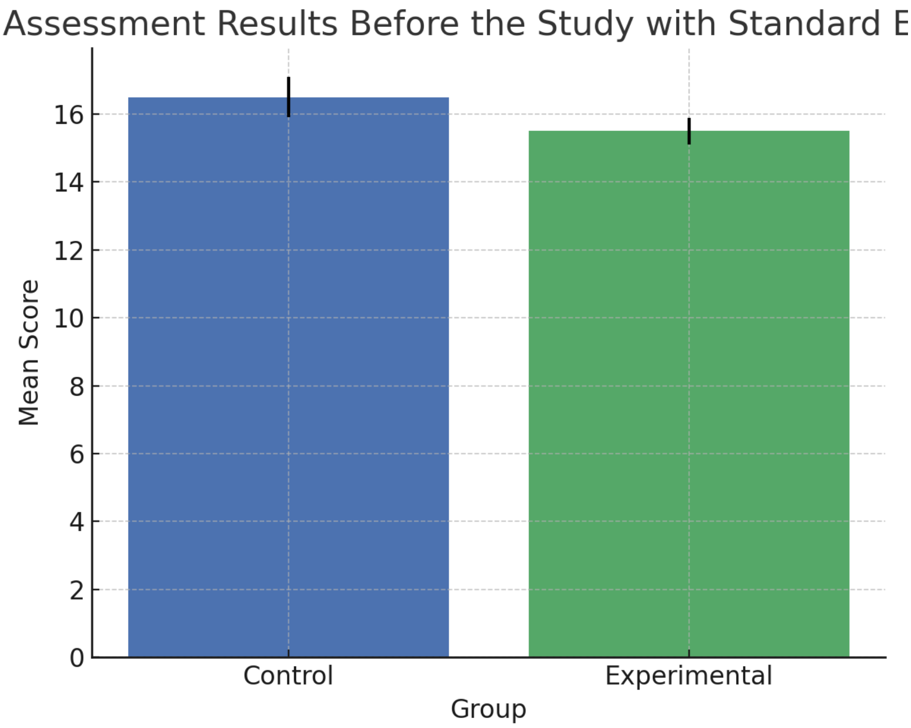


Figure 3.7 Pre-Test Results and Before-the-Study Academic Performance of 8th Grade Control and Experimental Groups

Analysis of Initial test Results

To determine the baseline knowledge level of the students and ensure the reliability of the study results, a pre-test was conducted, serving as the primary diagnostic tool before the implementation of practice-oriented homework assignments. The administration of the pre-test allowed for the establishment of the baseline academic performance in physics for participants in both the experimental and control groups. This is a crucial step, as comparing results before and after the intervention ensures an objective assessment of the effectiveness of the proposed method (Creswell, 2014, p. 200).

The test tasks were designed to assess key concepts, formulas, and skills, and were identical in difficulty for both groups. The analysis of pre-test results helps evaluate how homogeneous the groups are at the start of the study and serves as a benchmark for later comparison with the final results (post-test) (Table 3.19), which, in turn, will allow for the identification of changes in students' knowledge levels.

Table 3.39 Results (Initial test) of the control and experimental groups at the initial stage of the study.

	Control group		**Experimental group**
№	Maximum score 15	№	Maximum score 15
1	13	1	9
2	10	2	9
3	14	3	9
4	10	4	10
5	11	5	11
6	9	6	10
7	11	7	13
8	9	8	9
9	10	9	11
10	12	10	10
11	11	11	9
12	10	12	10
13	11	13	10
14	14	14	11
15	12	15	11
16	10	16	11
17	11	17	10
18	11	18	11
19	10	19	9
20	12	20	14
21	10	21	11
22	9	22	10
23	11	23	14
24	10	24	9
25	11	25	9
26	10	26	11

The comparison of the mean values of two independent groups was conducted using the one-way Welch ANOVA, recommended when there is a potential difference in variances (Table 3.20, Table 3.21, Figure 3.7).

Table 3.20 Analysis of Pre-Test Results in 8th Grade Using Welch's One-Way ANOVA

	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p value
Initial test	1.19	1	49.7	0.280

Table 3.21 Descriptive Statistics and Analysis of Initial test Results in Control and Experimental Groups (8th Grade)

	Groups	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Initial test	Control	26	10.8	1.35	0.264
	Experimental	26	10.4	1.45	0.284

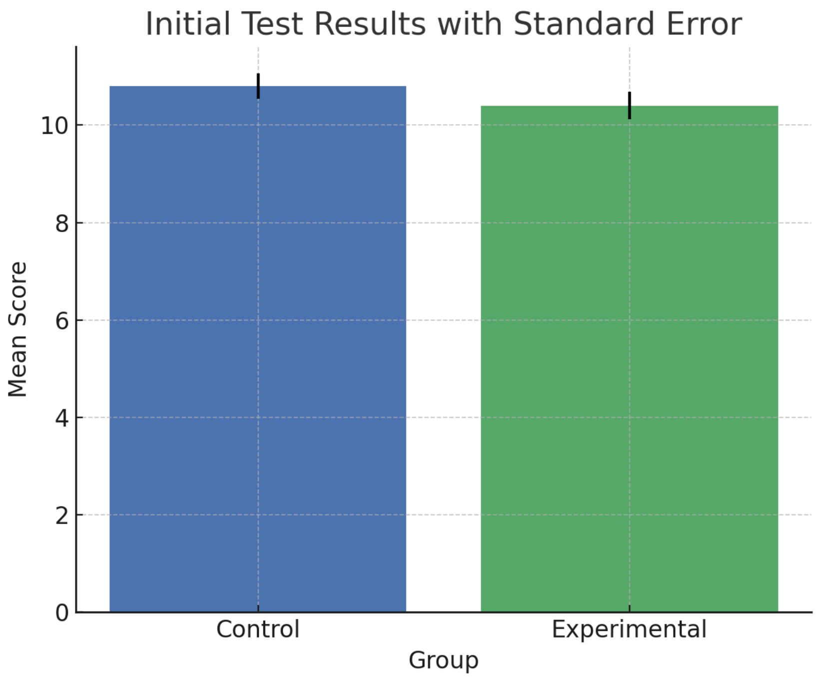


Figure 3.7 Comparison of Initial test Results Between Control and Experimental Groups (8th Grade)

The results of the analysis showed that the differences between the groups on the pre-test scores were statistically insignificant: $F(1, 49.7) = 1.19$, $p = 0.280$. This means that at the start of the study, students in the experimental and control classes had a similar level of preparation. This fact confirms the condition of sample homogeneity and justifies further comparisons after the implementation of the pedagogical intervention.

Thus, the pre-testing confirmed the validity of conducting a comparative analysis of the changes in students' knowledge levels, caused by the application of a practice-oriented approach to teaching physics.

3.2.2. Final test Results: Comparison between Control and Experimental Groups

Upon completion of the practice-oriented homework intervention, both groups participated in a post-test assessing their understanding of the studied physics topics.

The results revealed that students in the experimental group achieved higher scores compared to the control group, suggesting a positive effect of the practice-oriented approach.

The final stage of the study focused on analyzing the effectiveness of implementing a practice-oriented approach in homework assignments. For this purpose, a post-test was conducted at the end of the academic quarter to assess the level of content mastery among students in both the control and experimental groups. The results of the post test are included in Table 3.22.

Table 3.42 Results (Final test) of the control and experimental groups at the end of the research stage

Control group		**Experimental group**	
№	Maximum score 15	№	Maximum score 15
1	14	1	11
2	9	2	12
3	13	3	10
4	11	4	11
5	12	5	13
6	10	6	12
7	11	7	12
8	8	8	11
9	11	9	12
10	13	10	12
11	10	11	11
12	11	12	12
13	11	13	11
14	14	14	12
15	13	15	13
16	10	16	13
17	10	17	13
18	12	18	14
19	11	19	11
20	13	20	14
21	11	21	14
22	10	22	11

	Control group		Experimental group
№	Maximum score 15	№	Maximum score 15
23	12	23	11
24	11	24	11
25	11	25	12
26	10	26	12

The test included tasks covering key topics from the "Electric Current" unit, aligned with the learning objectives and curriculum content of the quarter. The results were analyzed using Welch's one-way ANOVA, which is appropriate when there is heterogeneity of variances between groups and an unequal number of participants.

The obtained results of the analysis were as follows:
F value = 4.15, Degrees of Freedom 1 (df_1) = 1,
Degrees of Freedom 2 (df_2) = 45.7, p value = 0.047
Since the p-value is less than 0.05, the null hypothesis of equal means between the control and experimental groups is rejected. This indicates that the difference in results is statistically significant and can be interpreted as an effect of the implemented pedagogical intervention (Table 3.23, Table 3.24, Figure 3.8).

Table 3.23 Comparison of Final test Results Between Control and Experimental Groups (8th Grade) Using Welch's One-Way ANOVA

	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p value
Final test	4.15	1	45.7	0.047

Table 3.54 Descriptive Statistics and Final test Comparison Between Control and Experimental Groups (8th Grade)

	Groups	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Final test	Control	26	11.2	1.48	0.290
	Experimental	26	12.0	1.08	0.211

Figure 3.8 Comparison of Final test Results Between Control and Experimental Groups (8th Grade)

Thus, the analysis showed that students in the experimental class, who completed homework in the form of mini-projects, demonstrated a higher level of content mastery compared to students in the control class who followed the traditional system. This confirms the research hypothesis about the positive impact of practice-oriented assignments on academic performance in physics.

3.2.3. Analysis of Changes in Academic Achievements

An analysis of the gain in scores from pre-test to post-test showed that the experimental group exhibited a more considerable improvement compared to the control group.

To assess the impact of the implemented pedagogical intervention on students' academic performance, a comparative analysis of the summative assessment results was conducted following the completion of the Post-test. At this stage, it is crucial to evaluate the differences in students' outcomes between the control and experimental groups in order to determine the effectiveness of practice-oriented homework tasks. Since the number of students in both groups was equal, the conditions for statistical comparison were considered valid. The results of the summative assessments for both groups are presented in the Table 3.25, Table 3.26, Table 3.27, Figure 3.9.

Table 3.25 Summative Assessment Outcomes Following the Study in Control and Experimental Groups

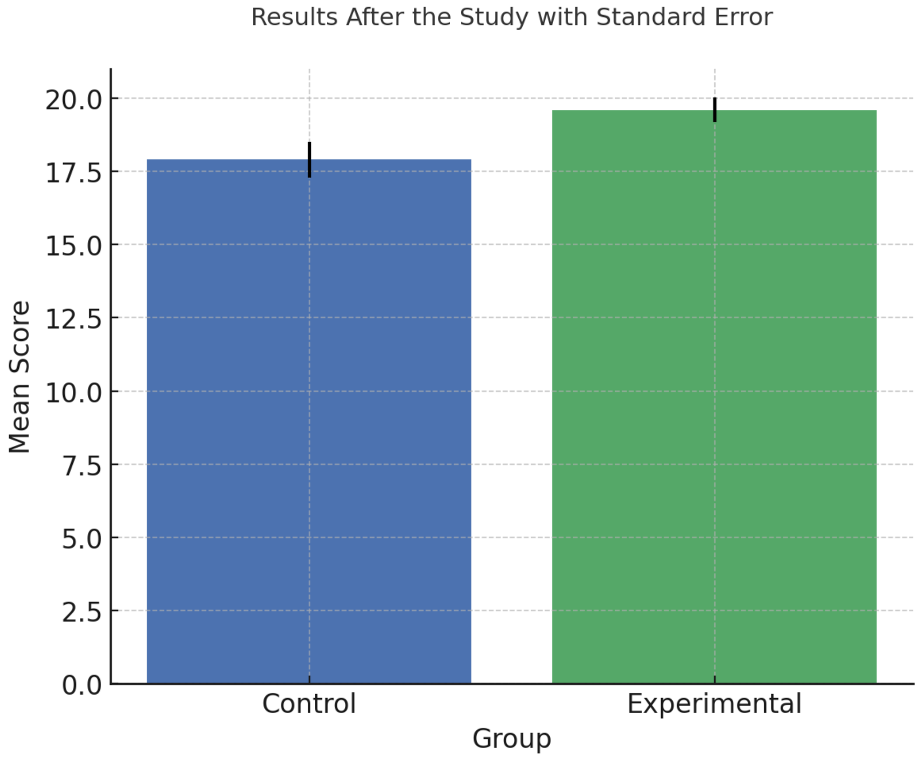
Control group		Experimental group	
№	Maximum score 25	№	Maximum score 25
1	23	1	20
2	15	2	16
3	23	3	14
4	14	4	21
5	18	5	18
6	15	6	17
7	19	7	19
8	15	8	17
9	13	9	17
10	20	10	21
11	15	11	15
12	17	12	18
13	17	13	17
14	23	14	16
15	23	15	18
16	15	16	17
17	17	17	18
18	19	18	21
19	17	19	18
20	23	20	22
21	15	21	22
22	17	22	16
23	18	23	18
24	18	24	15
25	18	25	15
26	15	26	18

Table 3.26 Analysis of Changes in Academic Achievement Using Welch's One-Way ANOVA (8th Grade)

	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p value
After the Study	5.32	1	44.0	0.026

Table 3.67 Descriptive Statistics and Analysis of Changes in Academic Achievement (8th Grade)

	Groups	N	Mean	Standard Deviation (SD)	Standard Error (SE)
After the Study	Control	26	17.9	3.10	0.607
	Experimental	26	19.6	2.10	0.412



Figures 3.9 Analysis of Academic Achievement After the Study in Control and Experimental Groups (8th Grade)

Welch's one-way analysis of variance was conducted based on the results of the summative assessment administered after the intervention to assess the impact of the implemented pedagogical intervention on students' academic achievement. This method was chosen due to its robustness against potential violations of the assumption of equal variances.

The analysis revealed a statistically significant difference between the control and experimental groups: $F(1, 44.0) = 5.32$, $p = 0.026$. Since the p-value is less than 0.05, the null hypothesis of equal means is rejected. This indicates that students in the experimental group, who completed practice-oriented mini-projects as homework, demonstrated significantly higher results compared to their peers in the control group who followed a traditional learning approach.

The obtained data further confirms the effectiveness of incorporating practice-oriented assignments into the physics curriculum, supporting the hypothesis that this approach positively impacts students’ academic performance.

Comparative analysis of initial test and final test results

To evaluate the effectiveness of the pedagogical intervention, a comparison was made between the test score gains (the difference between post-test and pre-test scores) in the control and experimental groups. This approach makes it possible to determine how significantly students’ understanding of the learning material changed as a result of implementing practice-oriented homework assignments.

Due to the potential difference in variances between the samples, Welch’s one-way analysis of variance (Welch ANOVA) was used for the statistical analysis, as it offers greater robustness in cases where the assumption of homogeneity of variances is violated. The results of the analysis are presented below (Table 3.28, Table 3.29, Figure 3.10).

Table 3.78 Comparative Analysis Of Initial Test And Final Test Results Using Welch’s One-Way Anova (8th Grade)

	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p value
Mean difference in test scores	14.3	1	41.0	<.001

Table 3.29 Descriptive Statistics and Comparative Analysis of Initial Test And Final Test Results (8th Grade)

	Groups	N	Mean	Standard Deviation (SD)	Standard Error (SE)
Mean difference in test scores	Control	26	0.385	0.804	0.158
	Experimental	26	1.538	1.334	0.262

Figure 3.10 Comparative Analysis of Initial Test And Final Test Score Gains in Control and Experimental Groups (8th Grade)

A one-way Welch's ANOVA was conducted to examine the differences between the control and experimental groups regarding students' academic achievement in physics. The analysis revealed a statistically significant difference, **$F(1, 41.0) = 14.3$, $p < .001$**, suggesting that the intervention had a substantial positive impact on student performance. These findings highlight the importance of implementing differentiated and practice-oriented homework strategies to enhance learning outcomes in secondary school physics education.

3.2.4. Interpretation of the Results for Practice-Oriented Homework

The findings support the hypothesis that practice-oriented homework positively influences students' academic achievements. By making physics learning more relevant and meaningful, practice-oriented tasks helped students to better comprehend theoretical concepts and apply them effectively.

These results are consistent with the theoretical frameworks outlined in Chapter 1, affirming that real-world applications of knowledge can substantially improve student motivation and learning outcomes.

The aim of the present study was to investigate the impact of practice-oriented homework on the academic performance of 8th-grade students in physics. Based on the idea that incorporating mini-projects into the structure of homework could promote deeper understanding of the material, a pedagogical intervention was organized, followed by a comparison of results between the control and experimental groups.

The results obtained from the analysis confirmed the research hypothesis: students who completed assignments in the form of mini-projects showed higher performance on the final test compared to those who were taught using the traditional approach. The application of one-way Welch's ANOVA revealed a statistically significant difference between the groups, indicating the effectiveness of the implemented strategy.

The significance of the obtained data lies in the practical orientation of the conclusions: the use of practice-oriented homework can be a valuable tool for increasing student motivation, developing research and engineering skills, and fostering more solid and meaningful knowledge acquisition. Such approaches are particularly relevant in the context of a modern educational environment that emphasizes active student engagement in the learning process.

A promising direction for future research could be the expansion of this methodology to other age groups and subject areas, as well as the investigation of its long-term impact on the quality of education and the development of cross-disciplinary competencies. In addition, the integration of practice-oriented assignments within the framework of the STEM approach (aimed at integrating science, technology, engineering, and mathematics) may enhance the applied nature of school education, contribute to the development of 21st-century skills, and increase students' interest in engineering and technical professions.

3.3. Comparative Analysis of Academic Achievement in Two Studies

3.3.1. Comparison of the Impact Level

In the first study, which implemented differentiated homework assignments for 9th-grade students, the results of the analysis showed a statistically significant improvement in academic achievement (**$F(1, 46.0) = 6.31$, $p = 0.016$**). This finding indicates the positive effect of an individualized approach to homework on students' learning outcomes.

In the second study, aimed at introducing practice-oriented homework assignments for 8th-grade students, the impact was even more pronounced (**$F(1, 41.0) = 14.3$, $p < 0.001$**). The very low p-value suggests a high level of reliability of the observed differences, confirming the significant influence of the practice-oriented approach on students' academic achievement.

3.3.2. Analysis of Differences

- In both studies, the experimental groups demonstrated **statistically significantly higher results** compared to the control groups.
- The **practice-oriented homework** showed a stronger effect than the differentiated homework, possibly due to increased student engagement and the application of theoretical knowledge to real-world situations.
- Despite differences in student age (8th and 9th grades), both approaches proved effective in improving physics learning outcomes.

3.3.3. Conclusion of the Comparative Analysis

Both types of interventions - differentiated homework and practice-oriented learning - had a positive impact on students' academic performance in physics. However, the practice-oriented approach demonstrated a greater effectiveness within the scope of this study.
These results highlight the importance of incorporating innovative homework strategies that promote deep understanding of subject matter and enhance student motivation in physics education.

To provide a clearer overview of the statistical findings, the summarized results of Welch's ANOVA for both studies are presented in Table 3.30.

Table 3. 30 Summary of Welch's ANOVA results comparing the effects of differentiated and practice-oriented homework strategies on students' academic achievement.

Study	F value	Degrees of Freedom 1 (df_1)	Degrees of Freedom 2 (df_2)	p value	Conclusion
Differentiated Homework (9th Grade Students)	6.31	1	46.0	0.016	Statistically significant
Practice-Oriented Homework (8th Grade Students)	14.3	1	41.0	< .001	Highly statistically significant

Interpretation:
As shown in Table 30, both differentiated and practice-oriented homework strategies had a statistically significant impact on students' academic achievement in physics. However, the practice-oriented homework demonstrated a stronger effect, as indicated by a higher F-value (14.3) and a lower p-value (< .001) compared to the differentiated homework intervention (F = 6.31, p = 0.016).
These results suggest that integrating real-world applications into homework tasks may lead to greater improvements in students' learning outcomes.

Across both the 8th and 9th grades, students who participated in the experimental groups consistently outperformed those in the control groups.
The following general trends were identified:

Students exposed to differentiated or practice-oriented homework showed greater improvement in test scores.

Motivation and engagement, based on student feedback, were higher in the experimental groups.

The more personalized and relevant the homework tasks were, the better the students performed.

Thus, the comparative analysis supports the effectiveness of both differentiated and practice-oriented homework strategies in enhancing physics learning outcomes for secondary school students.

3.4. Discussion of the Research Findings

The results of the study confirmed the initial hypothesis, demonstrating that both differentiated and practice-oriented homework assignments have a positive impact on students' academic achievements in physics.

Students who received differentiated homework showed notable improvements in their academic performance, likely due to the alignment of tasks with their individual readiness levels, interests, and learning styles. Similarly, students engaged in practice-oriented homework assignments benefited from the opportunity to apply theoretical knowledge in real-world contexts, which enhanced their motivation, engagement, and depth of understanding.

This section provides a detailed discussion of the findings, comparing them with existing research on homework strategies and student achievement. It also explores the possible reasons behind the observed differences in outcomes between the two intervention groups and examines the role of differentiated instruction and real-world application in enhancing learning outcomes.

Additionally, the section highlights the limitations of the current study, such as sample size, duration of the intervention, and potential external factors that may have influenced the results.

Finally, practical implications for physics education are discussed, emphasizing the importance of tailoring homework tasks to students' needs and incorporating practice-based learning activities to foster a deeper understanding of scientific concepts and to support long-term academic success.

3.4.1. Comparison of the Findings with Previous Research

The positive impact of differentiated homework observed among 9th-grade students is in strong agreement with the findings of Tomlinson (2001) and Subban (2006), who emphasized that adapting educational tasks to students' individual readiness levels, interests, and preferred learning profiles significantly enhances learning outcomes. By providing tasks that are appropriately challenging and relevant, differentiated homework fosters deeper cognitive engagement, improves students' confidence in their abilities, and ultimately leads to higher levels of academic success.

Similarly, the success achieved through practice-oriented homework assignments for 8th-grade students aligns closely with the conclusions drawn by Trautwein and Köller (2003). Their research highlighted that connecting learning experiences to real-world contexts not only increases students' motivation and engagement but also helps solidify theoretical knowledge by demonstrating its practical value, particularly in the context of science education. Engaging students in meaningful, authentic tasks enhances their ability to apply abstract concepts to concrete situations, which is critical for developing a deeper understanding of physics principles.

The results of this study reinforce the idea that homework, when thoughtfully designed either to accommodate diverse learner needs or to establish strong links between theory and practice, can serve as a powerful tool for improving students' academic performance. It moves beyond the traditional view of homework as a mere reinforcement of classroom instruction and positions it as an active and integral part of the learning process, contributing to students' critical thinking, problem-solving abilities, and long-term retention of knowledge.

3.4.2. Possible Explanations for the Observed Effects

Several factors may explain the observed improvements in the academic performance of students within the experimental groups.

Increased relevance and motivation:

Practice-oriented homework assignments were designed to connect theoretical physics concepts to real-world applications, making the subject matter more tangible and meaningful for students. As a result, students found the tasks more engaging and were able to better appreciate the practical value of what they were learning. This relevance boosted intrinsic motivation, leading to higher levels of effort, persistence, and academic achievement. The ability to see direct applications of theoretical knowledge likely strengthened students' interest in the subject and encouraged a more active and enthusiastic approach to completing homework tasks.

Appropriate challenge:

Differentiated homework provided tasks that were carefully aligned with students' individual skill levels and learning needs. By offering assignments at varying degrees of complexity, students were neither overwhelmed by excessively difficult tasks nor disengaged by assignments that were too simple. This balance minimized frustration and anxiety, while promoting a sense of accomplishment and gradual mastery of content. Students who are appropriately challenged are more likely to experience academic growth, increased self-efficacy, and sustained engagement in the learning process.

Enhanced autonomy and responsibility:

Both differentiated and practice-oriented homework approaches encouraged students to take greater ownership of their learning. By giving students a degree of choice or allowing them to see personal relevance in their assignments, these strategies fostered a stronger sense of autonomy. This, in turn, promoted deeper cognitive engagement, critical thinking, and better retention of material. Students who feel responsible for their own learning are more likely to develop effective study habits, reflective skills, and the capacity for independent problem-solving, which are essential for long-term academic success.

3.4.3. Limitations of the Study

While the findings of the present study are promising and indicate the effectiveness of differentiated and practice-oriented homework strategies in improving academic achievement, several limitations must be acknowledged to provide a balanced and critical assessment of the results.

Sample size and research base:

The sample size used in this study was relatively small, encompassing students from only two secondary schools. This limited scope may affect the generalizability of the findings to a broader student population. Differences in educational environments, teaching styles, and student demographics in other schools could influence the outcomes of similar interventions. Therefore, while the results are indicative of positive trends, caution must be exercised in extending the conclusions beyond the specific context of this study.

Duration of the intervention:

The intervention was conducted over the course of one academic term (approximately 8–9 weeks), which may not have been sufficient to capture the full impact of differentiated and practice-oriented homework strategies. Longer-term interventions might reveal stronger or more sustained effects, including the development of deeper conceptual understanding, improved study habits, and the persistence of positive academic behaviors. A longer research period would allow for the monitoring of lasting changes and the identification of any delayed effects of the intervention.

Uncontrolled external factors:

Although efforts were made to maintain consistency in the educational setting, various external factors-such as differences in students' home environments, parental support, access to learning resources, and prior academic knowledge-were not fully controlled in this study. These variables could have influenced students’ performance independently of the homework interventions. Future research should consider incorporating strategies to monitor or control for these external influences to more accurately isolate the effects of the homework approaches under investigation.

Given these limitations, it is recommended that future studies involve larger and more diverse samples, extend the duration of the intervention to cover multiple academic terms, and implement methods to account for or control external variables. Such studies would provide deeper insights into the long-term effects and broader applicability of differentiated and practice-oriented homework strategies in enhancing physics education outcomes.

3.4.4. Practical Implications for Teaching Physics

The results of this study suggest that incorporating differentiated and practice-oriented homework into physics education can substantially enhance students’ learning experiences and improve academic outcomes.

Thoughtfully designed homework assignments not only reinforce the theoretical knowledge acquired in the classroom but also contribute to the development of critical thinking, problem-solving skills, and a deeper understanding of scientific concepts.

Based on the findings, several practical recommendations can be made for teachers:

Develop homework assignments adaptable to diverse student needs:

Teachers should design homework tasks that accommodate students’ varying levels of readiness, learning preferences, and interests. This may include creating assignments with multiple levels of difficulty, offering support materials for students who require additional guidance, and allowing advanced learners to explore more complex challenges. Differentiated homework helps ensure that each student remains appropriately challenged and engaged in the learning process.

Incorporate real-life contexts into homework tasks:

Assignments that connect physics concepts to real-world situations-such as household applications of physical laws, engineering problems, or environmental phenomena-make learning more meaningful and relevant. Embedding theoretical content in authentic scenarios increases student engagement, motivation, and the ability to transfer knowledge to everyday life, thereby strengthening long-term retention and application of skills.

Provide students with options and promote autonomy:

Allowing students to choose from a range of homework tasks or formats fosters a sense of ownership and responsibility for their own learning. Providing opportunities for choice encourages intrinsic motivation and supports the development of independent learning habits. Students who are given autonomy in how they approach homework are more likely to engage thoughtfully with the material and persist in overcoming academic challenges.

By applying these strategies, teachers can create more inclusive, supportive, and effective learning environments that meet the diverse needs of their students.

Differentiated and practice-oriented homework assignments can serve not only as a tool for academic reinforcement but also as a means of inspiring curiosity, building confidence, and nurturing a lifelong interest in science and physics.

3.5. Practical Recommendations for Physics Teachers

Based on the findings of this study, several practical recommendations can be made for physics teachers who are seeking to enhance students' academic achievements through the implementation of effective and meaningful homework practices.

Homework should not be viewed merely as a routine extension of classroom activities, but rather as a strategic educational tool that, when carefully designed and purposefully assigned, can substantially contribute to the development of students’ understanding, skills, and motivation. The results of the present study demonstrate that homework, when differentiated according to students’ readiness levels and when oriented toward practical, real-world applications, can play a crucial role in fostering deeper engagement with the subject matter and in improving overall academic performance.

Physics teachers are encouraged to reconsider traditional approaches to homework and to adopt more dynamic and student-centered strategies. First, homework assignments should be designed with differentiation in mind, addressing the varied needs, interests, and abilities of the students. Providing tasks at different levels of complexity, offering choices among assignments, and including scaffolded support materials where needed can help ensure that all students are appropriately challenged and supported in their learning journey.

Second, embedding real-life contexts and practical applications within homework tasks can significantly enhance their relevance and appeal. Students are more likely to engage actively with assignments that demonstrate how physics principles operate in everyday life, technology, engineering, and environmental phenomena. When students recognize the practical value of what they are learning, their intrinsic motivation increases, and they are more likely to invest effort and thought into their homework tasks.

Third, fostering autonomy by allowing students to make choices regarding the type, format, or focus of their homework can lead to increased ownership of the learning process. Providing opportunities for choice promotes self-regulation, critical thinking, and independent problem-solving abilities, which are essential skills not only for academic success but also for lifelong learning.

In addition, regular feedback on homework performance should be emphasized as an integral component of effective practice. Constructive and timely feedback helps students understand their progress, recognize areas for improvement, and maintain motivation. It also allows teachers to adjust instructional strategies based on students' evolving needs and to identify those who may require additional support.

Finally, collaboration with students in setting homework goals and expectations can further strengthen the effectiveness of homework practices. Engaging students in discussions about the purpose of assignments and encouraging reflection on their learning processes can promote a deeper, more meaningful approach to academic work.

By implementing these strategies, physics teachers can transform homework from a passive activity into an active, engaging, and impactful learning experience. Differentiated and practice-oriented homework assignments, grounded in thoughtful pedagogical principles, have the potential to significantly improve students' academic outcomes, foster a deeper understanding of physics, and nurture a sustained interest in scientific inquiry.

3.5.1. Implement Differentiated Homework Assignments

In order to maximize the effectiveness of homework and to address the diverse needs of students, it is essential for teachers to design assignments that are not only academically rigorous but also adaptable to varying levels of student readiness, learning styles, and interests.

Differentiated homework allows educators to meet students where they are in their learning journey, providing personalized challenges and support that foster engagement, autonomy, and sustained academic growth.

The following strategies outline practical approaches for implementing differentiated homework effectively in physics education.

Teachers should carefully design homework tasks that take into account the diverse levels of students' readiness, their individual learning preferences, and areas of personal interest. Recognizing and responding to the differences among learners is essential for creating inclusive and supportive educational environments that cater to the unique needs of every student.

One of the primary strategies for differentiation involves offering tasks at varying levels of difficulty-basic, intermediate, and advanced. By structuring assignments into different tiers, teachers ensure that all students can engage with material that is appropriately challenging. Students who may need more time to master fundamental concepts can work on basic tasks that build confidence and consolidate core knowledge, while more advanced students can tackle complex and higher-order problem-solving assignments that promote deeper inquiry and intellectual growth.

Another important approach is allowing students to exercise choice in their homework. Providing a selection of tasks from which students can choose according to their own capabilities, interests, or learning goals fosters a greater sense of ownership over the learning process. Choice empowers students to engage with material that resonates with them personally, encourages intrinsic motivation, and develops decision-making and self-regulation skills. Moreover, offering students the opportunity to challenge themselves by selecting more demanding tasks can stimulate academic ambition and resilience.

Additionally, providing scaffolding and supplementary support materials for students who require extra assistance is a critical component of effective differentiation. Scaffolding might include guiding questions, step-by-step instructions, graphic organizers, or worked examples that help bridge the gap between what a student can do independently and what they are expected to achieve. Such supports allow struggling students to access the curriculum meaningfully without lowering academic expectations. Over time, as students develop their skills and confidence, these supports can be gradually reduced to promote independence.

Through the thoughtful design of differentiated homework assignments, teachers can promote equitable learning opportunities, ensuring that all students, regardless of their starting point, have the ability to experience success and academic growth. Differentiation acknowledges that students progress at different rates and through different pathways, and it respects the diversity of learners by providing personalized avenues for achievement. By implementing differentiated homework practices, teachers contribute to a more just and effective educational system, fostering not only improved academic outcomes but also greater student satisfaction and engagement with learning.

3.5.2. Integrate Practice-Oriented Homework into the Curriculum

To enhance the relevance and impact of homework assignments in physics education, it is important for teachers to move beyond traditional question-and-answer formats and incorporate activities that connect theoretical concepts to students' everyday experiences.

Practice-oriented homework provides meaningful opportunities for students to observe, experiment with, and apply physics principles in real-world contexts, thereby fostering greater engagement, motivation, and deeper conceptual understanding.

The following strategies outline practical approaches for effectively integrating practice-based learning into homework tasks.

Practice-oriented homework serves as a powerful bridge between theoretical knowledge and real-life applications, transforming abstract concepts into tangible experiences that students can observe, manipulate, and understand more deeply.

By situating learning within authentic contexts, practice-oriented assignments not only make the study of physics more meaningful and relatable but also enhance students' engagement, motivation, and long-term retention of knowledge. When students recognize the relevance of their academic work to the real world, they are more likely to invest genuine effort and develop a lasting interest in scientific inquiry.

Teachers are encouraged to implement several strategies to maximize the effectiveness of practice-oriented homework:

- Assign simple experiments or observational tasks:

Educators should create homework assignments that involve basic experiments or hands-on investigations, using materials that are easily accessible at home. Tasks such as measuring the trajectory of a thrown ball, observing the behavior of light through a glass of water, or examining the cooling rate of heated liquids can effectively illustrate fundamental physics principles. These activities enable students to directly experience the phenomena discussed in class, fostering a deeper and more intuitive understanding of scientific laws.

- Encourage analysis of everyday phenomena:

Teachers should guide students to observe and analyze everyday situations through the lens of physics. Assignments might include explaining why a bicycle remains upright in motion, investigating how friction affects different surfaces, or exploring the principles behind household appliances. Encouraging students to apply theoretical concepts to familiar experiences promotes critical thinking, helps them recognize the ubiquity of physics in daily life, and builds their ability to transfer classroom learning to diverse contexts.

- Foster inquiry-based learning through open-ended questions:

Assignments that include open-ended or exploratory questions invite students to think beyond rote memorization and engage in deeper cognitive processing. Teachers can pose questions that require investigation, hypothesis formation, experimentation, and reflection. For instance, students might be asked to design an experiment to test how surface area affects the rate of evaporation or to explore factors that influence the strength of a magnetic field. Such tasks encourage creativity, foster scientific reasoning, and develop independent learning skills.

By incorporating practice-oriented tasks into homework assignments, teachers cultivate an educational environment that prioritizes exploration, inquiry, and the application of knowledge.

This approach significantly enhances students' problem-solving abilities, as they learn to navigate unfamiliar situations using scientific principles, and strengthens scientific thinking, as they practice formulating hypotheses, conducting investigations, analyzing data, and drawing evidence-based conclusions.

In the long term, practice-oriented homework supports the development of essential skills that extend beyond physics, preparing students for complex problem-solving in real-world scenarios and contributing to the cultivation of scientifically literate, critically thinking individuals.

3.5.3. Foster Student Autonomy and Motivation

Encouraging student autonomy is a fundamental aspect of effective homework design, particularly in subjects that demand high levels of critical thinking and conceptual understanding, such as physics.

When students are given opportunities to make meaningful choices about their learning tasks, they develop a stronger sense of ownership, responsibility, and intrinsic motivation.

Homework that promotes autonomy not only enhances engagement and persistence but also fosters essential academic skills that contribute to long-term success in scientific inquiry and problem-solving.

The following strategies illustrate how teachers can effectively promote autonomy and motivation through the design and implementation of homework assignments.

Providing students with choices and assigning them meaningful tasks is a critical strategy for increasing their sense of ownership over the learning process.

When students are actively involved in decision-making regarding their learning activities, they become more motivated, self-directed, and committed to achieving academic success. Fostering autonomy in homework assignments not only enhances students' engagement but also promotes the development of essential skills such as critical thinking, problem-solving, and independent inquiry-skills that are particularly vital in subjects like physics, which require deep conceptual understanding and analytical reasoning.

Teachers are encouraged to adopt several practical approaches to promote autonomy and meaningful learning through homework:

- Offer a variety of homework formats:

Instead of relying solely on traditional exercises, teachers should diversify the types of homework they assign. Options may include problem-solving tasks that require analytical reasoning, project-based assignments that involve creating models or simulations, research tasks that develop investigation and synthesis skills, and reflective journals that encourage students to connect new knowledge with prior experiences. By offering a range of formats, teachers can accommodate diverse learning styles and preferences, enabling students to engage with material in ways that are most meaningful and motivating to them.

- Set clear and achievable goals for homework assignments:

Clearly articulated objectives help students understand the purpose of each task and the specific learning outcomes they are expected to achieve. Assignments should be structured with realistic expectations, providing sufficient challenge to stimulate growth while remaining attainable to prevent frustration. When students perceive homework as purposeful and achievable, their motivation to complete tasks and their confidence in their academic abilities are significantly enhanced. Transparent goals also help students self-monitor their progress and reflect on their own learning.

- Give constructive and timely feedback:

Feedback is a powerful tool for supporting learning and encouraging further exploration. Teachers should provide specific, actionable comments that recognize students' efforts and achievements while also offering guidance for improvement. Timely feedback helps students correct misunderstandings, reinforces positive learning behaviors, and maintains momentum in the learning process. Moreover, constructive feedback fosters a growth mindset, encouraging students to view challenges as opportunities for development rather than obstacles to success.

Promoting autonomy and motivation through carefully designed homework assignments is crucial for developing lifelong learners who are capable of self-directed study and critical analysis.

In physics education, where mastering abstract concepts often requires sustained effort and deep engagement, empowering students to take ownership of their learning journey significantly enhances academic performance.

By providing choice, setting clear objectives, and delivering meaningful feedback, teachers create a supportive environment that not only improves immediate educational outcomes but also cultivates habits of curiosity, persistence, and independent thinking that extend far beyond the classroom.

3.5.4. Monitor and Reflect on Homework Effectiveness

In order to maximize the educational benefits of homework assignments and ensure their sustained effectiveness, teachers should adopt a systematic and continuous approach to evaluating homework practices. Regular evaluation allows educators to identify the strengths and weaknesses of assigned tasks, understand how different students respond to various types of homework, and make informed adjustments to improve learning outcomes.

Effective evaluation of homework can be achieved through several key strategies:

- **Analyzing student performance on assessments:** Teachers should closely examine students' results on both formative and summative assessments to determine how well homework assignments are reinforcing classroom instruction and contributing to knowledge retention and skill development. By comparing students' performance before and after the implementation of new homework strategies, teachers can gather evidence about the academic impact of differentiated or practice-oriented tasks and identify areas requiring additional support or enrichment.
- **Gathering feedback from students regarding homework relevance and difficulty:**

Direct feedback from students provides valuable insights into their perceptions of the homework tasks. Teachers should periodically conduct surveys, interviews, or informal discussions to collect students' opinions about the clarity, difficulty, and relevance of assignments. Understanding whether students find the homework appropriately challenging, engaging, and meaningful enables teachers to adjust tasks to better meet learners' needs and to maintain high levels of motivation and participation.

- **Adjusting homework strategies based on observations and student needs:** Classroom observations and ongoing interactions with students offer important qualitative data about how homework influences learning behaviors, study habits, and attitudes toward the subject.

Teachers should remain flexible and responsive, modifying the structure, content, or complexity of homework assignments as needed to align with students' evolving academic needs, interests, and levels of preparedness.

Differentiation and adaptation should not be viewed as one-time actions but as continuous processes that are refined based on observed outcomes and student progress.

Adopting a **reflective and adaptive approach** to homework practices ensures that assignments remain dynamic, responsive, and closely aligned with educational goals.

Rather than adhering rigidly to predetermined homework formats, teachers who regularly reflect on the effectiveness of their assignments and adapt their strategies accordingly are better positioned to support all learners.

A reflective practice fosters an educational environment where homework is not perceived as a routine or punitive task, but as a purposeful extension of classroom learning that promotes critical thinking, independent inquiry, and long-term academic success.

Ultimately, continuous evaluation and adaptation of homework strategies contribute to creating a more student-centered, effective, and motivating learning experience in subjects such as physics and beyond.

3.6. Conclusion to Chapter 3

The results of the pedagogical experiment conducted in this study provide strong confirmation that both differentiated and practice-oriented homework assignments exert a significant positive impact on students' academic achievements in the field of physics.

The findings align with the initial research hypothesis and demonstrate that carefully designed homework strategies, tailored to students' individual needs and promoting real-world application of theoretical knowledge, can substantially enhance educational outcomes at the secondary school level.

The differentiated homework approach implemented for 9th-grade students enabled a more personalized alignment of tasks with students' varying readiness levels, learning preferences, and interests.

This personalized approach fostered greater student engagement, increased intrinsic motivation to learn physics, and ultimately led to notable improvements in academic success.

Students who were provided with differentiated assignments were better able to navigate content at a pace and complexity level appropriate to their abilities, which facilitated more meaningful learning experiences and reduced frustration often associated with uniform, one-size-fits-all tasks.

Similarly, the practice-oriented homework approach applied to 8th-grade students effectively bridged the gap between abstract theoretical concepts and their practical applications in everyday life.

By engaging in hands-on activities, simple experiments, and real-world observations, students developed a deeper and more integrated understanding of physical principles.

The experiential nature of the practice-oriented tasks not only enhanced students' comprehension but also cultivated critical inquiry skills, problem-solving abilities, and a greater appreciation for the relevance of physics to their daily experiences and future endeavors.

Statistical analyses performed on the pre-test and post-test results substantiated the effectiveness of the interventions.

Welch's ANOVA revealed statistically significant differences between the control and experimental groups in both 9th and 8th-grade samples, indicating that the observed improvements were unlikely to be due to random chance.

Furthermore, the calculation of effect sizes (Cohen's d) provided additional evidence of the educational significance of the interventions, confirming that the differentiated and practice-oriented homework strategies produced not only statistically measurable but also practically meaningful improvements in students' academic performance.

The discussion of these findings emphasized the critical importance of thoughtful and intentional homework design.

Homework should not be perceived merely as a routine reinforcement of classroom material but as an opportunity to address individual learning needs, stimulate curiosity, and develop higher-order cognitive skills.

Assignments that are aligned with students' levels of readiness, cognitive styles, and personal interests are far more likely to promote sustained engagement, conceptual mastery, and the development of lifelong learning skills.

Based on the outcomes of the study, practical recommendations were proposed to guide teachers in integrating differentiated and practice-oriented homework practices into their physics instruction.

These recommendations include the systematic differentiation of task complexity, the incorporation of real-life applications into assignments, the promotion of student autonomy in homework selection, and the continuous evaluation and refinement of homework strategies based on student feedback and academic performance.

Thus, the results obtained through this pedagogical experiment not only validate the research hypothesis but also contribute valuable insights into the advancement of effective and innovative teaching practices in secondary school physics education.

By embracing differentiated and practice-oriented homework approaches, educators can better support the diverse learning needs of students, foster deeper understanding of scientific concepts, and cultivate a more motivated and scientifically literate student population.

The final chapter summarizes the key findings of the study, discusses their broader implications for physics education in secondary schools, and outlines practical recommendations as well as directions for future research.

This synthesis aims to highlight the contributions of the research to the field of educational practice and to provide a foundation for further advancements in the use of differentiated and practice-oriented homework strategies.

4. PRACTICAL RECOMMENDATIONS FOR PHYSICS TEACHERS

This chapter presents a series of practical recommendations derived from the findings of the conducted pedagogical experiment. These recommendations are intended to support teachers, curriculum developers, and educational administrators in enhancing the design, implementation, and evaluation of homework assignments in the context of secondary school physics education.

The recommendations are specifically aimed at improving students' academic achievements, promoting deeper engagement with the subject matter, and fostering the development of critical scientific thinking skills. They are grounded in the empirical evidence gathered during the study, which demonstrated the positive impact of differentiated and practice-oriented homework strategies on students' academic performance and motivation to learn physics.

Drawing from the observed effects of differentiated homework for 9th-grade students and practice-oriented homework for 8th-grade students, the following approaches are proposed to assist teachers in creating more effective, inclusive, and motivating learning environments:

- Designing homework tasks that are tailored to students' readiness levels, interests, and preferred learning styles;
- Developing assignments that connect theoretical physics concepts to real-life applications, thereby enhancing relevance and promoting active inquiry;
- Providing students with opportunities for choice and autonomy in homework selection to increase ownership of the learning process;
- Systematically evaluating and adapting homework strategies based on student feedback and academic performance data.

Enhancing the effectiveness of homework in physics education requires a **paradigm shift** from traditional, uniform task designs toward more **student-centered**, **differentiated**, and **practice-oriented approaches**. Homework should no longer be viewed as a mere reinforcement of classroom instruction but as an integral part of the learning experience that actively engages students, addresses their individual needs, and encourages the application of knowledge in diverse contexts.

The findings of this study provide a strong empirical basis for advocating such a shift.
They highlight the importance of aligning homework assignments with modern pedagogical principles that prioritize student engagement, autonomy, and the practical relevance of academic content. By adopting the recommended strategies, teachers can not only enhance students' academic achievements in physics but also contribute to the development of scientifically literate individuals who are capable of critical thinking and problem-solving in a rapidly changing world.

The following sections offer detailed practical recommendations structured around key aspects of homework design and implementation, intended to serve as a guide for teachers seeking to transform their homework practices in physics education.

4.1. Differentiating Homework Assignments

In order to maximize the effectiveness of homework assignments and to address the increasingly diverse needs of students in modern classrooms, it is essential for teachers to design homework that is not only academically rigorous but also adaptable to varying levels of student readiness, preferred learning styles, and individual interests.

Traditional, uniform homework practices often fail to recognize the wide spectrum of abilities and learning preferences present within any given group of students.

In contrast, differentiated homework offers a dynamic and responsive approach that acknowledges these differences and seeks to engage every learner at an appropriate and challenging level.

Differentiated homework enables educators to meet students where they are in their learning journeys, providing personalized challenges that stimulate intellectual growth while offering the necessary support to foster academic confidence and resilience.

When students are given tasks that match their current skill levels and are encouraged to stretch their abilities within a supportive framework, they are more likely to experience success, remain motivated, and develop a sense of ownership over their learning processes.

Teachers should carefully and systematically design homework tasks that explicitly recognize and respond to individual differences among learners.

Effective strategies for implementing differentiated homework include the following:

• Offering tasks at varying levels of difficulty (basic, intermediate, advanced):

Teachers can create tiered assignments that cater to a range of academic abilities within the classroom.

• Basic-level tasks can focus on reinforcing fundamental concepts and skills; intermediate-level tasks can require deeper analytical thinking and multi-step problem-solving; advanced-level tasks can challenge students to apply their knowledge creatively, engage in critical evaluation, or design small-scale experiments.

• Allowing students to choose assignments according to their capabilities or encouraging them to challenge themselves:

Providing options within homework assignments empowers students to select tasks that align with their readiness and interests, thereby fostering autonomy and motivation.

Alternatively, teachers can guide students in making appropriate choices, encouraging those who are ready to attempt more complex and demanding work, thus promoting academic risk-taking and growth mindset development.

• Providing scaffolding and supplementary support materials for students who require additional guidance:

Some students may benefit from additional explanations, examples, graphic organizers, or structured templates to help them successfully complete homework assignments.

Offering differentiated scaffolding ensures that all students, including those who may struggle with independent learning, are supported in ways that build competence and self-efficacy over time.

Moreover, the process of designing differentiated homework should be dynamic and reflective.

Teachers should continuously assess the effectiveness of their homework strategies through student performance data, feedback, and classroom observations, and be prepared to adjust tasks to better suit evolving student needs and learning goals.

Through the thoughtful and deliberate design of differentiated homework assignments, teachers promote equitable learning opportunities and create inclusive educational environments.

This approach ensures that all students, regardless of their starting point, have meaningful opportunities to engage with the content, experience academic success, and develop the skills and confidence needed for further learning in physics and beyond.

4.2. Incorporating Practice-Oriented Homework

To enhance the relevance and impact of homework assignments in physics education, it is important for teachers to move beyond traditional formats and integrate activities that connect theoretical concepts to students' everyday experiences. Practice-oriented homework provides opportunities for students to apply classroom knowledge in real-world contexts, thereby making learning more meaningful, engaging, and enduring.

Teachers are encouraged to:

- **Assign simple experiments or observational tasks** using readily available household materials to illustrate physics principles;
- **Encourage students to analyze everyday phenomena**-such as the mechanics of bicycles, the operation of appliances, or the behavior of forces in nature-through the lens of physics;
- **Foster inquiry-based learning** by posing open-ended questions that require students to explore, hypothesize, experiment, and reflect.

By incorporating these tasks, teachers not only enhance students' problem-solving skills and scientific reasoning but also stimulate curiosity and independent learning, preparing students for real-world applications of physics knowledge.

4.3. Promoting Student Autonomy and Motivation

Encouraging student autonomy is a fundamental aspect of effective homework design, particularly in subjects that demand high levels of critical thinking and conceptual understanding, such as physics. When students are given opportunities to make meaningful choices about their learning tasks, they develop a stronger sense of ownership, responsibility, and intrinsic motivation.

Teachers can promote autonomy and motivation through several strategies:

- **Offering a variety of homework formats**, such as problem-solving tasks, project-based assignments, and research activities, to accommodate different learning styles and preferences;
- **Setting clear and achievable goals** for each homework assignment to provide purpose, structure, and attainable expectations;
- **Providing constructive and timely feedback** that supports learning, encourages reflection, and fosters a growth-oriented mindset.

Promoting autonomy and offering meaningful tasks contribute significantly to students' engagement, persistence, and academic success, especially in complex subjects like physics where sustained cognitive effort and deep understanding are essential.

4.4. Conclusion to Practical Recommendations

By implementing differentiated, practice-oriented, and autonomy-supportive homework strategies, teachers can transform homework from a routine exercise into a powerful educational tool.

Such approaches foster not only improved academic outcomes but also greater motivation, critical thinking, scientific reasoning, and independent learning habits among students.

Ultimately, thoughtfully designed homework assignments can play a key role in nurturing lifelong learners and fostering a lasting appreciation for physics and science in general.

CONCLUSION

The theoretical analysis conducted in Chapter 1 confirmed the critical importance of homework as a pedagogical tool for reinforcing knowledge, developing cognitive and metacognitive skills, and fostering student motivation and responsibility for learning.

A review of the literature highlighted that traditional, one-size-fits-all approaches to homework often fail to meet the diverse needs of learners. In contrast, differentiation-adapting tasks to students' readiness levels, interests, and learning profiles-and practice orientation-connecting academic content to real-world applications-emerged as promising strategies for enhancing the educational value and effectiveness of homework in physics instruction.

In Chapter 2, the design and implementation of a pedagogical experiment were described in detail. Differentiated homework assignments were developed for 9th-grade students, aiming to align with individual learning needs and to promote academic growth across a range of abilities.

Concurrently, practice-oriented homework tasks were created for 8th-grade students, emphasizing the application of theoretical physics concepts to everyday phenomena and encouraging inquiry-based learning.

Control and experimental groups were established to facilitate a comparative analysis of the interventions' impact, enabling a rigorous examination of the differences between traditional homework practices and the proposed innovative approaches.

The results presented and discussed in Chapter 3 demonstrated several key findings:

Differentiated homework significantly improved the academic performance of 9th-grade students by addressing their individual strengths, challenges, and preferred learning modalities. Students engaged more actively with assignments tailored to their capabilities, resulting in higher achievement and greater satisfaction with the learning process.

Practice-oriented homework had a strong positive effect on 8th-grade students by enhancing their engagement, deepening their understanding of physics principles, and making the learning experience more meaningful through real-life applications.

Statistical analyses, including Welch's ANOVA, confirmed the significance of the differences between the control and experimental groups, thereby validating the research hypothesis that both differentiated and practice-oriented homework strategies contribute positively to students' academic outcomes.

The findings of the study led to the formulation of practical recommendations for physics teachers. Emphasis was placed on the necessity of tailoring homework tasks to students' individual abilities, learning preferences, and interests, as well as on the importance of embedding real-world contexts into homework assignments to increase relevance, motivation, and retention of knowledge.

Such pedagogical approaches are expected to foster the development of higher-order thinking skills, deeper conceptual understanding, and intrinsic motivation among students, ultimately leading to improved academic performance and greater enthusiasm for the study of physics.

The practical significance of the research lies in offering teachers effective, evidence-based strategies for enhancing the quality of physics education and supporting the academic success of students in Kazakhstan's secondary schools.

These strategies not only address the current challenges associated with traditional homework practices but also align with broader educational goals of promoting student-centered learning and fostering 21st-century skills.

Future research could explore the long-term impacts of differentiated and practice-oriented homework on students' academic development, engagement, and attitudes towards science education. Further studies might also examine the applicability of these strategies across a wider range of educational contexts, different subject areas, and more diverse student populations, thereby contributing to the development of a more comprehensive understanding of effective homework practices in modern education.

This dissertation was dedicated to investigating the effectiveness of differentiated and practice-oriented homework assignments in improving students' academic achievements in physics in secondary schools in Kazakhstan.

The research aimed to address the pressing need for more effective, engaging, and personalized learning strategies in science education, with a particular focus on enhancing the role of homework as an active and meaningful extension of classroom learning.

In conclusion, this study highlights the significant potential of differentiated and practice-oriented homework strategies to improve the quality of physics education in secondary schools.

By aligning homework practices with students' individual needs and promoting real-world applications of knowledge, educators can create more engaging, effective, and equitable learning experiences.

Continued efforts to refine and expand these approaches will contribute to the development of a more student-centered, dynamic, and forward-looking educational system.

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