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Research Article

The Effectiveness of Daily-Life Oriented Project Based Learning on Students' Conceptual Understanding

Günlük Yaşam Odaklı Proje Tabanlı Öğrenmenin Öğrencilerin Kavramsal Anlamalarına Etkisi

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ABSTRACT

The research explores the influence of project-based learning (PBL) centered around daily-life scenarios on the conceptual comprehension of fifth-grade students in the Matter and Change unit. The study involved 80 students from a public secondary (middle) school in Istanbul, Turkey. The experimental group received daily-life oriented PBL activities, while the control group received traditional instruction. A quasi-experimental model known as the pretest-posttest control group was employed. The two-tier Conceptual Understanding Test was used to measure the students' conceptual understanding before and after the intervention. The responses of experimental group students for open ended questions in this test were also examined. The study found a significant difference between the scores of the groups from the conceptual understanding pre-test and conceptual understanding post-test in favor of the post-test. The study also found a decrease in misconceptions and an increase in sound understanding of concepts such as "heat exchange," "boiling point," "expansion," "contraction," and "evaporation" in the experimental group. The study suggests that PBL activities aligned with key concepts and emphasizing connections between daily life and subject achievements can enhance students' learning outcomes. The study provides practical implications for educators, emphasizing the importance of pedagogical approaches that prioritize student-centered, inquiry-based learning.

Keywords: Conceptual understanding, daily-life oriented project based learning, misconception.

ÖZ

Bu çalışma, günlük yaşam odaklı proje tabanlı öğrenmenin 5. sınıf Madde ve Değişim ünitesi kapsamında öğrencilerin kavramsal anlayışlarına etkisini araştırmaktadır. Araştırma İstanbul'da bir devlet okulunda öğrenim gören 80 5. sınıf öğrencisi ile gerçekleştirilmiştir. Deney grubu günlük yaşam odaklı proje tabanlı öğrenme etkinlikleri alırken, kontrol grubu geleneksel öğretim almıştır. Ön test-son test kontrol gruplu yarı deneysel model kullanılmıştır. Öğrencilerin uygulamadan önce ve sonra kavramsal anlamalarını değerlendirmek için iki aşamalı Kavramsal Anlama Testi kullanılmıştır. Bu testte deneysel grup öğrencilerinin açık uçlu sorulara verdikleri yanıtlar da incelenmiştir. Araştırmada, grupların kavramsal anlama ön testi ve kavramsal anlama son testi puanları arasında anlamlı bir fark, son test lehine ortaya çıkmıştır. Çalışmada ayrıca deney grubunda kavram yanılgılarında azalma ve "ısı değişimi", "kaynama noktası", "genleşme", "büzülme" ve "buharlaşma" gibi kavramların anlamlı öğrenilmesinde artış olduğu tespit edilmiştir. Çalışma, temel kavramlarla uyumlu ve günlük yaşam ile

konu başarıları arasındaki bağlantıları vurgulayan proje tabanlı öğrenme etkinliklerinin öğrencilerin öğrenme çıktılarını artırabileceğini öne sürmektedir.

Anahtar Kelimeler: Kavramsal anlama, günlük yaşam odaklı proje tabanlı öğrenme, kavram yanılgısı.

INTRODUCTION

We live in an ever changing world and in this dynamic world, the needs, lifestyles, thoughts of people also change and in order to meet these requirements, science has an important place because it helps us in understanding the real life. Essentially, science is a discipline that explores nature, natural phenomena, and the universe, offering opportunities to apply acquired knowledge in practical situations. As children embark on their educational journey, they likely encounter various scientific concepts, attempting to understand them either independently or with parental guidance. However, these initial understandings may be misconstrued, leading to misconceptions. Consequently, the existing knowledge and comprehension of concepts significantly influence their learning process.

Concepts play a pivotal role in teaching and significantly impact academic achievement (Ayas & Coştu, 2001; Pınarbaşı & Canpolat, 2003). Learning a concept inaccurately can hinder the correct understanding of subsequent topics, leading to lower academic performance. It is crucial to have well-defined and clearly explained concepts to ensure smooth comprehension, as individuals may otherwise interpret them based on their pre-existing knowledge, which is not necessarily accurate. Misconceptions are more than mere misunderstandings; they involve the incorrect relations between interrelated concepts within a knowledge system (Çepni, 2005; Gomez-Zwiep, 2008). Concepts can be categorized into two groups, with concrete concepts evolving from students' experiences, while abstract concepts, prevalent in chemistry, pose a significant challenge for students to grasp collectively (Canpolat et al., 2004). Existing literature affirms the difficulty students face, often harboring scientifically incorrect thoughts termed as misconceptions. Conventional teaching methods struggle to eradicate these misconceptions, as students individually construct knowledge based on their abilities and experiences. Addressing this issue involves identifying and rectifying misconceptions rooted in students' prior knowledge.

The traditional method of teaching concepts involves presenting the term, providing its definition, and outlining key qualities for comprehension. However, research, such as that by Çepni et al. (1997), suggests that this approach is insufficient. Mere identification and memorization of concepts are inadequate for understanding their relationships. Teaching and learning methods aim to foster meaningful learning by having students process external information through their cognitive filters. A solid grasp of fundamental concepts is essential for this process. Misconceptions, often rooted in inaccurate prior knowledge, can hinder meaningful learning. Understanding chemical concepts, which involves recognition at both macroscopic and microscopic levels, may lead to various misconceptions, particularly with abstract concepts (Canpolat et.al., 2004; Novick & Nussbaum, 1981; Ürek & Tarhan, 2005). In this manner, effective learning environments should encourage students to develop scientific knowledge autonomously, fostering conceptualization without the need for rote memorization. In this aspect, various methods were created/formed in order to diagnose or eliminate the misconceptions (Kaltakci Gürel et al., 2015) such as concept maps, interviews, multiple-choice tests, drawings, word association tests, two-tier or three-tier tests, open-ended questions, and predict-observe-explain (POE) (Kaur, 2013).

Canpolat (2006) utilized open-ended diagnostic questions and interviews to identify misconceptions about evaporation, revealing that traditional methods may be ineffective in diagnosing misconceptions. Keleş and Kefeli (2010) employed interviews to diagnose misconceptions on photosynthesis and respiration, not only identifying misconceptions but also uncovering their underlying reasons. Akpınar (2014) implemented interactive computer animations based on the POE method to address misconceptions about static electricity, showing partial success in eliminating misconceptions. Other studies used methods like word association tests (Kurt & Ekici, 2013; Özata Yücel & Özkan, 2015; Polat, 2013), two-tier multiple tests (Adadan & Savaşçı, 2012), four-tier tests (Sreenivasulu and Subramaniam, 2013), concept maps (Djanette & Fouad, 2014), and drawing methods (Köse, 2008) to diagnose misconceptions on various topics. Some researchers combined methods, such as interviews and drawings (Köse, 2008) or word association test and drawing methods (Kurt et al., 2013), to gain a deeper understanding of misconceptions. These studies collectively highlight the significance of students' prior knowledge and the importance of identifying and addressing misconceptions in the teaching/learning process. One of the valuable instructional approach to engage students and enhance their comprehension of science concepts is the Project-Based Learning (PBL) model (Adrianti & Raida, 2022). In Kılıç's (2015) research, the focus was on investigating the impact of project-based teaching on the conceptual understanding of 4th-grade students in the context of the "Electricity in Our Lives" unit. The research demonstrated a favorable rise in conceptual understanding among students in the experimental group who underwent project-based instruction.

PBL involves assigning students a project task, which serves as a central component of their learning. These projects encompass real-world activities directly linked to the surrounding environment. By immersing students in authentic tasks, PBL actively engages them and fosters creativity, thereby optimizing the knowledge transfer process (Ardianti et al., 2017). This educational process centers around the principles PBL, embracing a student-centered methodology that promotes relational learning. PBL is characterized as a contemporary learning strategy in which students integrate insights gained from mental and physical activities into real-life conditions or analogous situations (Doğanay & Tok, 2003). The primary goal of this approach is to augment individuals' cognitive skills, development, and problem-solving abilities within environmental contexts (Matyar, 2008).

The implementation of PBL mandates that students assume the responsibility of their learning journey, employing cognitive skills to integrate newly acquired information from research into their existing knowledge base (Krajcik & Blumenfeld, 2006). This active involvement fosters creativity, independent work, multidimensional thinking, research skills, and collaboration within group settings, positioning students in a more effective learning stance (Altun, 2008). Assessment holds paramount importance for teachers when planning subsequent stages of projects. Teachers meticulously assess students' progress during the preparation phase, monitor their advancements, and seek responses to the questions they have posed. Conceptual understanding is verified before progressing to the next stage, and teachers evaluate what students have learned, identifying areas that may require additional emphasis.

When discussing PBL in a daily life-oriented context, the focus is on creating projects that directly relate to students' everyday experiences and challenges. This approach seeks to integrate real-life scenarios into the learning process, thereby bridging the divide between theoretical knowledge and practical application. By addressing issues and problem-solving in familiar contexts, students are more likely to grasp abstract concepts and enhance their conceptual understanding (Zhang & Ma, 2023). The effects of daily life-oriented PBL on students' conceptual understanding are often positive. It not only makes learning more relevant and engaging but also helps students develop a deeper understanding of theoretical concepts as they see the direct application in their lives. This approach nurtures critical thinking skills, problem-solving abilities, and a holistic comprehension of subject matter, contributing to a more comprehensive and lasting learning experience (Kılıç, 2015). Building upon the recognized challenges inherent in comprehending the "Change of Matter" unit, particularly encompassing the concepts of state change, distinctive properties of matter, heat and temperature, and the effects of heat on substances, this study aims to elucidate the potential of project-based learning (PBL) in addressing these difficulties. Extensive research has underscored prevalent misconceptions among students across various age groups regarding the aforementioned topics. These misconceptions persist despite efforts to address them through traditional instructional methods (Şendur et al., 2008). Consequently, there exists a compelling rationale to explore the efficacy of PBL, particularly when focused on daily life scenarios, in enhancing conceptual understanding within the domain of matter and its transformations. So, in this study, a daily-life-oriented PBL approach was implemented in science education to investigate its impact on the conceptual understanding levels of 5th-grade students.

1.1.Theoretical Framework

Daily-Life Oriented Project Based Learning (PBL)

Project-Based Learning (PBL) is a learner-centric approach that prioritizes the learning process over the final product. It encourages creativity by involving students in imagining, designing, planning, and constructing, contributing to the development of their mental framework (Gillies & Ashman, 2000; Kalaycı, 2008; Liu & Hsiao, 2002; Solomon, 2003; Yurtluk, 2003). PBL empowers students to actively address challenges and build knowledge in dynamic life situations, creating an energetic classroom environment and involving families in the learning process. Aligned with national science education recommendations, such as the Framework for K-12 Science Education (NRC, 2012), PBL emphasizes the application of scientific practices, core principles, and hands-on activities for improved decision-making, societal participation, and economic productivity. Actively engaging in scientific and engineering practices allows learners to construct knowledge, fostering a deeper understanding (NRC, 2012).

The success of PBL relies on six key elements: driving questions, learning objectives, active scientific practices, collaboration, learning technologies, and artifact creation (Krajcik & Shin, 2014). Differing from traditional methods in roles, content delivery, and assessment, PBL immerses students in real-life challenges to enhance problem-solving and advanced cognitive skills (Bender, 2012; Kadıoğlu, 2007; Krajcik et al., 2023; Yurtluk, 2003; Zhang & Ma, 2023).

PBL traces its roots back to John Dewey's early 1900s advocacy for "learning by doing" (Krajcik & Blumenfeld, 2006), aligning with constructivism and constructionism philosophies. These philosophies underscore knowledge construction through interactions with the environment. PBL, influenced by learner-centered principles, promotes significant individualization in curriculum, instruction, and assessment (Hugerat, 2016; Moursund, 1998).

Conceptual Understanding

Concept is the first association that an object creates in the human mind (Çepni, 2005). Concept learning begins with the birth of the individual and continues throughout life. It is to form information by dividing stimuli into certain classes. It is a structuring process (Ülgen, 2001). In science education, it is very important for students to understand science concepts. Because, students misunderstand some concepts scientifically and as a result, this returns to the student as a misconception. Therefore, these misconceptions prevent conceptual understanding (Atav et al., 2004; Konicek-Moran & Keeley, 2015).

The concept is used to describe a particular piece of knowledge that needs to be learned by the student. While explaining these concepts, understanding, alternative meanings or misunderstandings may occur in the student and it is more than solving problems with formulas that require understanding, definition or memorization (Konicek-Moran & Keeley, 2015; Sözbilir, 2003; White & Gunstone, 1992). Therefore, it is very important for students to understand a concept and establish a new system by associating this concept with other concepts. Conceptual understanding; it can be defined as students expressing the new concept with their own sentences by explaining and associating with the concept they have learned before. “Why?” questions should be asked and it should be ensured that they can answer them correctly (Demirelli, 2003). In order to achieve a conceptual understanding, the basis of the subject must be assimilated well (Özmen et al., 2009; White & Gunstone, 1992).

1.2. Rationale and Statement of the Problem

Daily-life-oriented PBL is an educational approach grounded in inquiry, where students actively contribute to knowledge creation through assigned tasks that necessitate the development of real-world products (Brundiers & Wiek, 2013; Krajcik & Shin, 2014; Prajoko et al., 2023). When oriented towards daily life, PBL offers numerous advantages, initiating questions rooted in real-world problems encountered in students' everyday experiences. This approach is dedicated to achieving specific learning objectives, encouraging active student participation in relevant learning activities, fostering collaboration, utilizing technology to address practical challenges, and culminating in the creation of authentic products with real-world applications (Krajcik & Shin, 2014). A distinctive aspect that sets daily-life-oriented PBL apart from other student-centered approaches, such as traditional PBL, is its emphasis on generating products that directly address authentic problems encountered in daily life (Hidayah et al., 2021; Jalinus et al., 2019). In this context, daily-life-oriented PBL not only enhances engagement and meaningfulness in learning experiences for students but also facilitates the connection of theoretical concepts to practical, real-life situations. By integrating daily-life challenges into the learning process, students can develop a deeper conceptual understanding of subject matter and acquire problem-solving skills directly applicable to their lived experiences (Shpeizer, 2019). This integration fosters a holistic and enduring grasp of theoretical concepts through their practical application in daily life.

As can be seen in the reviewed literature, there are many studies on students' conceptual understanding. Also, students must have conceptual understanding in order to find a solution to a problem, relate concepts to daily life, and realize meaningful learning. Being able to combine existing concepts with newly acquired concepts and establish relationships between them improves his conceptual understanding. Since science is in every field of life, it is considered very important to realize it in the sense of science. Developing conceptual understanding can be achieved by using many different methods-techniques, tools, as seen in the literature. According to the relevant literature (e.g., Krajcik & Czerniak, 2018; Korkmaz & Kaptan, 2002), one of the most effective methods for students to transfer the knowledge and skills they acquire in science classes to everyday life is project-based learning. In this approach, students not only carry out projects related to the curriculum but also use their creativity to find solutions to real-life problems. They also engage in activities such as accessing information, analysing, synthesizing, and questioning. Through research they conduct based on their interests and abilities, children have the opportunity to find themselves in the real world (Solomon, 2003). Research conducted in various fields has shown that this approach enhances students' achievements and attitudes towards classes (Balkı, 2003; Coşkun, 2004; Çeliker & Balım, 2012; Çıbık, 2006; Demirel et al., 2001; Korkmaz, 2002). However, there is limited research focusing on students' conceptual understanding. In this context, this study aims to investigate the impact of daily life-oriented PBL, particularly on the conceptual understanding of 5th-grade students. By exploring this, the study contributes to the existing literature by shedding light on the effectiveness of PBL in enhancing students' conceptual understanding in science education. Additionally, it addresses a gap in the research, as there is limited focus on students' conceptual understanding in this context. Understanding the potential of PBL to improve conceptual understanding is crucial for educators and curriculum developers in designing effective teaching strategies that promote deeper learning and meaningful engagement with scientific concepts. So, the aim of this study was to assess the impact of integrating daily-life oriented PBL on the 5th-grade students' conceptual understanding and the presence of misconceptions related to the topic of matter and change. In this aspect, the problem statement of the study is “What are the effects of daily-life oriented project based learning on students' conceptual understanding?”

The sub problems also can be listed as follows:

1. Is there a statistically significant difference between students’ conceptual understanding before and after the intervention in both the experimental group (i.e., daily life-oriented PBL) and the control group (i.e., traditional)?

2. How the students’ conceptual understanding in the experimental group changes after the intervention?

METHOD

In the study, a quasi-experimental model known as the pretest-posttest control group was employed to collect and analyze data, particularly suitable for situations where experimental and control groups cannot be randomly selected (Campbell & Stanley, 2015). Also in education, quasi-experimental designs are considered an alternative to actual experimental designs due to random and manipulation conditions (Bi et al., 2020; Campbell & Stanley, 2015; Fraenkel et al., 2011; McMillan & Schumacher, 2010). The responses of experimental group students for open ended questions in two-tier conceptual understanding test were also examined. The control group received a Science curriculum with a teacher-oriented approach, while the experimental group underwent an 8-week teaching program involving PBL activities and measurement tools. Notably, the control group was selected from a different school. The same practices should be applied to all students at the same level in the school where the experimental group is selected. For this reason, the students in the control group were selected from a different school where traditional teaching methods were applied. Students in both groups do not have any prior knowledge or experience with PBL.The lessons in the experimental and control groups were taught by different teachers. But, both teachers are at the same level in terms of professional development, educational background and teaching experience. Also during the implementation process, it was remained that in communication about all the activities carried out and the lesson process. The implementation groups are detailed in Table 1.

Table 1

Implementation Groups

Groups	Pre-Tests	Implementation	Post-Test
Experimental Group	Two-tier Multiple Choice Concept Test	Science lessons based on Daily-Life Oriented Project Based Learning	Two-tier Multiple Choice Concept Test
Control Group	Two-tier Multiple Choice Concept Test	Teacher Oriented Curriculum	Two-tier Multiple Choice Concept Test

2.1. Study Group

The participants of the study consist of 5th grade students in the 2022-2023 academic year, with a total of 80 (Boys=48; Girls=32), 48 in the experimental group in three classes and 32 in the control group in one class. The selection of the study group followed the purposeful sampling method commonly employed in qualitative research to guarantee that the data collection process generates comprehensive and insightful information (Creswell, 2012). All students actively participated in classroom activities, and none had prior experience with project-based learning. However, the experimental group received prior information about PBL before the commencement of the unit. The researchers employed a questioning approach to introduce the project, ensuring that students were prepared for the PBL process. Throughout the activities, researchers observed, guided, and directed the students, aiming to foster independence and critical thinking. Overall, measures were taken to ensure students' readiness and provide support throughout the daily-life-oriented PBL activities. Table 2 provides descriptive data on the participants, including gender and group assignment.

Table 2

Descriptive Data

		Number (n)	%
Gender	Girl	48	60.0%
	Boy	32	40.0%
Group	Experiment	48	60.0%
	Control	32	40.0%

2.2. Data Collection Tools

Two-Tier Multiple Choice Concept Test

In the research, Conceptual Understanding Test prepared by Bakır (2019) were used to determine students' conceptual understanding of the subject. While this test was being created by Bakır (2019), the acquisitions of the 5th grade Science course "Matter and Change" unit of the Ministry of National Education Board of Education and Discipline were examined and the concepts given in the textbook were listed. Then, the misconceptions observed in these concepts were determined by literature review and the content validity of the test questions was ensured by creating a Concept Analysis Table. Then, a pool of questions was created and grouped according to the concept analysis table. Considering the achievements, multiple choice and open-ended questions were prepared in which the reason for the answer given to the test was prepared in the first stage and the reason for the answer given to the second stage of the test. In order to ensure the content validity of the test, expert opinions were obtained from 3 science teachers and three field experts working in the Science Education department. In line with these expert opinions, necessary corrections and changes were made in the test questions. The prepared test was applied to a total of 144 5th grade students studying in different secondary schools and reliability analyses were made. Reliability analysis was carried out on 12 test items with only two-tier questions. Expert opinions were considered sufficient in open-ended questions. Cronbach's Alpha value, which was found to be 0.717, showed that the test was a reliable test. In this way, the Conceptual Understanding Test consisting of 12 test items and 7 open-ended questions was formed. Accordingly, the lowest score that can be obtained from the conceptual understanding test is 0, and the highest score is 76. According to the validity and reliability studies of Bakır (2019), Conceptual Understanding Test was used directly in this study.

2.3. Implementation Process

This study aimed to assess the impact of a daily-life oriented PBL approach on the conceptual understanding of 5^{th} grade students. The experimental group engaged in PBL activities related to the matter and change unit. Before starting the unit, students were informed about the PBL approach, introduced to the project, and the unit commenced with a statement of inquiry. Also, all students in the experimental and control group applied two-tier multiple choice concept test as pre-test before implementation. Throughout the unit, experimental group students explored the "Matter and Change" topic through activities aligned with key concepts, emphasizing the "Sustainable Resources" theme. With the question "Systems that will ensure the sustainability of resources for a hopeful future can be achieved by the transformation of materials", the students have completed the preliminary studies and activities for the project they will prepare: chocolate factory experiment, activities of inquiry, pool, global warming, heat and temperature experiments etc. For example, students modeled a system in which they could observe melting, freezing, evaporation and condensation by applying heat to chocolate chips. They modeled a system in which they could observe melting, freezing, evaporation and condensation by applying heat to chocolate chips. While doing this, they took the fondue system they use in daily life as an example and realized their projects with their design skills.

Within the scope of the activities, connections were established between daily life and subject achievements. During the implementation process, the teacher observed the students throughout the activities, guided each group, and took care to direct the students to research instead of giving information directly to the students. At the application's conclusion, students, acting as State Hydraulic Works engineers, designed a sustainable dam for a summative assessment, focusing on analysing water evaporation. Their task was to create a project addressing water loss prevention or reduction through evaporation protection. After instructions, they executed designs, documented observations, and self-evaluated within a week. The teacher offered reflections and evaluations out of 8 points. The unit concluded with the same two-tier multiple choice concept test as the control group, serving as a post-test. While in experimental group these activities were applied, in the control group, the lessons was taught with the direct explanation method and demonstration experiments. That is, the subject has been completed with teacher-centered traditional teaching methods and the application process in the control group followed traditional methods aligned with the content of the textbook and the current science curriculum.

2.4. Data Analysis

Quantitative data in the study were analyzed via a statistical packet programme. Categorical data were presented as number and percentage, mean-standard deviation when continuous data fit the normal distribution, and median and interquartile range when it did not fit the normal distribution. Kolmogorov-Smirnov/Shapiro-Wilk tests and histogram graphs assessed normality. Mann-Whitney U test compared test scores between control and experimental groups for continuous data and not normally distributed. Wilcoxon signed-rank test assessed pre and post intervention differences when data deviated from normal distribution. Statistical significance level p value was accepted as <0.05. In calculating the percentage change in test scores according to the experimental and control groups, the first test score was subtracted from the last test score and the result was divided by the first test score. It was then multiplied by 100 to get a percentage: [(last test score - first test score)/ first test score]x100. This result shows the effect of the applied method on the experimental group as a percentage. The examination of 12 two-tiered test items has been subject to diverse analytical approaches. Existing literature reveals variations in the analysis of these items, with researchers adopting different criteria based on the specific aims and scope of their studies. In certain investigations, such as Chandrasegaran et al. (2007), the two-tiered test item is deemed correct only if both the content and reason components are answered accurately. Conversely, research such as that conducted by Tsai and Chou (2002) employs a classification system that differentiates among incorrect responses (faulty in both tiers, granted 1 point), partially correct responses (correct in only one tier, granted 2 points), and fully correct responses (accurate in both tiers, granted 3 points). Additionally, other studies, including Özmen et al. (2009) and Bakır (2019), employ extended category systems with varied point scales. The current investigation aligns with the latter approach, as shown in Table 3.

Table 3

Examining the First-Tier Items of the Concept Test

Answer (First-tier)	Scientific Explanation *(Socond-tier)*	Grading
Correct answer	full explanation	4 points
Correct answer	partial explanation	3 points
Correct answer	incorrect explanation	2 points
Correct answer	explanation left blank	1 points
Incorrect answer	incorrect explanation	0 points
Incorrect answer	explanation left blank	0 points
No answer	explanation left blank	0 points

Analysis of students' conceptual understanding on matter and change using the two-tier multiple choice open ended questions as qualitative data is shown in Table 4 according to levels as “Sound Understanding (SU)”, “Partial Understanding (PU)”, “Misconception (M)” and “No Understanding (NU)” as employed with similar criteria by Coştu et al. (2007) to analyze comparable open-ended test items Also, students’ misconceptions are determined from answers (Sukarmin et al., 2017). In the case of second-tier open ended items, each explanation for the corresponding question had only one correct answer, while misrepresentation of the concepts related to content were considered as misconceptions. Consequently, an analysis of students' responses was conducted to characterize their conceptual understanding, taking into account pre-test and post-test responses. The table 9 illustrate alterations in student responses, depicting the extent of conceptual changes following daily-life oriented PBL.

Table 4

Examining the Second-Tier (Open-Ended) Items of Concept Test

Content	Level of Concept Understanding
Giving all concepts related to the content	Sound Understanding (SU)
Giving most of the concepts related to the content	Partial Understanding (PU)
Misrepresentation of concepts related to content	Misconception (M)
Does not give any concept about the content	No Understanding (NU)

2.5. Ethical Principles

Before the data collection process of the study, both participants and parents were informed about the research, and written consent was obtained. Also, written permission was obtained from the educational institutions where the research will be conducted. Throughout all stages of the study, attention was given to ethical principles, including voluntariness and confidentiality. The study received ethical approval from the Yıldız Technical University Social and Human Sciences Research Ethics Board on March 27, 2023. All stages of the study adhered to ethical procedures recommended by the American Psychological Association (APA). No descriptive information (such as name, surname, ID number, etc.) about the participants was collected. Participants were asked to provide a nickname (a personal identifying name), and they were explicitly notified that they had the option to withdraw from the study at any point without facing any conditions. To maintain confidentiality, each participant was assigned a code such as "S1, S2, S3,..." for representation purposes. The personal privacy, reputation, and rights of the participants were ensured. The research posed no risk to participant students. The analysis and reporting process adhered to the transparency principle, ensuring compliance with publication ethics.

Beyond this, the practitioner conducting the implementation works at a school that offers education within the International Baccalaureate (IB) Middle Years Programme, which also incorporates project-based learning. With 5 years of experience and certification in this field, the practitioner exhibits adeptness in formulating and executing pedagogical strategies grounded in project-based learning principles. Furthermore, in crafting the lesson plans, the collaborative input of the school's academic coordinator, science teachers, and the co-author, who is an academician in science education were taken as expert opinion.

FINDINGS

The findings regarding the answers to the multiple-choice questions and open-ended questions of the concept test are presented in two parts.

Findings Regarding the First Sub-Problem

Table 5

Comparison of Concept Test Scores by Groups

Groups		**Mean**	**Standard Deviation**	**Median**	**IQR**	**P Value**
Experiment	Concept Pre-test	19.71	9.98	19	9	0.009
Control	Concept Pre-test	27.63	15.00	33	22	
Experiment	Concept Post-test	44.92	15.50	41	27	0.071
Control	Concept Post-test	36.13	18.61	37	22	

Table 5 represents the comparison of pre-test and post-test results according to experimental and control groups. The median value of Concept pre-test scores in the experimental group is 19 (IQR=9) and control group is 33 (IQR=22). A significant difference was found between the experimental and control groups in terms of achievement pre-test scores (p=0.009). The median value of Concept post-test scores in the experimental group is 41 (IQR=27) and control group is 37 (IQR=22). A significant difference was not found between the experimental and control groups in terms of achievement post-test scores (p=0.071). So, it shows that before the implementation while there was a significant difference between the groups, after implementation of daily-life oriented PBL there was no significant difference, but median value has increased more in experiment group.

Table 6

Comparison of Pre-Test Post-Test Scores of the Experimental Group

	N	Mean	Std. Deviation	Median	IQR	P value
Concept Pre-test	48	19.71	9.979	19.0	9	<0.001
Concept Post-test	48	44.92	15.501	40.5	27	

Table 6 represents the comparison of pre-test and post-test results of the experimental group. The median value of Concept pre-test scores in the experimental group is 19 (IQR=9) and Concept post-test score is 40.5 (IQR=27). A significant difference was found between Concept pre-test and post-test scores in the experimental groups (p<0.001). So, daily-life oriented PBL approach applied to the experimental group were effective in increasing students' conceptual understanding in a positive way.

Table 7

Comparison of Pre-Test Post-Test Scores of the Control Group

	N	Mean	Std. Deviation	Median	IQR	P Value
Concept Pre-test	32	27.63	14.995	32.50	22	<0.001
Concept Post-test	32	36.13	18.608	36.50	22	

Table 7 represents the comparison of pre-test and post-test results of the control group. The median value of Concept pre-test scores in the control group is 32.5 (IQR=22) and Concept post-test score is 36.5 (IQR=22). A significant difference was found between Concept pre-test and post-test scores in the experimental groups (p<0.001).

Table 8 also represents the comparison of the experiment and control groups' test results as percentage. Median percent change in concept test scores in the experimental group was 133.97% (IQR=138.76), and 34.04% (IQR=51.02) in the control group. A significant difference was observed between the experimental and control groups concerning the percentage change in concept test scores (p<0.001). This implies that the implementation of daily-life oriented project-based learning in the experimental group has a more pronounced impact on students' conceptual understanding when compared to the control group.

Table 8

Comparison of the Groups' Tests Scores Percent Changes

		Mean	Standard Deviation	Median	IQR	P Value
Concept Test Score Percent Change	Experimental	159.69	105.41	133.97	138.76	<0.001
	Control	56.37	91.37	34.04	51.02	

Findings Regarding the Second Sub-Problem

The scores of the 48 experimental group students participating in the research from the conceptual understanding pre-test and post-test were determined and the average values of these scores were found. The experimental group's conceptual understanding pre-test score average was 19.70; the post-test was found 44.92. The lowest score from the pre-test is 6.00; the highest score is 51.00. The lowest score from the post-test is 14.00; the highest score is 76.00. Since $p<0.05$, there is a significant difference between the pre-test and post-test scores of the group. Based on these results, it can be inferred that PBL centered around real-life experiences positively influences students' conceptual understanding. Beyond this result, analysis of students' conceptual understanding on matter and change concepts of “heat exchange”, “boiling point”, “expansion”, “contraction” and "evaporation” obtained from 7 open-ended questions of concept test is shown in Table 9 according to their frequencies and percentages at levels: “Sound Understanding (SU)”, “Partially Understanding (PU)”, “Misconception (M)” and “No Understanding (NU)”. The aim of the study is to examine the impact of PBL on students' conceptual understanding. In this context, PBL activities were implemented with the experimental group students, and their responses to open-ended questions in the concept test were analyzed. The responses of the experimental group students to the open-ended questions in the concept test during the pre-test and post-test phases provide valuable data for a more effective understanding of the impact of the PBL approach. This focused analysis allows for a nuanced exploration of the influence of PBL on students' conceptual understanding, contributing to a deeper understanding of the pedagogical effectiveness of PBL methodologies.

Table 9

Frequency and Percentage Distribution of the Concept of Matter and Change Obtained from Concept Test Open-Ended Questions (Q13 to Q19)

Number of Question/Concept	Level of Concept Understanding	Pre-test	Post-test
		f (%)	f (%)
Q13, Q16, Q18 / Heat Exchange	Sound Understanding (SU)	5 (10.41%)	27 (56.94%)
	Partially Understanding (PU)	9 (18.75%)	7 (14.58%)
	Misconception (M)	11 (22.22%)	4 (9.02%)
	No Understanding (NU)	12 (25%)	5 (10.42%)
Q19 / Boiling Point	Sound Understanding (SU)	1 (2.08%)	24 (50%)
	Partially Understanding (PU)	0 (0.00%)	1 (2.08%)
	Misconception (M)	5 (10.41%)	2 (4.16%)
	No Understanding (NU)	42 (87.5%)	21 (43.75%)
Q14 / Expansion	Sound Understanding (SU)	10 (20.83%)	32 (66.66%)
	Partially Understanding (PU)	3 (6.25%)	3 (6.25%)
	Misconception (M)	10 (20.83%)	5 (10.41%)
	No Understanding (NU)	25 (52.08%)	5 (10.41%)
Q15 / Contraction	Sound Understanding (SU)	9 (18.75%)	36 (75%)
	Partially Understanding (PU)	3 (6.25%)	0 (0.00%)
	Misconception (M)	3 (6.25%)	2 (4.16%)
	No Understanding (NU)	34 (70.83%)	10 (20.83%)
Q17 / Evaporation	Sound Understanding (SU)	16 (33.33%)	26 (54.16%)
	Partially Understanding (PU)	4 (8.33%)	1 (2.08%)
	Misconception (M)	17 (35.41%)	12 (25%)
	No Understanding (NU)	11 (22.91%)	6 (12.5%)

As can be seen from Table 9, more students gave responses classified as sound understanding (SU) after the intervention. In a similar manner, responses classified as misconception (M) decreased from pre-test to post-test. Students' responses were also analyzed to determine specific misconceptions based on pre and post-test.

Question 13, 16 and 18 refer to the concept of "heat exchange" and the proportion of students' responses in the level of Sound Understanding (SU) changed from 10.41% to 56.94% for the pre and post-test respectively. Beyond this, proportion of students' responses in the level of Misconception (M) changed from 22.22% to 9.02% for the pre and post-test respectively. Accordingly, Table 10 represents the misconceptions of students regarding heat exchange in pre-test and their changes in post-test:

Table 10

Stıdents' Conceptual Understandings Changes on "Heat Exchange" in Pre-test and Post-test

Students	Misconceptions	Sound Understanding
	Pre-test	**Post-test**
S1	Water destroys temperature	Wet cloth absorbs heat
S2	Cold eliminates temperature	Heat exchange occurs
S3	The fever goes down because the coldness is gone	Wet cloth absorbs body heat
S21	Cold attracts heat	When snow falls, it gives heat to the air
S36	The reason why the air gets warmer when it snows is because the clouds condense	When water freezes, it gives off its own heat
S42	Wet cloth absorbs temperature	The wet cloth dries as it absorbs heat

When the answers in Table 10 were examined, it can be concluded that the concept of heat exchange is not well established in the students' minds in pre-test. Students generally think that coldness can be exchanged and that temperature is transferred instead of heat. It has also been observed that heat and temperature concepts are confused. But when post-test results examined it was seen that misconceptions were eliminated, most of the students learning turned into sound understanding from misconception.

Question 19 refers to the concept of "boiling point" and the proportion of students' responses in the level of Sound Understanding (SU) changed from 2.08% to 50% for the pre and post-test respectively. Beyond this, proportion of students' responses in the level of Misconception (M) changed from 10.41% to 4.16% for the pre and post-test respectively. Accordingly, Table 11 represents the misconceptions of students regarding boiling point in pre-test and their changes in post-test:

Table 11

Students' Conceptual Understandings Changes on "Boiling Point" in Pre-test and Post-test

Students	Misconceptions	Sound Understanding
	Pre-test	**Post-test**
S8	The boiling temperatures of different amounts of water are not the same. Because the smaller amount boils faster.	The boiling temperatures of different amounts of water are same. Because ıt doesn't depend on amount.
S11	Not same. Because excess water boils slower. That's why its heat is high	Boiling point doesn't depend on amount
S25	The smaller one starts to get gas quicker.	Boiling point are the same

When the answers in Table 11 were examined, it can be concluded that the concept of boiling point is not well established in the students' minds in pre-test. Students generally think that the boiling point increases as the amount of substance increases. They also think that boiling temperature and boiling time have the same meaning. But when post-test results examined it was seen that misconceptions were eliminated, most of the students learning turned into sound understanding from misconception.

Question 14 refers to the concept of "expansion" and the proportion of students' responses in the level of Sound Understanding (SU) changed from 20.83% to 66.66% for the pre and post-test respectively. Beyond this, proportion of students' responses in the level of Misconception (M) changed from 20.83% to 10.41% for the pre and post-test respectively. Accordingly, Table 12 represents the misconceptions of students regarding expansion in pre-test and their changes in post-test:

Table 12

Students' Conceptual Understandings Changes on "Expansion" in Pre-test and Post-test

Students	**Misconceptions**	**Sound Understanding**
	Pre-test	**Post-test**
S9	Glass becomes lighter under the influence of temperature	the lid of the jar expands
S28	Glass shrinks under the influence of temperature.	expansion occurs
S37	As the temperature increases, the lid of the jar softens.	expansion occurs

When the answers in Table 12 were examined, it can be concluded that the concept of expansion is not well established in the students' minds in pre-test. Students generally commented by concluding that the amount of matter changes as the temperature increases After the implementation, they realized that expansion occurs when the jar lid comes into contact with hot water.

Question 15 refers to the concept of "contraction" and the proportion of students' responses in the level of Sound Understanding (SU) changed from 18.75% to 75% for the pre and post-test respectively. Beyond this, proportion of students' responses in the level of Misconception (M) changed from 6.25% to 4.16% for the pre and post-test respectively. Accordingly, Table 13 represents the misconceptions of students regarding contarction in pre-test and their changes in post-test:

Table 13

Students' Conceptual Understandings Changes on "Contraction" in Pre-test and Post-test

Students	**Misconceptions**	**Sound Understanding**
	Pre-test	**Post-test**
S14	When the temperature increases, the ball deflates.	In the cold, the ball contracts because it gives heat.
S42	In the cold, the air in the ball evaporates and the ball shrinks.	The ball contracts by giving heat

When the answers in Table 13 were examined, it can be concluded that the concept of contraction is not well established in the students' minds in pre-test. It seems that students confuse contraction with evaporation. But when post-test results examined it was seen that misconceptions were eliminated, most of the students learning turned into sound understanding from misconception.

Question 17 refers to the concept of “evaporation” and is about whether wet hair dries faster in hot or cold weather. The proportion of students’ responses in the level of Sound Understanding (SU) changed from 33.33% to 54.16% for the pre and post-test respectively. Beyond this, proportion of students’ responses in the level of Misconception (M) changed from 35.41% to 25% for the pre and post-test respectively. Accordingly, Table 14 represents the misconceptions of students regarding evaporation in pre-test and their changes in post-test:

Table 14

Students' Conceptual Understandings Changes on “Evaporation” in Pre-test and Post-test

Students	Misconceptions	Sound Understanding
	Pre-test	**Post-test**
S18	Water loses its heat	The water in the hair turns into steam
S19	Water becomes cold and hot air carries away cold water.	hot air evaporates water faster
S33	Since the hair is given warmth, it dries quickly in the temperature.	Wet hair dries faster as it absorbs heat.

When the answers in Table 14 were examined, it can be concluded that the concept of evaporation is not well established in the students' minds in pre-test. It was intended to express that heat was taken from outside during evaporation, but it was observed that temperature and heat were confused. But when post-test results examined it was seen that misconceptions were eliminated, most of the students learning turned into sound understanding from misconception.

These results represents that after implementation of daily life oriented PBL, percentage of students increased on understanding the concepts of “heat exchange”, “boiling point”, “expansion”, “contraction” and "evaporation” with full explanation. Also, misconception percentage decrease. This shows that daily life oriented PBL have positively effect on students’ conceptual understanding.

DISCUSSION AND CONCLUSION

In this study, in which the conceptual understanding of 5th grade students was investigated using a daily-life oriented PBL in the Matter and Change unit, learning methods prepared by the researcher were given by focusing on events and situations encountered in daily life. In this context, the Conceptual Comprehension Test was employed to assess the impact of PBL on conceptual understanding. A notable distinction emerged between the scores of the groups in the pre-test and post-test phases, indicating a significant improvement in conceptual understanding in favor of the post-test. Based on these findings, it can be concluded that PBL has a positive impact on students' conceptual understanding. During the activity, students question their own conceptual understanding as they relate events to daily life (Stephenson & Warwick, 2002). There are studies in the literature where conceptual understanding is determined using different methods. Tola (2016) observed that the conceptual understanding scores of the experimental and control group students did not differ at the end of the courses taught with the argumentation method. However, Bell (1998) found in his study that argumentation with computer-aided instruction positively affected students' conceptual understanding. In addition, project-based teaching (Kılıç, 2015); differentiated teaching method (Kaplan, 2016); STEM or STEM activities (Büyükdede & Tanel, 2018; Konca Şentürk, 2017); formative evaluation method (Topçu, 2017). The effects of many different methods on conceptual understanding, such as the use of scientific toys (Gedik, 2018), have been investigated. In this study, conceptual understanding of students investigated in the light of daily-life oriented PBL.

The study's findings indicate that the PBL is effective in enhancing students' conceptual understanding of matter and change topics. This effectiveness stems from PBL's ability to render abstract concepts more tangible by incorporating real-life scenarios, thereby facilitating the development of students' conceptual comprehension. Acknowledging the significance of students' cognitive levels in mental construction, the study underscores the significance of learning environments specifically crafted to enhance thinking and problem-solving skills. Unlike mere memorization, PBL fosters a deeper internalization of knowledge, ensuring its lasting impact (Demirel, 2011). These conducive learning environments are inherent in the structure of the PBL approach.

The literature provides substantial evidence of misconceptions regarding the concepts of matter and change, particularly among students (Bakır, 2019; Coştu et al., 2007; Coştu et al., 2010; Sözbilir, 2003). These misconceptions can hinder meaningful learning and understanding of scientific principles. Several studies have highlighted the prevalence of misconceptions and the challenges they pose in science education. For instance, Canpolat (2006) utilized open-ended diagnostic questions and interviews to identify misconceptions about evaporation, revealing that traditional methods may be ineffective in diagnosing misconceptions. These studies demonstrate the existence of misconceptions and the need to address them in science education. Furthermore, the study by Çepni et al. (1997) suggests that traditional teaching approaches focused on identification and memorization of concepts are insufficient for understanding their relationships. This highlights the importance of addressing misconceptions and fostering meaningful learning experiences to promote conceptual understanding. So, the literature supports the presence of misconceptions related to matter and change concepts, emphasizing the need for effective methods to diagnose and address these misconceptions in science education.

At this point, the results of the study underscore the potential of daily-life oriented PBL in promoting deeper conceptual understanding among 5th grade students. The observed decrease in misconceptions and the increase in sound understanding of concepts such as "heat exchange," "boiling point," "expansion," "contraction," and "evaporation" highlight the positive impact of PBL on students' learning. These findings suggest that integrating real-world applications and inquiry-based activities into the curriculum can lead to more meaningful and enduring learning experiences for students.

SUGGESTION

Educators can draw several practical implications from this study. Firstly, the integration of daily-life oriented PBL activities into science curricula can serve as a powerful tool for engaging students and fostering a deeper understanding of scientific concepts. By connecting classroom learning to real-world phenomena and encouraging student-led inquiry, educators can create a more dynamic and meaningful learning environment. Additionally, the study's emphasis on the role of the teacher as a facilitator of learning, guiding students through activities and promoting research-based exploration, highlights the importance of pedagogical approaches that prioritize student-centered, inquiry-based learning.

While this study provides valuable insights into the impact of daily-life oriented PBL on students' conceptual understanding, there are opportunities for further research. Future studies could explore the long-term retention of knowledge following PBL interventions and investigate the transfer of learning to new contexts. Furthermore, an investigation into the influence of PBL on the cultivation of 21st-century skills like critical thinking, collaboration, and problem-solving would enhance our holistic comprehension of the advantages associated with this educational approach. Beyond this, students' misconceptions have an important place in concept teaching and learning. In this respect, if it is aimed for students to have a more scientific understanding of the subjects, the teaching materials to be used should be developed by taking into account the misconceptions frequently encountered by students. Including content and activities in line with the daily life-oriented PBL approach in science textbooks can contribute to better learning of subjects and concepts and developing worksheets that include the applications of the PBL approach and using them in courses can contribute to increasing students' interest in courses.

The findings have implications for educators and curriculum developers and highlight the potential benefits of integrating PBL focused on daily life into science education. The study contributes to the existing literature by providing empirical evidence on the effectiveness of project-based learning in improving students' conceptual understanding in the specific context of the Matter and Change unit for 5th grade students. More research is needed to investigate the long-term effects and scalability of PBL in science education. Limitations of the study include the small sample size and the specific context of the study; This may limit the generalizability of the findings. Future research should address these limitations and explore the potential of PBL in other contexts and larger sample sizes. Overall, the study highlights the potential of PBL focused on daily life to enhance students' conceptual understanding in science education, contributing to ongoing efforts to improve science education and prepare students for the challenges of the 21st century.

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GENİŞLETİLMİŞ ÖZ

Giriş

Fen eğitimi, modern öğretimin temel bir unsuru olarak, öğrencilere bilimsel kavramlarla derin bir bağlam oluşturma yeteneği kazandırmak amacıyla kritik bir rol oynamaktadır. Bu bağlamda, proje tabanlı öğrenme (PTÖ), öğrenci merkezli bir metodoloji olup, öğrenme sürecini nihai ürüne odaklanarak şekillendirir. PTÖ, öğrencileri hayal etmeye, tasarlamaya, planlamaya ve inşa etmeye dahil ederek yaratıcılıklarını teşvik eder ve zihinsel çerçevelerinin gelişimine katkı sağlar. Bu yaklaşım, öğrencilere dinamik yaşam durumlarıyla etkin bir şekilde başa çıkma, bilgi oluşturma, enerjik sınıf ortamları oluşturma ve aileleri öğrenme sürecine dahil etme yeteneği kazandırır. Günlük yaşam odaklı PTÖ ise, özgün sorunlara doğrudan hitap eden ürünler üretmeyi vurgulayan bir yaklaşımdır. Bu metodoloji, öğrencilerin öğrenme deneyimlerine katılımını artırmakla kalmaz, aynı zamanda teorik kavramların pratik, gerçek yaşam durumlarıyla bağlantısını kolaylaştırır. Bu bağlamda, çalışmanın temel amacı, madde ve değişim ünitesi bağlamında günlük yaşam odaklı proje tabanlı öğrenmenin 5. sınıf öğrencilerinin kavramsal anlayışları üzerindeki etkilerini araştırmaktır.

Yöntem

Çalışmada günlük yaşam odaklı proje tabanlı öğrenmenin (PTÖ) 5. sınıf öğrencilerinin "Madde ve Değişim" ünitesindeki kavramsal anlamalarına etkisini kapsamlı bir şekilde incelemek üzere ön test-son test kontrol gruplu yarı deneysel model kullanılmıştır. Deney grubu günlük yaşam odaklı proje tabanlı öğrenme etkinlikleri alırken, kontrol grubu geleneksel öğretim almıştır. Öğrencilerin uygulamadan önce ve sonra kavramsal anlamalarını değerlendirmek için iki aşamalı Kavramsal Anlama Testi kullanılmıştır. Kavram yanılgılarının belirlenmesi ve madde ve değişimle ilgili temel bilimsel kavramları anlama düzeyi de dahil olmak üzere, öğrencilerin kavramsal anlayışlarına daha derin bir bakış açısı kazandırmak için açık uçlu sorular da değerlendirilmiştir. Çalışma için etik onay alınarak ilgili birimler tarafından önerilen etik prosedürlere uyulmuştur.

Araştırma Türkiye'de bir devlet ortaokulunda gerçekleştirilmiş olup katılımcılar 5. sınıf öğrencileridir. Deneysel grup, 8 haftalık bir süreci içeren günlük yaşam odaklı PTÖ etkinliklerini içeren bir öğretim programına tabi tutulurken, kontrol grubu geleneksel öğretmen-merkezli müfredat almıştır. Çalışma, deneysel grupta 48 öğrenci ve kontrol grubunda 32 öğrenci olmak üzere toplamda 80 öğrenciden oluşmaktadır. Veri toplama için "Madde ve Değişim" ünitesine odaklanan İki Aşamalı Çoktan Seçmeli Kavram Testi kullanılmıştır. Bu test, Bakır (2019) tarafından oluşturulmuş olup, uzman görüşleri ve güvenilirlik analizi aracılığıyla içerik geçerliğini sağlam bir şekilde geliştirilmiştir. Testin güvenilirliğini gösteren Cronbach'ın Alfa değeri 0.717 olarak belirlenmiştir. Test, 12 çoktan seçmeli soru ve 7 açık uçlu sorudan oluşmaktadır ve öğrencilerin kavramsal anlamalarını değerlendirmektedir.

PTÖ yaklaşımını tanıtmak için bir sorgulama yaklaşımı benimsenmiş ve deneysel gruba proje öncesinde bilgi sağlanmıştır. Çalışma tasarımı, nicel sonuçlar ve deney grubu öğrencilerinin veri toplma aracındaki açık uçlu sorulara verdikleri yanıtlar ile sonuçların desteklenmesini sağlamış ve günlük yaşam odaklı PTÖ'nün öğrencilerin kavramsal anlamaları üzerindeki etkisinin kapsamlı bir değerlendirmesine katkıda bulunmuştur.

Bulgular

Bulgular, günlük yaşam odaklı proje tabanlı öğrenme yaklaşımının öğrencilerin kavramsal anlamaları üzerinde olumlu bir etkisi olduğunu ortaya koymaktadır. Kavramsal Anlama Testi ön test ve son test puanları açısından deney ve kontrol grupları arasında anlamlı bir fark olduğunu göstermiştir. Deney grubu, kontrol grubuyla karşılaştırıldığında madde ve değişime ilişkin kavramsal anlayışlarında önemli bir gelişme göstermektedir. Ayrıca açık uçlu soruların analiz sonucunda kavram yanılgılarının azaldığı ve öğrencilerin madde ve değişimle ilgili bilimsel kavramları anlama derinliğinin arttığı gözlemlenmiştir. Bu veriler, proje tabanlı öğrenme yaklaşımının öğrencilerin teorik kavramları pratik, gerçek hayattaki durumlarla ilişkilendirmelerine yardımcı olduğunu ve bilimsel kavramların daha derin anlaşılmasına yol açtığını ortaya çıkarmıştır. Çalışma bulguları, günlük yaşam odaklı proje tabanlı öğrenmenin öğrencilerin fen eğitimindeki kavramsal anlamalarını geliştirme potansiyelini vurgulayan önceki araştırmalarla uyumlu olduğu görülmektedir.

Sonuç ve Tartışma

Çalışmanın sonuçları, günlük yaşam odaklı proje tabanlı öğrenmenin öğrencilerin kavramsal anlayışı üzerinde olumlu bir etkisi olduğunu göstermektedir. Öğrencilerin kavramsal anlayışı, PTÖ uygulamasından önce ve sonra yapılan kavramsal anlama testi sonuçlarına göre karşılaştırıldığında, son test sonuçlarında anlamlı bir artış gözlemlenmiştir. Bu sonuçlar, öğrencilerin günlük yaşam olaylarına odaklanarak kavramları daha iyi anladıklarını ve kavram yanılgılarının azaldığını göstermektedir. Benzer şekilde, Tola (2016) tarafından yapılan bir çalışmada, öğrencilerin kavramsal anlama puanları, argümantasyon yöntemiyle öğretilen derslerin sonunda deney ve kontrol grubu öğrencileri arasında farklılık göstermemiştir. Ancak, Bell (1998) yaptığı çalışmada, bilgisayar destekli öğretimle yapılan argümantasyonun öğrencilerin kavramsal anlayışını olumlu yönde etkilediğini bulmuştur. Bu sonuçlar, PTÖ'nün öğrencilerin kavramsal anlayışını artırmada etkili bir yöntem olduğunu göstermektedir. Ayrıca, çalışmanın sonuçları, öğrencilerin madde ve değişim konusundaki kavram yanılgılarının azaldığını göstermektedir. Bu sonuçlar, öğrencilerin günlük yaşam olaylarına odaklanarak kavramları daha iyi anladıklarını ve kavram yanılgılarının azaldığını göstermektedir. Ayrıca, günlük yaşam odaklı proje tabanlı öğrenmenin öğrencilerin kavramsal anlayışını artırmada etkili bir yöntem olduğu gözlemlenmştir. Bu yaklaşım, öğrencilerin kavramları daha iyi anlamalarına ve kavram yanılgılarının azaltılmasına yardımcı olabilir. Çalışma bulguları incelendiğinde, günlük yaşam odaklı proje tabanlı öğrenmenin öğrencilerin fen eğitimindeki kavramsal anlamalarını geliştirme potansiyelini vurgulayan önceki araştırmalarla uyumlu olduğu görülmektedir.

Bulguların eğitimciler ve müfredat geliştiriciler için çıkarımları bulunmaktadır ve günlük yaşam odaklı proje tabanlı öğrenmeyi fen eğitimine entegre etmenin potansiyel faydalarını vurgulamaktadır. Çalışma, 5. sınıf öğrencilerine yönelik Madde ve Değişim ünitesi özel bağlamında öğrencilerin kavramsal anlamalarını geliştirmede proje tabanlı öğrenmenin etkililiğine dair ampirik kanıtlar sağlayarak mevcut literatüre katkıda bulunmaktadır. Fen eğitiminde proje tabanlı öğrenmenin uzun vadeli etkilerini ve ölçeklenebilirliğini araştırmak için daha fazla araştırma yapılması gerekmektedir. Araştırmanın sınırlılıkları arasında örneklem büyüklüğünün küçük olması ve çalışmanın özel bağlamı yer almaktadır; bu durum, bulguların genellenebilirliğini sınırlayabilmektedir. Gelecekteki araştırmalar bu sınırlamaları ele almalı ve proje tabanlı öğrenmenin diğer bağlamlardaki potansiyelini ve daha büyük örneklem büyüklüklerini keşfetmelidir. Genel olarak çalışma, öğrencilerin fen eğitimindeki kavramsal anlayışlarını geliştirmek, fen eğitimini geliştirmek ve öğrencileri 21. yüzyılın zorluklarına hazırlamak için devam eden çabalara katkıda bulunmak için günlük yaşam odaklı proje tabanlı öğrenmenin potansiyelini vurgulamaktadır.