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Investigation of the Effects of Understanding by Design Model on Problem-Solving, Collaboration, and Academic Achievement in Social Studies Course

Sosyal Bilgiler Dersinde Tasarımla Anlama Modelinin Problem Çözme, İş Birliği ve Akademik Başarı Üzerindeki Etkilerinin İncelenmesi

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Abstract: The purpose of this study is to examine the effect of the Understanding by Design Model (UbD) on students' problem-solving skills, collaboration skills, and overall academic achievement in the fourth-grade social studies course. The research was conducted with mixed methods, and an enriched design was used in the study. The participants of the study consisted of 41 fourth-grade students: 22 in the experimental group and 19 in the control group. 'Problem-Solving Steps Teacher Observation Form', 'Cooperative Learning Rubric', and 'UbD Application Teacher Interview Form' were used as qualitative data collection tools. 'Problem-Solving Skills Scale', 'Cooperative Work Scale', and 'Social Studies Academic Achievement Test' were used as quantitative data collection tools. Descriptive statistics results were used to analyze qualitative data, and Mann-Whitney U, Welch t-test, ANOVA, and Shapiro-Wilk test were used to analyze quantitative data. The findings obtained from the data of the study show that UbD contributed to the development of problem-solving and collaborative working skills, increased academic achievement, and increased students' motivation towards the learning process.

Keywords: Understanding by Design (UbD), problem-solving, collaboration, academic achievement

Öz: Bu araştırmanın amacı ilkokul dördüncü sınıf sosyal bilgiler dersinde Anlamaya Dayalı Tasarım Modelinin (UbD) öğrencilerin problem çözme, iş birliği becerisi ve akademik başarısına etkisini incelemektir. Araştırma karma yöntemle yürütülmüş ve araştırmada zenginleştirilmiş desen kullanılmıştır. Araştırmanın katılımcılarını dördüncü sınıfa devam eden 22'si deney, 19'u kontrol grubunda olmak üzere toplam 41 öğrenci oluşturmaktadır. Araştırmada nitel veri toplama araçlarından "Problem Çözme Basamakları Öğretmen Gözlem Formu", "İş Birlikli Öğrenme Rubriği", "UbD Uygulaması Öğretmen Görüşme Formu" kullanılmıştır. Nicel veri toplama aracı olarak "Problem Çözme Becerisi Ölçeği", "İş Birlikli Çalışma Ölçeği", "Sosyal Bilgiler Akademik Başarı Testi" kullanılmıştır. Nitel verilerin analizinde betimsel istatistik sonuçlarından, nicel verilerin analizinde Mann-Whitney U, Welch t-testi, ANOVA ve Shapiro-Wilk testinden faydalanılmıştır. Araştırmanın verilerinden elde edilen bulgular, UbD'nin problem çözme ve iş birlikli çalışma becerisinin gelişimine, akademik başarının artmasına katkı sağladığı ve öğrencilerin öğrenme sürecine karşı motivasyonlarını arttırdığını göstermektedir.

Anahtar Kelimeler: Anlamaya dayalı Tasarım (UbD), problem çözme, işbirliği, akademik başarı

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Introduction

Social studies has been defined as a field of research that makes interactive use of social and human sciences to develop citizenship competencies (NCSS, 1994, as cited in Öztürk, 2009, p.4). In addition to this, social studies also aims to provide individuals with skills such as being productive in a democratic society, putting the right decision-making mechanisms into action, planning the future by looking at the past, and citizenship awareness.

The Social Studies curriculum (2015) aims to raise individuals who are active and creative, who develop positive relationships, and who aim to improve their citizenship competencies. While conducting studies to achieve this goal, all sciences such as history, geography, anthropology, archeology, economics, law, philosophy, political science, psychology, and sociology have been utilized within the scope of the social studies course. In social studies teaching, which has been affecting an important part of human life since the day it was taken into the teaching process, raising conscious citizens who are beneficial to society has been one of the focal points in the program.

Curricula have some general objectives. These objectives are complementary and supportive of each other from pre-school to high school completion and are specified in detail for each level. A student who completes primary school is expected to be a self-confident and self-disciplined individual with high awareness, who has acquired verbal, numerical, and social skills that they can actively use in daily life, and who makes choices that affect their life for their benefit (Ministry of National Education and the Board of Education and Discipline, 2023).

The general and specific objectives of the Social Studies programs include outcomes and topics, values, skills, and competencies that are formed in a spiral manner at different levels (Ministry of National Education, Board of Education and Discipline, 2005; 2015; 2023). Especially in the Social Studies program, which started to be used in 2005, values, skills, and concepts were included in detail for the first time. Starting this year, it is seen that thinking skills such as decision-making, problem-solving, creative thinking, and critical thinking are among the skills that students should acquire.

Skill can be defined as being able to do anything of interest and affinity. Bolat (2021) defined the concept of skill as the ability to behave following the specified criteria by using the individual's existing physical tendency or competencies developed through the teaching process. Skill is also

associated with people's being in harmony with society throughout their lives, adapting easily to the world they live in, and being successful in education and business life (Şimşek et al., 2022).

The ability to produce new ideas by analyzing information and thoughts to reach a result and by identifying the connections between situations is called thinking skills (Özdemir, 2021). Thinking skills include processes such as critical, creative, innovative, and analytical thinking (Binkley et al., 2012). According to the research report of the Board of Education (2023), high-level thinking skills are classified as innovative and creative thinking, problem-solving, decision-making, reflective thinking, critical thinking, analytical thinking, and metacognition.

John Dewey presents problem-solving as a life skill with systematized stages. Dewey considers this skill as a 'reflection on life' (Yenice, 2011, as cited in Bolat, 2021). Problem-solving skills have been recognized as important for more than 60 years. It came to the fore especially in the 1980s (Muir et al. cited in Bolat, 2021). Problem-solving can be defined as consciously examining the problem, choosing the most appropriate one among the ways to solve it, and being aware of the differences in the whole process.

The skill of collaboration involves the processes of sharing responsibility and division of labor by meeting at a common point by the individuals involved in the study before starting to work within the framework of a subject. This skill also includes processes such as cooperation, sharing, acting according to instructions and rules. In addition, cooperation includes processes such as acting according to rules (Özdemir, 2021, p. 29).

Many systems and models have been developed, and many different applications have been made in the world to gain the life skills and thinking skills in the explanations. All experiments that have been tried throughout history, whether successful or unsuccessful, have been produced and tried to develop and contribute to the individual. One of these approaches, the Understanding by Design (UbD), is a model that aims to enable individuals to acquire knowledge and skills permanently and transfer them to life.

UbD is an approach to learning that takes students' readiness and learning characteristics into account, aims for permanent understanding, and supports students to easily transfer this understanding to life. According to Wiggins and McTighe (2005), UbD is not a prescriptive program, but a way of thinking in which goals are at the center. In this model, information or ideas that are considered important are expected to be more easily understood by the student and used where necessary.

Through UbD, a framework is created by determining learning and teaching priorities. Planning within the boundaries of this framework should consist of students' readiness, skills and predispositions, their developmental status, the conditions of the teaching environment, their responsibilities, and the assessment process. By identifying goal-oriented methods and designing materials, a guiding map of what the student needs to acquire should be created. The ideal design process is aimed at creating a productive and authentic learning process for the student, far beyond providing the student with technical skills (Wiggins & McTighe, 2005, p. 14).

Teachers, who are defined as designers in UbD, need to clearly define their goals and the results they want to achieve at the beginning of the design process. Then, comprehension objectives and related basic questions are created for these knowledge and skill objectives. Then, process and outcome evaluations are made with various teaching methods and techniques and finally, the learning process is planned in detail. This whole process consists of desired outcomes, evidence, and instructional planning (Wiggins & McTighe, 2005).

Determining the desired outcomes is the first stage of planning. It consists of three parts: attainment, comprehension, and transfer. The big idea, basic questions, comprehension statements, knowledge and skill acquisitions, and transfers are determined in this section (Altun & Yurtseven, 2020, p. 38). At this stage, the teacher should have determined the appropriate time interval and should plan with appropriate choices for this period (Wiggins & McTighe, 2005, p. 18). In the stage of determining the desired results, the big idea, basic questions, comprehension goals, knowledge and skill gains, and transfer process, which are among the basic concepts of UbD, take place. The big idea is the definition of the whole process to be gained by the student regarding the theme or topic.

At the end of the process, students are expected to construct what they have learned and acquired in line with this idea. The comprehension process is seen as a critical process in which permanent understanding is the focus, and this process is supported by basic questions. Knowledge is shaped within the framework of skill objectives. The transfer process can be defined as students' use of what they have learned in environments outside of school or in new processes they encounter by mobilizing their own will and decisions.

The stage of determining the evidence is divided into two, namely, process assessment and summative assessment. In the process assessment phase, traditional or alternative assessment and evaluation tools are included in the implementation phase of the plan, while in the summative assessment phase, there is a performance task that the student must perform at the end of the subject or unit. Performance tasks are tasks that are included in every plan in this design model and that students perform by using their knowledge and skills effectively. Wiggins and McTighe (2005, p. 18) state that before planning assessments and activities, teachers should know how to think like an evaluator.

The third and final step, the preparation of the learning plan, should be designed to ensure integrity with the previous two steps. In addition, in this section, students should be in contact with activities that will support the necessary knowledge and skills (Altun & Yurtseven, 2020, p. 40). The teacher can prepare the methods, techniques, and materials to be used in this section in advance or reorganize them during or at the end of the process.

UbD aims to increase student achievement and ensure permanent and effective learning. In addition, this model emphasizes the concept of permanent comprehension and the transfer process and aims for a process in which students actively participate and individual differences are taken into account (Wiggins & McTighe, 2011). There are many studies on the effects of UbD in the world, and it is seen that these studies have positive effects on student participation, achievement, attitude toward the learning process, and motivation (Andrews, 2011; Bodur & Yurtseven, 2021; Özdemir & Yurtseven, 2023; Som et al., 2016).

In studies conducted to investigate the effect of UbD on student achievement (Andrews, 2013; Geylan, 2023; Keskin Çinkaya, 2022; Tshering, 2022; Uyguç, 2022), it was

concluded that student achievement was positively affected. In these studies, in addition to student achievement, behavioral development, attitude, and retention variables were examined. In the studies examining the effect of UbD on students' thinking skills (Chaisa & Chinokul, 2021) and its effect on problem-solving skills (Durmaz, 2014), the results that UbD contributed to students' thinking skills were shared. These studies also investigated the effects of UbD on class participation, attention and motivation, self-efficacy, and self-regulation skills. In a study examining the effect of UbD on collaborative work (Florian & Zimmerman, 2015), critical thinking and effective communication skills were also examined, and it was concluded that UbD had a positive effect on skill development.

In this study, unlike other studies, the effects of UbD on student achievement and students' problem-solving and collaboration skills were examined together through qualitative and quantitative data. It is thought that the study will contribute to the field within the scope of the Social Studies course and the UbD processes. In line with these explanations, it was aimed to answer the following questions to examine the effect of the Social Studies lesson plans designed with UbD on fourth-grade students' problem-solving and collaboration skills and academic achievement:

1. What is the effect of the Understanding by Design Model (UbD) on students' problem-solving skills in the 4th-grade social studies course?
2. What is the effect of the Understanding by Design Model (UbD) on students' collaboration skills in the 4th-grade social studies course?
3. What is the effect of the Understanding by Design Model (UbD) on students' academic achievement in the 4th-grade social studies course?
4. According to the opinions of classroom teachers, what is the effect of the Understanding by Design Model (UbD) on students' problem-solving, collaboration, and academic achievement.

Method

Research Model

This research was conducted with mixed methods. Mixed methods are studies in which qualitative and quantitative methods are used together (Büyüköztürk et al., 2021).

In this study, in which the effect of UbD on students problem-solving and collaboration skills and academic achievement was examined, an enriched research design, the triangulation method, one of the mixed method designs, was used. In the enriched design, qualitative and quantitative data are collected simultaneously, and the findings are examined to see if they support each other (Creswell & Plano Clark, 2007, as cited in Büyüköztürk et al., 2021). This design can also be called a convergent parallel design.

The quantitative part of the study was conducted with a post-test control group experimental model. The experimental model is the examination of the effect of different teaching programs, methods, classroom practices, and lesson plans on individuals or groups (Büyüköztürk et al., 2021). The experimental model with the post-test control group is the one in which the experimental and control groups are formed by random assignment and only the post-test is applied. In these studies, pretesting is seen as unnecessary or impossible (Karasar, 2016).

The qualitative part of the research was conducted as a case study. Case studies are used to see the details of an event, to develop possible explanations for an event, and to evaluate an event (Gall et al., 1996).

Work Group

This study, which examined the effect of the Social Studies lesson plan prepared based on UbD on students' problem-solving and collaboration skills and academic achievement, was conducted in a private school in Etimesgut district of Ankara province in the fall semester of the 2023-2024 academic year. Two fourth-grade classes were randomly selected as experimental and control groups. The study was conducted with a total of 41 students: 22 in the experimental group and 19 in the control group. Simple random sampling was used in the study. In this method, all units in the universe have an equal and independent chance to be selected for the sample. In simple random sampling, universe units are known and listed. Units are selected until the sample size is reached (Büyüköztürk et al., 2021). The reason for choosing this study group for the research was that the only grade level in the curriculum that includes the Social Studies course is the fourth grade. Another reason is that the study group meets the criteria of easy accessibility and affordability. In convenience sampling, the researcher determines the number that is sufficient for the research among the existing elements as the sample. For this reason, it is also defined as random sampling (Singleton & Straits, 2005, as cited in Baltacı, 2018).

Data Collection Tools

Qualitative Data Collection Tools

Problem-Solving Steps Teacher Observation Form: The researchers sorted the problem-solving steps into 22 sub-steps and created an observation form. The observation form was presented to two expert classroom teachers and one instructor, and their opinions were taken. In line with the opinions expressed, some items were combined, some items were removed, and some items were formally edited. The observation form was finalized with 16 items. These items include processes such as defining the problem, collecting and synthesizing data, making use of previous knowledge, investigating the source of the problem, determining possible solutions, deciding on the appropriate one, determining the cause-and-effect relationship, and making observations. This form was filled in for each student by the branch classroom teacher of the experimental group at the end of the five-week implementation.

Collaborative Learning Rubric: The rubric, originally named 'Collaborative Work Skills' and created by Sarah Nilsson, was translated into Turkish by Önger (2019) as 'Collaborative Learning Rubric'. The rubric includes the categories of 'working with others', 'quality of work', 'problem solving', 'focusing on the task', 'being prepared', and 'monitoring group activity'. The cooperative learning rubric was piloted in a 3rd grade class of 18 students at a private school in Etimesgut district of Ankara, and the items did not need to be revised. At the end of the five-week UbD implementation, the experimental group branch classroom teacher filled out this form for each student in the class.

UbD Practice Teacher Interview Form: First of all, the researchers clearly defined the answers sought by the research from the beginning to the end. Then, by analyzing the general questions asked, a semi-structured interview form consisting

of 25 functional questions was prepared. Since semi-structured interviews are conducive to deepening the questions along with fixed options, the questions were prepared in this context. During the preparation of the questions, the criteria of relevance, suitability for the participant, and ease of answering were taken into consideration. The prepared question form was presented to the expert opinion, and a few of the interview questions were eliminated and turned into 15 questions. Then, a sample application was made with three expert classroom teachers, and some of the questions were eliminated again and some were structured. Finally, the interview form was finalized with 10 open-ended questions and used as the main data collection tool. The questions in the interview form were designed to elicit opinions on the reflection of the UbD implementation on the teaching environment, its effect on problem-solving and collaboration skills, its effect on the academic process, and its effect on students' attitudes and motivation. The interview questions were directed to four teachers who taught in the experimental group after the UbD implementation, and teachers' opinions about the process were obtained. The interviews were conducted face-to-face and individually in a private environment. The interviews of the teachers who gave permission were audio recorded, while the interviews of the teachers who did not give permission were recorded by taking notes. The same interviewer acted as the interviewer in all interviews and refrained from making personal directives.

Quantitative Data Collection Tools

Problem Solving Skills Scale: In the study, the 'Problem Solving Skills Scale' developed by Sezgin (2011) was used to measure students' problem-solving skills. The scale was taken from Sezgin's master's thesis. The scale consists of eight sections and is unidimensional. It covers eight sub-skills of problem-solving skills. The study group in the development phase of the scale consisted of 264 fourth, fifth, sixth, seventh, and eighth graders. In the preparation phase of the scale, 16 sub-steps of problem-solving skills were taken, and the items were created after the item frequency, the items to be measured were reduced to eight. The scale was made ready for application by taking expert opinions. The application time of the scale for fourth-grade students was determined as 30 minutes.

Collaborative Work Scale: In the study, the 'Collaborative Work Scale' developed by Durmuş (2020) was used to measure the collaborative work skills of fourth-grade students. While preparing the scale, 52 items were prepared and presented for expert opinion. After the expert opinion, a draft of 43 items was prepared and data were collected from 479 students. As a result, a three-factor, 17-item scale was obtained. The alpha coefficients of the factors in the scale are known to be .83 for Collaborative Learning Skills, .64 for Group Reflection, .61 for Positive Commitment, and .87 for Cooperative Learning Scale. The administration time of the scale for fourth-grade students was determined as 20 minutes.

Social Studies Academic Achievement Test: While developing this achievement test, the following steps were followed: determining the unit and related achievements, preparing test items, getting expert opinion for content validity, trial application, item difficulty, and discrimination analysis, and creating the test. First of all, learning areas were examined, and it was decided to conduct the application concerning the 'Individual and Society' unit. Thirty questions were prepared to cover five learning outcomes related to the unit. While preparing the questions, the 4th grade Social Studies textbook by the Ministry of National Education, and auxiliary resources were utilized, but original questions were also created. Test questions were analyzed according to Bloom's taxonomy at the stage of selecting and creating questions. The pre-test was applied to 107 fourth-grade students. As a result of the application, the difficulty and discrimination indices of the items were calculated. The items whose item difficulty index related to each outcome were outside the range of .3 - .8 and the items that were furthest away from the value were removed from the test. The actual achievement test was created with the remaining 20 items. The test was administered to the experimental and control groups as a pre-test at the beginning of the process and as a post-test at the end of the process.

Permissions for the measurement tools used in the study were obtained by contacting the researchers who developed the original scales. In addition, permissions for all measurement tools used in the study were obtained from the Kırıkkale University Social Sciences Research Ethics Committee. Research permissions were obtained from AYSE.

Data Analysis

Qualitative Data Analysis

Both descriptive and content analyses were used to analyze the qualitative data obtained from the research. Descriptive analysis is the analysis of the documents used in the research and the documents collected during interviews and observations on the basis of subject and question (Ekiz, 2020). Content analysis is a systematic, repeatable technique in which results are summarized in smaller content categories by coding based on certain rules (Büyüköztürk et al., 2021). The data analysis stages of the Miles and Huberman model were followed in the study. In this model, there are processes of data reduction, display, description and verification (Punch, 2020). In the data reduction part of the study, the collected data were organized, divided into sections and summarized. In this process, preparations were made for the notetaking and data coding steps. The data were sorted by bringing them together and organizing them. Coding is the process of giving labels, names or descriptions to groups of data. Notetaking can involve many things: substantive, theoretical, methodological and personal. These processes are not in a sequential order (Punch, 2020).

In order to increase the reliability of the research, audio recordings and notes of the interviews with the participants were taken. For the internal validity of the study, the researcher acted as a practitioner in the experimental and control groups. For the external validity of the research, expert opinion was taken at the stages of data analysis, coding, and interpretation. Inter-expert coding agreement was calculated as %89. This similarity, called internal consistency in this model, is calculated with the formula $\Delta = C \div (C + Ə) \times 100$. Consensus is expected to be at least 80% (Miles & Huberman, 1994).

Quantitative Data Analysis

Mann-Whitney U, Welch t-test, ANOVA, and Shapiro-Wilk tests were used in the SPSS statistical program for significance tests of quantitative data.

Table 1. Mann-Whitney U test results of problem-solving skill scores according to the teaching method applied

Group	n	Row Total	Rank Mean	U	Z	p	d
Experiment	22	571.50	25.98	99.50	-2.916	0.004	1.00
Control	19	289.50	15.24				

Table 2. Experimental group averages in the problem-solving steps teacher observation form

	Problem Solving Steps															
Statistics	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
N	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
$\bar{X}$	.95	.86	.68	.68	.90	.40	.63	.77	.68	.5	.86	.27	.63	.72	.81	.40

Findings

This section presents the findings of the study conducted to examine the effect of UbD on students' problem-solving, collaboration skills, and academic achievement. The findings were analyzed according to the four sub-problems of the research, respectively.

Investigation of the Effect of Understanding by Design Model (UbD) on Students' Problem-Solving Skills

Problem-Solving Skills Scale: To compare the mean total problem-solving skill scores of the students in the experimental group using the UbD method and the students in the control group using the traditional method, the normality of the distributions was first analyzed with the Shapiro-Wilk test, and it was determined that the experimental group score distributions were not normal ($S\text{-}W_{deney(22)} = 0.856$, $p = 0.004$; $S\text{-}W_{kontrol(19)} = 0.953$, $p = 0.439 > 0.05$). Accordingly, Mann-Whitney U test, which is a nonparametric test, was used to compare the averages. The results of the analysis are given in Table 1.

According to the Mann-Whitney U results shown in Table 1, there was a statistically significant difference between the mean problem-solving skill scores of the experimental and control group students ($U = 99.50$, $p<0.05$, $d = 1.00$). According to the rank averages, there was a significant difference in favor of the experimental group students. The effect size $d = 1.00$ has a value greater than 0.8, in other words, the significant difference between the mean problem-solving skill scores of the experimental and control group students is quite high.

Problem-Solving Steps Teacher Observation Form: The 16-item observation form, which was prepared to observe processes such as defining the problem, data collection and synthesis, utilizing previous knowledge, investigating the source of the problem, identifying possible solutions, deciding on the appropriate one, determining the cause-effect relationship, and making observations, was completed by the experimental group classroom teacher. Table 2 shows the results of the problem-solving steps observation form filled out by the class teacher of the experimental group.

It is observed that the rate of realization of the problem-solving steps by the 22 students in the class is generally quite high. Among the sixteen problem-solving steps in the students' observation form, 'defining the problem (.95)' ranked first, 'utilizing previous knowledge (.90)' ranked second, and 'applying the solution result (.86)' ranked third. According to the teacher observation results, the rates of 'producing different solutions (.40)', 'investigating the source of the problem (.40)', and 'verifying the result (.27)' are at the bottom of the problem-solving steps in which students were observed.

Investigation of the Effect of Understanding by Design Model (UbD) on Students' Collaboration Skills

Cooperative Work Scale: To test the significant difference between the cooperative work skills of the experimental and control group students, a normality test was performed to determine how the data were distributed. It was determined that the collaborative skill scores of both groups were normally distributed ($S\text{-}W_{test(22)} = 0.951$, $p = 0.337$; $S\text{-}W_{control(19)} = 0.966$, $p = 0.693$). In addition, the homogeneity of the variances of the measurements was also examined by Levene's test and it was determined that the condition of homogeneity of variances was not met ($F = 12.265$; $p = 0.001$). In this context, Welch's t-test, which is a parametric test, was applied (Table 3). According to the results obtained, it was determined that there was a statistically significant difference between the mean cooperative learning skill scores of the students in the experimental and control groups ($t_{(23.96)} = 5.073$; $p<0,05$). According to the cooperative learning scores of the groups, the cooperative learning scores of the students in the experimental group ($\bar{X}=3.46$) were higher than the students in the control group ($\bar{X} = 2.77$). The effect size is large with Cohen's $d = 1.67$.

Table 3. Welch's t-test results of collaborative skill scores according to the applied teaching method.

Group	**n**	$\bar{X}$	**SS**	**Sd**	**t**	**p**	**d**
Experiment	22	3.46	0.24	23.96	5.073	<0.001	1.67
Control	19	2.77	0.55				

Table 4. Cooperative learning rubric experimental group averages

Statistics	**Collaborative Work Categories**					
	Working with Others	**Quality of the work**	**Quality of the work**	**Focus on the task**	**Preparedness**	**Group activity monitoring**
N	22	22	22	22	22	22
$\bar{X}$	2.40	2.22	2.27	2.5	2.31	2.27

Table 5. Descriptive statistics for the experimental and control group achievement test results

Measurements	Experimental Group			Control Group		
	N	X̄	SS	N	X̄	SS
Pre-test	22	0.50	0.17	19	0.58	0.14
Final test	22	0.87	0.08	10	0.74	0.15

Table 6. Shapiro-Wilk test results for experimental and control group pre- and post-test score distributions

Measurements	Experimental Group			Control Group		
	S-W	sd	P	S-W	sd	p
Pre-test	0.917	19	0.102	0.915	22	0.061
Final test	0.959	22	0.461	0.950	19	0.390

Table 7. ANOVA results of pretest and posttest scores of the experimental and control groups

Variance source	Sum of squares	sd	Mean squares	F	p	(η^2)
Between subjects	1.178	40	0.038			
Group	0.008	1	0.008	0.262	0.612	0.007
Error	1.170	39	0.030			
Within subjects	1.935	41	1.619			
Measurement	1.401	1	1.401	168.374	<0.001*	0.812
Group*Measurement	0.210	1	0.210	25.282	<0.001*	0.393
Error	0.324	39	0.008			
Total	3.113	81				

*p<0,05

Cooperative Learning Rubric

The collaborative work status of the experimental group is presented in Table 4 according to the results of the collaborative work rubric. Although the highest score that can be obtained according to the collaborative work categories is four, all scores were filled in individually by the group class teacher according to the observation results for each student. It is observed that the average scores of the 22 students in the class are close to each other in each category. However, in the collaborative work categories, it is seen that the highest mean scores of the students are in the category of 'focusing on the task (2.50)' and the lowest in the category of 'quality of work (2.22)' out of four points.

Investigation of the Effect of Understanding by Design Model (UbD) on Students' Academic Achievement

Descriptive statistics for the pre-test and post-test scores obtained during the implementation process in the experimental and control groups are given in Table 5.

When the pre-test and post-test averages applied during the research are analyzed in Table 5, it is seen that the achievement averages of both groups increased, and the increase in the experimental group was higher. The group, instructional strategy, or the interaction of group and instructional strategy may have been effective in the increases in these mean scores. In this context, in this study in which two different teaching methods were used, a two-way analysis of variance for mixed measures was conducted to determine whether there was a significant difference between the students' achievement scores before and after the application. To test the assumptions of the test before the analysis, the normality of the distributions of the measurements of the dependent variable, the equality of the covariances of the groups, and the equality of the variances of the measurements obtained from different groups were tested, respectively. Since there were only two measurements, the assumption of sphericity was not tested. The normality test results for the distributions of the scores in each pore are presented in Table 6.

Table 6 shows that the experimental and control group pre- and post-test score distributions are normal at a 0.05 confidence level. As a result of the Box'M Test for covariance equality, which is another assumption, it was determined that this assumption was met ($F_{(4.1090723.031)} = 3.128$, $p = 0.025 > 0.01$). As a result of the Levene's Test conducted to determine the equality of variances in the measurements of the different groups, the condition of equality of variances was met in the pre-test measurements but not in the post-tests (Pre-test: $F_{(1.39)} = 1.082$, $p = 0.305$; Post-test: $F_{(1.39)} = 4.995$, $p = 0.031$). However, Stevens (1996, p. 249) stated that analysis of variance is highly resistant to violations of this assumption when sample sizes are close to each other ($n1/n2 < 1.5$).

The results of the two-way analysis of variance for mixed measures to test whether there is a significant difference between the achievement scores of the students before and after the application of the teaching strategies are given in Table 7.

As seen in Table 7, there was no significant difference between the mean scores of the experimental and control groups without test distinction ($F_{(1.39)} = 0.262$; $p = 0.612 > 0.05$). When the effect of measurement was tested, in other words, a significant difference was detected when the pre-test and post-test mean scores were compared regardless of the groups ($F_{(1.39)} = 168.374$; $p < 0.01$, $\eta 2 = 0.812$). When the common effect of measurement and group was taken into account, it was determined that there was a significant difference between the averages ($F_{(1.39)} = 25.282$; $p < 0.01$, $\eta 2 = 0.393$). According to this situation, it was determined that the change in pre-test and post-test score averages differed with the method applied in the test and control groups. In other words, the interaction of different teaching methods and measurements was found to be significant. In the experimental group, while the pre-test mean was $\bar{X} = 0.50$, the post-test mean was $\bar{X} = 0.87$ and a higher increase was obtained

compared to the control group. According to this, being in the experimental group where UbD teaching was applied and being in the control group where the traditional method was applied had a different effect on student achievement. This effect can be said to be a moderate effect ($\eta 2 = 0.393$). As a result, students showed a higher increase in achievement in the environment where UbD-based teaching was applied.

Investigating the Effects of Understanding by Design Model (UbD) on Students' Problem Solving, Collaboration, and Academic Achievement from the Views of Classroom Teachers

After the implementation, semi-structured interviews consisting of 10 questions were conducted with 4 teachers in the experimental group. Similar codes were thematized by content analysis and descriptive analysis of the qualitative data. The themes that emerged according to the findings of the interviews with the four teachers in the experimental group were 'Opinions about UbD', 'The effect of UbD on problem-solving skills', 'The effect of UbD on collaborative work', 'The effect of UbD on academic achievement', 'The effect of UbD on students' attitudes towards the course', and 'The contribution of UbD to the learning process'. While analyzing the data, the support of the interview data for the research hypotheses, the support of the literature, the support of similar interviews, and the main theme of the interview were examined.

T1, who taught as a classroom teacher in the experimental group, expressed a positive opinion about the implementation process of UbD and stated that it contributed especially to interest and motivation in the lesson. He stated that he did not have a direct observation about the effect of UbD on problem-solving skills, but the effect of UbD on collaborative work can be observed, especially in group work. She reported that the effect of UbD on academic achievement and attitudes towards the course was positive since students were active in the learning process. T1, who stated that UbD contributed to the learning process, stated that it would be very useful to carry out the whole curriculum planning in this way, especially in terms of reaching the target.

T2, who taught as a physical education and game lesson teacher in the experimental group, expressed a positive opinion about the implementation process of UbD because it increased the motivation of the students. He stated that he had no idea about the effect of UbD on problem-solving skills and academic achievement. He stated that the positive effects of UbD on collaborative work were seen, especially in team games and acting in groups. In addition, she stated that students' motivation towards the learning process increased with UbD practices, and that the application was positively effective.

T3, who conducts the English lessons of the class, stated that there were positive reflections on the implementation process of UbD and students' motivation towards the learning process. She stated that there was a noticeable improvement in the group work and problem-solving skills of the students, who had previously experienced conflicts while working together. In addition, she stated that it contributed positively to students' attitudes towards the course, that students enjoyed the activities and were more enthusiastic about expressing themselves.

T4, who conducted the mind games and thinking skills course in the experimental group, stated that the students eagerly awaited the next lessons after the application. She also stated that it positively affected students' problem-solving and cooperative working skills. T4 stated that the fact that the students were actively involved in the process directly in UbD increased their motivation towards the lesson, and that the students expressed this. It was suggested by T4 that it would be more beneficial to continue the application not for a limited period but to cover the whole process.

Discussion and Conclusion

In this study, four sub-problems were examined to examine the effect of the Understanding by Design Model (UbD) on students' problem-solving, collaboration skills, and academic achievement in the fourth-grade social studies course. In this section, the results of the research are discussed in the light of the research findings.

In the study, it was concluded that the Understanding by Design Model had a high impact on students' problem-solving skills. The findings obtained from the opinions of the teachers who participated as observers in the study show that the students were in very good condition, especially in the sub-dimensions of defining the problem, utilizing previous knowledge, and reflecting on the skill. Similar to this result, Durmaz's (2014) study on the problem-solving strategies of gifted students concluded that UbD contributed to students' problem-solving skills. In addition, Chaisa and Chinokul (2021) reported in their research results that the lessons conducted with a rotational design improved thinking skills. In parallel with the observation result of the study, Gloria et al. (2019) reported that UbD had a positive effect on students' mental habits. It is thought that the positive effect of UbD on problem-solving skills is related to the knowledge and skill objectives set by the designer teacher at the beginning of the process. The basic questions created for these objectives are designed to encourage students to actively use their thinking skills. UbD is accepted as a way of careful thinking beyond being a program that sets rules (Wiggins & McTighe, 2005). In connection with all these, it can be said that it also contributes to the development of problem-solving skills.

In the study, it was concluded that the effect of the Understanding by Design Model (UbD) on collaboration skills was positive and significant. Based on the observations of the group teacher, it is thought that the students were better in the categories of focusing on the task and working with others. Similar to the results of this study, Florian and Zimmerman (2015) found that UbD had a positive effect on students' collaboration and effective communication skills. The methods and techniques used in UbD, such as Jigsaw, RAFT, station studies, etc., in the process and result-oriented evaluation stages (Dündar & Erdağı, 2023) are thought to have a positive effect on the development of collaboration skills as group work supports collaborative work. In addition, the designs prepared by students in small groups during the UbD process, in-group sharing, and working together towards the same goal (Wiggins & McTighe, 2005) are among the factors that contribute to this process.

In the study, the effect of the Understanding by Design Model (UbD) on students' academic achievement was examined, and it was concluded that the increase in achievement was higher in the experimental group, where UbD teaching was carried out, compared to the control group. Like this result, Geylan (2023) conducted a study with 10th-grade students to investigate the effects of UbD and concluded that students' academic achievement increased. Andrews (2013) reported that UbD had a positive effect on student

achievement scores. There are many studies with similar results in the literature (Keskin Çinkaya, 2022; Rubrica, 2018; Tshering, 2022; Uyguç, 2022; Yurtseven, 2016). The comprehension step, which is one of the basic concepts of UbD, is monitored through six basic indicators, and corrections related to the process are made continuously (Wiggins & McTighe, 2005). In addition, the eight basic principles of UbD include the process of deepening and developing what is learned through 'big ideas' (Tomlinson & McTighe, 2007). All these approaches in the philosophy of UbD are carried out by focusing on permanent understanding. In this context, it is thought that plans prepared with UbD contribute to student achievement.

In the study, the teachers whose opinions were taken to determine the effect of the Understanding by Design Model (UbD) on students' problem-solving, collaboration, and academic achievement generally reported that the application had a positive effect on problem-solving and collaboration skills and increased students' academic achievement. In addition, they stated that students' interest and motivation toward lessons and their active participation increased as a result of UbD practices. There are studies to support this result. There are many research results similar to this study in the categories of increasing student motivation after UbD implementation (Boozer, 2014; Chaisa & Chinokul, 2021; Gül et al., 2021; Özdemir, 2021), developing positive attitudes towards the course (Geylan, 2023), and active participation (Som et al., 2016; Uluçınar, 2021).

Recommendations

According to the results obtained from this study, some suggestions can be made. First of all, considering the positive effects of UbD on students, the application can be made widespread throughout the country by piloting it at various levels and in different disciplines in certain regions. Teachers can be supported to increase their knowledge and competencies in this field by providing in-service training on UbD. In this way, awareness of teaching methods and techniques used in UbD, and traditional and alternative assessment and evaluation tools can be increased. Educators can be made aware of process- and outcome-oriented measurement and its reflections on the teaching process. Digital platforms that can be actively used within the scope of this subject can be created to increase UbD practices and to enable UbD practitioners to share and collaborate.

The study is limited to a five-week UbD study conducted with a total of 41 fourth-grade students in a primary school. The research data were collected from the students of the applied branch and the teachers whose opinions were taken. In this context, it is thought that the results of the study on student achievement, problem-solving, and collaborative work will be a guide for other researchers, and it is recommended that UbD research be increased quantitatively.

Author Contributions

This study was developed based on a master's thesis. The first author is the thesis owner, and the second author is the thesis advisor.

Ethical Declaration

Before the research, "Ethics Committee Approval" was obtained from Kırıkkale University regarding the ethical suitability of the research (document date and meeting number: 23.08.2023, 186467).

Conflict of Interest

Both researchers confirm that there is no conflict of interest in the study.

References

Altun, S. ve Yurtseven, N. (2020). *Tasarımcı Öğretmen* (2.Baskı). ASOS Yayınları.

Andrews, A. (2013). *Development and use of essential learning goals and their effect on student achievement in grades two through five* [Doctoral dissertation, St. Louis: University of Missouri]. https://irl.umsl.edu/dissertation/282

Binkley M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M. & Rumble, M. (2012). Assessment and teaching of 21st-century skills. *Dordrecht: Springer,* 17-66. http://dx.doi.org/10.1007/978-94-007-2324-5_2

Baltacı, A. (2018). Nitel araştırmalarda örnekleme yöntemleri ve örnek hacmi sorunsalı üzerine kavramsal bir inceleme. *Bitlis Eren Üniversitesi Sosyal Bilimler Enstitüsü Dergisi,* 7(1), 231-274.

Bodur, Z. T. ve Yurtseven, N. (2021). İngilizce dersinde UbD temelli yaratıcı drama etkinliklerinin öğrenciler üzerindeki yansımalarının incelenmesi. *Yaşadıkça Eğitim, 35*(1), 88-103.

Bolat, Y. (2021). *Yaşam becerileri eğitimi* (1.Baskı). Ankara: Pegem Akademi.

Boozer, A. (2014). *Planning backwards to go forward: Examining pre-service teachers' use of backward design to plan and deliver instruction* [Doctoral dissertation, Arizona State University]. http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:3618183

Burak, D. (2020). *İlkokul sosyal bilgiler öğretimine yönelik uyarlanabilir bir öğrenme ortamının tasarlanması, uygulanması ve değerlendirilmesi* [Yayınlanmamış doktora tezi, Eskişehir: Anadolu Üniversitesi Eğitim Bilimleri Enstitüsü. tez.yok.gov.tr

Büyüköztürk, Ş., Çakmak, E., Akgün, Ö., Karadeniz, Ş. ve Demirel, F. (2021). *Eğitimde bilimsel araştırma yöntemleri* (31.Baskı). Ankara: Pegem Akademi.

Chaisa, P. & Chinokul, S. (2021). Effects of reading instruction using backward design framework and citizenship theme to enhance English reading comprehension and social responsibility of tenth-grade Thai EFL students. *LEARN Journal: Language Education and Acquisition Research Network.14*(1), 176-207. https://so04.tcithaijo.org/index.php/LEARN/article/view/248688/168992

Durmaz, B. (2014). *Üstün yetenekli ilköğretim öğrencilerinin problem çözme stratejilerini öğrenme düzeyleri* [Doktora tezi, Bursa: Uludağ Üniversitesi Eğitim Bilimleri Enstitüsü]. tez.yok.gov.tr

Dündar, H. ve Erdağı T. (2023) *Eğitimde büyük fikirler ilkokulda anlamaya dayalı tasarım (UbD) uygulamaları* (1.Baskı). Ankara: Pegem Akademi.

Ekiz, D. (2020) *Bilimsel araştırma yöntemleri* (6.Baskı). Ankara: Anı Yayıncılık.

Florian, T. P. & Zimmerman, J. P. (2015). Understanding by Design, moodle and blended learning: A secondary school case study. *MERLOT Journal of Online Learning and Teaching, 11*(1), 120-129.

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction* (6th ed.). Longman Publishing.

Geylan, H. A. (2021). *Ekosistem ekolojisine yönelik anlamaya dayalı tasarımın başarı, tutum ve kalıcılığı etkisi* [Doktora tezi, Ankara: Gazi Üniversitesi Eğitim Bilimleri Enstitüsü]. tez.yok.gov.tr

Gloria, R. Y., Sudarmin, Wiyanto & Indriyanti, D. R. (2019). Applying formative assessment through Understanding by Design (UbD) in the lecture of plant physiology to improve the prospective teacher education students' understanding. *Journal of Turkish Science Education, 16*(3), 350-363. https://doi:10.1088/1742-6596/983/1/012158

Gül, M., Altun, S. ve Yücel Toy, B. (2021). Anlamaya dayalı tasarım uygulamasının (Ubd) öğrencilerin bilişsel ve duyuşsal gelişimlerine etkisi: T.C. inkilap tarihi ve Atatürkçülük dersi üzerine bir çalışma. *Van Yüzüncü Yıl Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 51*, 123-152.

Karasar, P. D. (2016). *Bilimsel araştırma yöntemi: Kavramlar ilkeler teknikler* (38.Baskı). Ankara: Nobel Yayın.

Keskin Çinkaya, Y. (2022). *Anlamaya Dayalı Tasarım (UbD) temelli ters-yüz edilmiş sınıf modelinin, kimya derslerinde öğrenciler üzerine etkisinin incelenmesi* [Yüksek Lisans tezi, İstanbul: Bahçeşehir Üniversitesi Eğitim Bilimleri Enstitüsü.]. tez.yok.gov.tr

Miles, M, B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded Sourcebook.* (2nd ed). Thousand Oaks, CA: Sage.

Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu. (2023). Sosyal bilgiler dersi öğretim programı (ilkokul ve ortaokul 4, 5, 6 ve 7. sınıflar). Ankara: Milli Eğitim Bakanlığı.

Millli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı. (2005). Sosyal Bilgiler 4.-5. sınıf programı. Ankara: Milli Eğitim Bakanlığı.

Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı. (2015). Sosyal bilgiler dersi 4, 5, 6 ve 7. sınıflar öğretim programı. Ankara: Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı.

Önger, S. (2019). İşbirliği. B. Aksoy, B. Akbaba ve B. Kılcan (Ed.), *Sosyal bilgilerde beceri eğitimi* (s. 277) içinde. Ankara: Pegem Akademi Yayınları

Özdemir, C. (2021). *Hayat bilgisi dersinde yer alan sorumluluk değeri ve iş birliği becerisinin kazandırılmasında uzman mantosu yaklaşımının etkisi* [Doktora tezi, Trabzon: Trabzon Üniversitesi Lisansüstü Eğitim Enstitüsü.]. tez.yok.gov.tr

Özdemir, E. (2021). *UbD temelli farklılaştırılmış fen bilimleri derslerinin öğrencilerin motivasyonlarına, bilimsel süreç becerilerine ve akademik başarılarına etkisinin incelenmesi* [Yüksek Lisans tezi, İstanbul: Bahçeşehir Üniversitesi Eğitim Bilimleri Enstitüsü.]. tez.yok.gov.tr

Özdemir, E. ve Yurtseven, N. (2023). UbD temelli farklılaştırılmış fen öğretiminin öğrencilerin motivasyonlarına, bilimsel süreç becerilerine ve akademik başarılarına etkisi. *Ulusal Eğitim Akademisi Dergisi 7*(1), 1-16.

Öztürk, C. (2009). *Sosyal bilgiler öğretimi* (1.Baskı). Ankara: Pegem Akademi Yayınları.

Punch, K. F. (2020). *Sosyal araştırmalara giriş* (5.Baskı). Ankara: Siyasal Kitabevi

Rubrica, R. D. (2018). *An actıon research on project-based learning and understandıng by desıgn and theır effects on the science achıevement and attitude of science students* [Doctoral dissertation, Phılıppınes: Caloocan Cıty]. https://files.eric.ed.gov/fulltext/ED585254.pdf

Sezgin, E. (2011). *Problem çözme becerisi ölçeğinin geliştirilmesi* [Yüksek Lisans tezi, Ankara: Ankara Üniverstesi Eğitim Bilimleri Enstitüsü]. tez.yok.gov.tr

Som, İ., Türkan, A. ve Altun, S. (2016). UbD modeline göre Eğitim Bilimlerine Giriş dersinin tasarlanması: Öğretmen adaylarının başarı, tutum ve derse ilişkin görüşlerinin değerlendirilmesi. *International Journal of Social Sciences and Education Research 2*(4), 1341-1351.

Şimşek, U., Topkaya, Y. ve Şentürk, M. (2022). 21. Yüzyıl becerileri ve eğitimi. M. Şentürk, U. Şimşek ve Y. Topkaya (Ed.), *Yenilikçi yaklaşımlarla 21.yüzyıl becerileri eğitimi* (s. 2) içinde. Ankara: Vizetek Yayıncılık.

Tomlison, C.A. & McTighe, J. (2007). *Integrating differentiated instruction understanding by design: connecting content and kids* (2nd edition). Alexandria, Virginia USA: Association for Supervision and Curriculum Development.

Tshering, S. (2022). The impact of using Understanding by Design (UbD) model on class 10 student's achievement in chemistry. *International Journal of Chemistry Education Research, 6*(1), 29-33. https://doi: 10.20885/ijcer.vol6.iss1.art4

Uluçınar, U. (2021). Findings of qualitative studies on Understanding by Design: A meta-synthesis. *International Journal of Curriculum and Instructional Studies, 11*(2), 167-194. https://doi.org/10.31704/ijocis.2021.009

Uyguç, H. O. (2022). *Tasarım yoluyla anlama modelinin 6. sınıf fen bilimleri dersindeki akademik başarı ve kalıcılığa etkisi* [Yüksek Lisans tezi, Gaziantep: Gaizantep Üniversitesi Eğitim Bilimleri Enstitüsü]. tez.yok.gov.tr

Wiggins, G. & McTighe, J. (2005). *Understanding by design* (2nd edition). Alexandria, Virginia USA: Association for Supervision and Curriculum Development.

Yurtseven, N. (2016). *Yabancı dil öğretiminde eylem araştırmasına dayalı UbD (Anlamaya dayalı tasarım) uygulamalarının öğretmenler ve öğrenciler üzerindeki yansımalarının incelenmesi* [Doktora tezi, İstanbul: Yıldız Teknik Üniversitesi Sosyal Bilimler Enstitüsü.]. tez.yok.gov.tr