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| Research Article / Araştırma Makalesi |

Comparison of Face-to-face and Distance Education Based on Incremental Self-theory in terms of Students' Academic Achievement, Self-confidence, and Motivation and Teacher Views[1]

Gelişim Öz-teorisine Dayalı Yüz Yüze ve Uzaktan Eğitimin Öğrencilerin Akademik Başarısı, Öz-güveni ve Motivasyonu Açılarından Karşılaştırılması ve Öğretmen Görüşleri [1]

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Keywords
1. Incremental self-theory
2. Face-to-face education
3. Distance education
4. Science lesson

Anahtar Kelimeler
1. Gelişim öz-teorisi
2. Yüz yüze eğitim
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4. Fen bilimleri dersi

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Abstract

Purpose: This study aimed to compare the effects of implementing activities and materials designed according to incremental self-theory in face-to-face and distance education teaching the cell and divisions unit in the 7th-grade science lesson on students' academic achievement, self-confidence, and motivation. Another aim is to gather the science teacher's views about the implementation process.

Design/Methodology/Approach: In the research, a sequential explanatory design, which is a type of mixed research method in which quantitative and qualitative research methods are used together, was used.

Findings: As a result of the research, significant differences were found in favor of the students who received face-to-face education in terms of academic achievement levels, and the students who received distance education in terms of motivation levels. There was no significant difference between the two groups regarding self-confidence levels. The teachers, also, stated that the designed education positively affected students' morale, and motivation toward the lesson.

Highlights: Within the scope of the research, it may be helpful to integrate the teaching process, which is designed in line with the incremental self-theory and does not interfere with the curriculum of any lesson, into other lessons and subjects where students have learning problems and low motivation.

Öz

Çalışmanın amacı: Bu araştırmada, 7. sınıf fen bilimleri dersi hücre ve bölünmeler ünitesinin öğretiminde gelişim öz-teorisine göre tasarlanan etkinlik ve materyallerin yüz yüze ve uzaktan eğitimle uygulanmasının öğrencilerin akademik başarı, öz-güven ve motivasyonlarına etkisinin karşılaştırılması amaçlanmıştır. Diğer bir amaç ise, uygulama sürecine katılan fen bilimleri öğretmenlerinin görüşlerinin alınmasıdır.

Materyal ve Yöntem: Araştırmada, nicel ve nitel araştırma yöntemlerinin bir arada kullanıldığı karma araştırma yönteminin bir çeşidi olan sıralı açıklayıcı desen kullanılmıştır.

Bulgular: Araştırmanın sonucunda, akademik başarı düzeyleri açısından yüz yüze eğitim uygulanan öğrencilerin lehine, motivasyon düzeyleri açısından ise uzaktan eğitim uygulanan öğrencilerin lehine anlamlı farklılıklar tespit edilmiştir. Öz-güven düzeyleri açısından ise iki grup arasında anlamlı bir farklılık görülmemiştir. Öğretmenler ise, tasarlanan öğretimin öğrencilerin derse karşı moral ve motivasyonlarını olumlu yönde etkilediğini ifade etmişlerdir.

Önemli Vurgular: Araştırma kapsamında gelişim öz-teorisi doğrultusunda tasarlanan uygulama süreci oldukça kolay olan ve hiçbir dersin müfredatına müdahalede bulunmayan bu öğretimin, öğrencilerin öğrenme problemi ve motivasyon düşüklüğü yaşadığı diğer ders ve konulara entegre edilerek uygulanması faydalı olabilir.

[1] This study was produced from the first author's doctoral thesis, and a part of the study was presented as an oral presentation at the 3rd International Science, Mathematics, Entrepreneurship and Technology Education Congress (Online), on 30 September-3 October 2021, Uludag University, Bursa, TÜRKİYE.

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INTRODUCTION

Since education has a highly interactive structure, it is a phenomenon that needs to be addressed together with the many elements it is related to (Bircan, 2018). In this context, efforts have been made to make education more qualified by considering the changing needs of the individuals who make up the society from past to present. In this regard, both the teaching programs and the strategies, methods, and techniques used have been tried to be developed through studies (Yıldız, 2016). Education is one of the services states must provide to their citizens in line with the principle of equality. In this regard, in case of geographical limitations, insufficient teachers, unsuitable learning environments, boarding education, bussed education, or distance education methods can be used to provide uninterrupted education. The distance education model is the most readily applicable of these methods as long as there is the necessary technical infrastructure (Kahraman, 2020).

In face-to-face education, the lessons specified in the curriculum are taught under the supervision of teachers, theoretically and practically, and in educational environments such as laboratories, classrooms, and workshops. In distance education, there is an educational method rather than an educational philosophy. The distance education process consists of a pre-prepared educational environment and teacher-student interaction. Technological developments also lead to significant consequences for the country and the result of the academic environment and interaction (Holmberg, 2005). Distance education students can continue regardless of location and time (Bates, 2005). Therefore, distance education contributes to equal opportunities in learning (Engelbrecht, 2005), and technology is a critical element of distance education (Bates, 2005). However, technological infrastructure and internet access may limit the fact that everyone can benefit equally from this education. Although the environments in which teachers and students are separated from each other are known as distance education, face-to-face meetings can be provided when necessary (Gunawardena & McIsaac, 2013).

Educational research adopted as face-to-face and distance application is conducted on various educational elements based on providing more effective and qualified education (Tutkun, 2010; Ural & Bümen, 2016). In this direction, many curriculums, teaching environments, models, and methods are developed and implemented (Nash, 2016; Nissim et al., 2016). In this context, one of the concepts that has emerged in recent years is the incremental self-theory. This theory is based on the view that a person's talent and intelligence level are characteristics that can be developed with sufficient and suitably focused effort (Boaler, 2013; Keenan, 2018; Orosz et al., 2017; Snipes & Tran, 2017). Individuals who believe that talents can be developed through good strategies, hard work, and the contributions of others have a growth mindset and tend to achieve more than individuals with a fixed mindset who believe talents are innate gifts (Dweck, 2016). According to Dweck (2016), this is related to individuals with a growth mindset focusing on learning rather than appearing bright. According to the incremental self-theory, not every individual is born with the same level of intelligence and talent. However, individuals with a growth mindset describe the difficulties they experience as opportunities for development and failures as helpful feedback to avoid making the same mistake again (Blackwell et al., 2007). In this context, it has been determined that a growth mindset increases the desire to learn (Burnette et al., 2020) and directs the person toward learning goals (Bempechat et al., 1991; Chen et al., 2020).

According to Dweck (2006), not only mental abilities but all human characteristics that people have can be improved with effort. Studies show that this belief of individuals who believe in the incremental self-theory affects their brain processes and closely affects their achievement (Mangels et al., 2006) and their ability to recover from mistakes by improving their awareness of mistakes (Moser et al., 2011; Schroder et al., 2017).

Incremental Self-theory and Science Education

In addition to having comprehensive content due to its structure, science education has a significant place in understanding and interpreting the natural world and creating critical and collaborative awareness in the light of scientific knowledge (De Melo et al., 2020). For this reason, the place of science subjects and concepts in the education process is essential. It is stated that the mindset, which is considered and discussed as an aspect of a person's identity in studies conducted within the framework of incremental self-theory, is an important variable that should be taken into account in future research on science and chemistry identity (Hosbein & Barbera, 2020). Spatz and Goldhorn (2021) found that incremental self-theory positively affects students' beliefs about learning physics. When taken together with the literature review results, all these issues show a need for new research to determine the effects of incremental self-theory on science and sub-disciplines.

In this research, which was conducted to determine the effect of applying this theory, whose effectiveness on learning has been demonstrated in line with the research in the literature, in face-to-face and distance education, activities designed according to the incremental self-theory within the scope of science lesson were applied both face-to-face and distance education. It has been determined that a few studies have been conducted in the domestic literature on incremental self-theory, especially in science education (Orhan & Aydın, 2021; 2022). There are many studies on this subject in the international literature, and new ones are added daily (King, 2020; O'Brien & Lomas, 2017; Rissanen et al., 2019; Seals, 2018; Sheffler & Cheung, 2020).

Confidence

One of the critical concepts reported to be influential on human behavior is self-confidence. Self-confidence, which is fundamentally rooted in one's self-respect, is one of the essential elements in attributing oneself as valuable (Malakcıoğlu, 2020). Heslin and Keating (2017) stated that concepts such as locus of control, self-esteem, self-confidence, and self-efficacy should be

considered to clarify the nature of the mindset. According to Dweck (2006), the self-confidence of people with a fixed mindset is more fragile due to the mindset they adopt in the face of problems and difficulties they experience.

Motivation

Motivation is one of the most critical factors affecting academic achievement (Mega et al., 2014; Robbins et al., 2006; West et al., 2016). The adopted mindset is reported to significantly affect the struggle, continuing the effort or giving up motivation, and reactions in case of failure (Dweck, 2000; 2006). Since individuals who believe in the entity self-theory believe that deficiencies in talent and intelligence are permanent, they define failure as a negative situation. They are negatively affected by it (Dweck et al., 1995). However, individuals who think that the characteristics in question can be improved are less affected by their failures because they define failure as an ordinary situation that may be encountered in the process (Aronson et al., 2002; Good et al., 2003). It is also reported that having a mindset that intelligence can be improved positively affects self-efficacy and motivation levels in addition to academic achievement (Bedford, 2017).

Similarly, Blackwell et al. (2007) also argue that students who focus on these potentials in line with the belief that intelligence can be developed will be positively affected in a motivational sense. Dinger and Dickhäuser (2013) state that the idea that intelligence can be developed will be beneficial in creating teaching environments that increase students' motivation. Similar studies in this direction show that adopting a growth mindset affects positively people through their motivational beliefs (Diseth et al., 2014; Ng, 2018; Rhew et al., 2018).

Importance of the Research

Throughout the historical process, many strategies, methods, and techniques have been used in the context of the education system, and new learning environments have made their importance felt in every period in line with the scientific and technological developments of the age and the changing needs of people (Yıldız, 2016). Since the education process is a service that the state provides equally to all its citizens, it is a necessary process that must continue uninterrupted. Especially in compulsory education, different methods such as bussed education, boarding school, or distance education can be used in places where educational institutions cannot be opened or when individuals cannot go to the educational institution. The easiest of these methods is the distance education model (Kahraman, 2020).

The method by which education and training activities will be carried out is determined and implemented within the framework of the education and training programs defined by the states within the scope of the education of their citizens. However, where the number of teachers cannot meet the number of students, increasing education and training costs, globalization, and the evolution of learning towards lifelong learning rather than a specific period may make distance education mandatory continuously or for particular periods (Urdan & Weggen, 2000). Recent extraordinary situations, such as epidemics and earthquakes..., similarly necessitate urgent distance education practices. Since distance education has become necessary, students' face-to-face and distance education views must be examined and evaluated in more detail on a lesson basis. Improvements must be made in the missing areas to make this education more useful to be carried out following its purpose and to eliminate the deficiencies compared to face-to-face teaching. As a result of the literature research, various studies were found in which student and teacher views were taken regarding the conduct of different lessons as distance education (Avcı & Güven, 2021; Aydın, 2022; Kahraman, 2020; Kan & Fidan, 2016; Karacaoğlu et al., 2021; Özkan, 2022; Pınar & Dönel-Akgül, 2020; Şirin & Tekdal, 2015; Yılmaz et al., 2021). However, no national or international study comparing the effects of applying incremental self-theory with face-to-face and distance education could be found. When the studies in the literature are examined, there are many studies with new ones being added day by day in the international literature on the incremental self-theory, which is described as one of the theories that are reported to be quite effective on various elements of education (Joo et al., 2019; Miyazawa, 2019) and it seems that these studies are pretty limited in the national literatüre. Therefore, this research is based on a self-theory that has been used limitedly in the national literature; unlike other studies, it is applied with two methods, face-to-face, and distance education, instead of a single application method, and the results are evaluated within the framework of academic achievement, motivation, and self-confidence, which can be considered among the essential elements in education. It fills a critical literature gap and provides valuable data to researchers who want to research this field later.

Purpose of the Research

This study compared the effects of implementing activities and materials designed according to incremental self-theory in face-to-face and distance education teaching the cell and divisions unit (CDU) in the 7th-grade science lesson on students' academic achievement, self-confidence, and motivation. Another aim is to gather the science teacher's views about the implementation process. For these purposes, answers were sought to the following research questions:

Instruction designed within the framework of incremental self-theory;

1. How do face-to-face and distance education impact students' academic achievement at CDU?
2. How do face-to-face and distance education impact students' self-confidence?
3. How do face-to-face and distance education impact students' motivation toward science learning?
4. What are teachers' views about implementing face-to-face and distance education?

METHOD

Model of the Study

The research used a sequential explanatory design, a mixed research method in which quantitative and qualitative research methods are used together. The first stage of the research was conducted with face-to-face education with 27 students studying at a public secondary school in the 2019-2020 academic year, and the last step was performed with distance education with 18 students studying at the same school in the 2020-2021 academic year, due to the COVID-19 pandemic. According to Creswell (2012), combining quantitative and qualitative methods in mixed-method research ensures a good understanding of the problem in the study. In the explanatory design, quantitative and qualitative data are collected sequentially in two stages (Creswell & Plano-Clark, 2015). In this design, primarily quantitative data is collected and analyzed, and then qualitative data is collected and analyzed. The analyses of the data obtained are interrelated and are usually combined in the interpretation and discussion sections (Baki & Gökçek, 2012). In this research, quantitative data were first collected and analyzed from face-to-face and distance education students. The findings obtained were explained and interpreted according to each research question. Qualitative data were then collected, analyzed, and interpreted by two teachers. In the last stage, the results obtained from the quantitative data were discussed, supported by qualitative data.

We used the quasi-experimental design with a pre-test and post-test control group in the quantitative part of the research, and we used the case study method in the qualitative aspect. A case study is a longitudinal approach that explains the current situation, examines and analyzes the communication between the factors affecting change and development, and shows the growth in the process (Best & Kahn, 2017). Quantitative research data were collected with the Cell and Divisions Unit Academic Achievement Test (CDUAAT), Self-confidence Scale (SCS), and Science Learning Motivation Scale (SLMS), and qualitative data were collected with a Written View Taking Form (WVTF).

Study Group

In determining the study group of the research, easily accessible case sampling was preferred because it provides practicality and speed to the study by quickly reaching the participants, saving energy, time, and financial resources (Bakırcı et al., 2016; Yıldırım & Şimşek, 2018). The research was conducted with students who continued their education activities in two 7th-grade branches of a public secondary school in a city center in the Western Black Sea Region. Among the reasons for choosing the 7th-grade level, it can be said that this age group is considered to be the period when secondary childhood ends and adolescence begins, and it is characterized as a period in which interpersonal relationships are developed. People focus on their search for identity (Selçuk et al., 2003). Additionally, some studies provide evidence that interventions aimed at creating a growth mindset are more effective at earlier levels of education (Ortiz-Alvarado et al., 2019). Therefore, it was decided that the 7th-grade level was suitable for this application, including interventions for students to develop a growth mindset.

The study group of the face-to-face application of the research, which was conducted in the first semester of the 2019-2020 academic year, consisted of students studying in the 7/F branch (N=27). In the application via distance education due to the COVID-19 pandemic, students studying in the 7/C addition (N=18) formed the study group. Branches were determined randomly. Information about the demographic characteristics of the study group is presented in Table 1.

Table 1. Demographic characteristics of students in the study group

	Branch	Gender			
		Female		Male	
		N	%	N	%
Face-to-Face Education	7/F	14	51.85	13	48.15
Distance Education	7/C	7	38.89	11	61.11

According to Table 1, 46.67% (21) of students are female and 53.33% (24) are male. The other research participants are two science teachers who participated in the face-to-face and distance education process with the students. Information about teachers is given in Table 2.

Table 2. Information about teachers

Teacher	Application Process	Branch
Teacher 1	Face-to-Face Education	7/F
Teacher 2	Distance Education	7/C

Data Collection Tools

The data collection tools used in the research are the Cell and Divisions Unit Academic Achievement Test (CDUAAT), Self-Confidence Scale (SCS), Science Learning Motivation Scale (SLMS), and Written View Taking Form (WVTF) used to obtain teachers' views about these practices.

Cell and Divisions Unit Academic Achievement Test (CDUAAT)

Researchers developed CDUAAT to determine the knowledge levels of students receiving face-to-face and distance education about CDU before and after the designed application within the scope of the relevant unit. CDUAAT has been prepared by considering the achievements of the appropriate team. Information regarding the validity and reliability of CDUAAT developed in this context is presented under the headings below. To determine the construct validity of CDUAAT, the achievement test was applied to 185 students from the 8th grade who were not included in the research group, and the obtained data were analyzed. CDUAAT was examined in terms of item discrimination and item difficulty values, and considering that five questions were easy and had low bias, it was deemed appropriate to remove them from the test in line with expert opinion, and they were reduced from 25 questions to 20 questions.

CDUAAT test items were prepared based on eight achievements determined for the unit discussed and contain 25 questions. Within the framework of content validity, the test was subjected to necessary corrections in line with the expert views and suggestions of two science teachers and two faculty members. As a result of the construct validity study, CDUAAT was reduced to 20 questions and was finalized to include at least one question for each outcome, thus ensuring both content and construct validity. The achievements associated with each question in CDUAAT (MoNE, 2018) are given in Table 3.

Table 3. Distribution of each question in CDUAAT according to acquisitions

Subject	Acquisition	Question Number	Total
1. Cell	Compares animal and plant cells in terms of their essential parts and functions.	2, 3, 4, 8, 16	5
	Discusses views on the cell structure from past to present, relating them to technological developments.	5	1
	Explains the cell-tissue-organ-system-organism relationship.	6	1
2. Mitosis	Explain the importance of mitosis for living things.	7, 13	2
	Explains that mitosis consists of different stages that follow each other.	10, 18	2
3. Meiosis	Explain the importance of meiosis for living things.	1, 9	2
	Shows on the model how meiosis occurs in reproductive mother cells.	17, 20	2
	Compares the differences between meiosis and mitosis.	11, 12, 14, 15, 19	5
		Total	**20**

In evaluating the questions in CDUAAT, questions answered correctly were scored 1 point, and questions left blank or answered incorrectly were scored 0 points. The data obtained from the developed test was subjected to reliability analysis with the SPSS 28.00 statistical package program, and the results are presented in Table 4.

Table 4. Reliability analysis data of CDUAAT

N	$\bar{X}$	Median	Sd	Average Difficulty (p_j)	Average Discrimination (r_j)	Reliability (KR-20)
20	13.14	20.49	4.53	.62	.56	.88

According to Table 4, it was determined that the *r*j value of the developed achievement test was .56, the pj value was .62, and the KR-20 reliability value was .88. The test was deemed appropriate to be used in the research in its final form. In this context, it is stated that for the designed test to be considered a reliable test, the reliability value of that test must be .70 and above (Büyüköztürk, 2011).

Self-confidence Scale (SCS)

Self-confidence Scale (SCS) was introduced to the literature by Akın (2007). It contains 33 five-point Likert-type items, including internal self-confidence (17) and external self-confidence (16), in response to the items on the scale, 1=Never, 2=Rarely, 3=Often, 4=Usually, and 5=Always. According to this scoring, a minimum of 33 and a maximum of 165 points can be obtained from the scale. The Cronbach Alpha value of the scale was determined as .91 by Akın (2007). For this research, the scale was applied to 185 8th-grade students who were not included in the study group, and the reliability value was recalculated as .95 and used in the research.

Science Learning Motivation Scale (SLMS)

SLMS was developed by Dede and Yaman (2008) to determine students' motivation levels for learning science. The scale contains a total of 23 items in a five-point Likert type. In response to the items on the scale, 1=Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, and 5=Strongly Agree. While the maximum score that can be obtained from the scale is 115, the minimum score that can be obtained is 23. According to the results of the exploratory factor analysis conducted to determine the scale's

validity during the development phase, it is reported that the factors explain 47% of the total variance in the five-factor scale. In this regard, the scale's reliability coefficient value (Cronbach Alpha) was determined to be .80 (Dede & Yaman, 2008). Necessary permissions were obtained for the use of SLMS within the scope of the research. A preliminary application was made with 185 8th-grade students not included in the study group. Its reliability was found to be .89. It was deemed appropriate to use SLMS in this form in the research.

Written View Taking Form (WVTF)

The teachers' views in the groups where the teaching was designed according to face-to-face and distance education based on the incremental self-theory was implemented, regarding this process after the implementation was completed, were taken with the prepared WVTF. Expert opinion was born for this open-ended question, designed before taking the teachers' views, and the necessary arrangements were made in line with their suggestions. Questions are "What are your thoughts about the applicability of the prepared activities? Can you evaluate the changes you noticed in your students after the application?".

Design of the Application

To determine the effect of the face-to-face and distance education applications of the activities prepared based on the incremental self-theory on students' academic achievement, self-confidence, and motivation toward science learning in the relevant unit, it was deemed appropriate to carry out the application period for five weeks, four lessons per week, and 20 lesson hours in total. In both applications, the lessons were taught by the course teacher and the researcher. In this way, it was tried to make the students feel comfortable, and it was aimed to minimize the effect of the researcher.

Design of Face-to-Face Education Application

The face-to-face application phase of the research was conducted in the first semester of the 2019-2020 academic year. The face-to-face application was completed during the research process, where the science lesson was designed and implemented within the scope of CDU. It aimed to identify possible deficiencies and determine the feasibility and effectiveness of the planned activities. The face-to-face application process of the research is shown in Figure 1.

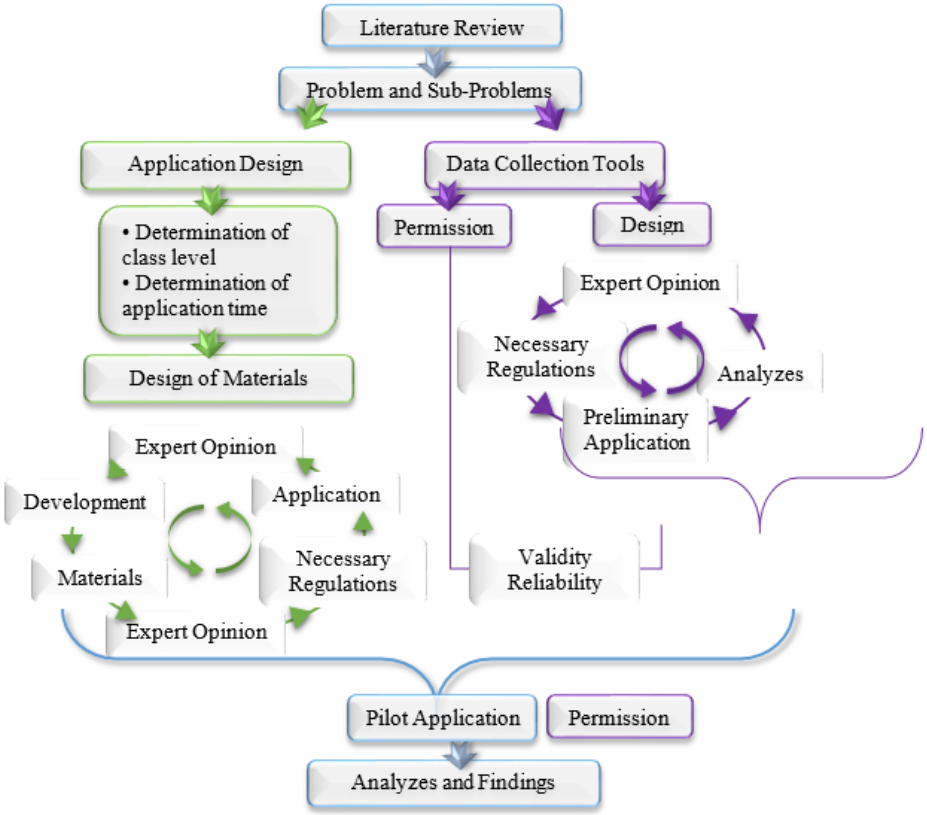

Figure 1. Face-to-face education implementation process

As seen in Figure 1, the measurement tools were first applied as a pre-test to the students in the 7/F branch, where face-to-face application was carried out. Later, in addition to the 2018 Science Curriculum, activities and materials designed based on incremental self-theory were used. After the application, the same tests and scales were applied again as a post-test. After the face-to-face education process was completed, the COVID-19 pandemic emerged. In this regard, adaptation and updating studies were carried out on the current situation after determining the situation and expert views.

Design of Distance Education Application

The measurement tools used in face-to-face application, lesson plans designed for students in the 7/C branch designated as distance education, and additional materials have been updated to be integrated into distance education. In this regard, the scales used within the scope of the research were converted into a format that can be applied in distance education via the Microsoft Office Forms program. The process followed in distance education application is given in Figure 2.

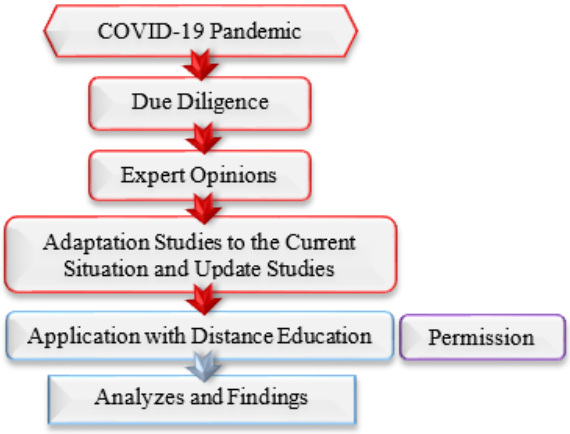

Figure 2. Distance education implementation process

In line with the process specified in Figure 2, the implementation phase for distance education was carried out with students studying in the 7th grade in the secondary school, where face-to-face application was carried out in the first semester of the 2020-2021 academic year. The process was carried out as specified in the face-to-face application, and unlike the face-to-face application, activities, and materials adapted to distance education were used. Examples of activities and materials used in both face-to-face and distance education are given below.

Feedback Sentences

Feedback sentences are frequently used in learning environments, provide information about the learning process to both the teacher and the student, and are very effective on students (Peker, 1992; Sönmez, 1994). As an example of the feedback to be given within the scope of incremental self-theory, Dweck (2006) suggests giving the following types of feedback to students who choose a challenging project in science class;

"I love that you chose a challenging project in science class. You will have to work hard; You'll need to research, design tools, get the necessary parts, and set up experiments. You will learn so much, amazing things…"

For questions that students solve quickly, it is recommended to use feedback of the type given below. According to Dweck (2006), lowering the bar so students can solve questions more efficiently does not make students more successful. In this context, it is recommended that students be given similar feedback as stated below.

"I guess this was very easy for you. Sorry for wasting your time. Let's learn something new."

For the same purpose, the use of feedback sentences for face-to-face and distance education students, which are stated below, may prevent students from adopting a growth mindset and encourage them to think with a fixed mindset by praising their intelligence when their efforts should be applauded, has been avoided.

- That was an intelligent answer, congratulations.
- You are brilliant, well done.
- …… your friend was brilliant and could solve the question immediately.
- The most brilliant student in this class…

Role Model Activities

The successes, efforts, and life stories of individuals defined as role models inspire many others (Dweck, 2006). Within the scope of the cell and divisions unit, role model activities designed according to incremental self-theory were used to help students develop growth mindsets. In this context, four people were identified, each of whom can be considered a role model in their field. These are American inventor and businessman Thomas EDISON, Joanne Kathleen ROWLING, author of the fantasy novel series Harry Potter, famous Physicist Albert EINSTEIN, and American voice actor, animator, producer, screenwriter, and director Walt DISNEY. A poster was designed containing statements about the failures these individuals, each defined as geniuses in their fields, had to struggle with before achieving these successes (Figure 3).

Figure 3. Example of a poster prepared for the role model activity

Cartoons

A platform called Class Dojo was used for the cartoons used within the scope of the application. Briefly, Class Dojo is an open-access communication platform for teachers, students, and families, where students create communities by sharing what they have learned in class through messaging, pictures, and videos when they go home. There are also cartoons on this platform aimed at developing a growth mindset. The researcher translated these cartoons, whose original language was English, and the translated expressions were added to the cartoons as speech bubbles. An example of Class Dojo is shown in Figure 4. The cartoons, rearranged in this form and consisting of five parts, have been uploaded to the channel created on YouTube and made available to the user, and the links to the cartoons are given below.

- Section 1: https://youtu.be/iNd1FEkQHhY
- Section 2: https://youtu.be/WYXxVDnBakE
- Section 3: https://youtu.be/FG3fBdCK3SU
- Section 4: https://youtu.be/NSV2cJSIKAI
- Section 5: https://youtu.be/9C6ZZMXh0ho

For several weeks we followed the stories of Moto, Keyti and Brus in Class Dojo. In the first episode, Moto was considering dropping out of school because he thought he wasn't smart enough. But now he knows what to do.

So do you know? What will you do if you fail at anything from now on?

Figure 4. Example of Class Dojo

In the face-to-face application, the cartoons were watched in the classroom via an interactive whiteboard (Figure 5). In the distance education application, they were transferred to the students' screens via desktop sharing.

Figure 5. Students watching Class Dojo in face-to-face practice

Additional materials.

Some additional materials have been designed to support students in developing a growth mindset within the scope of incremental self-theory. These are materials such as bookmarks (Figure 6) and personalized notebooks (Figure 7), which contain motivating expressions to develop a growth mindset and consist of Class Dojo characters that students follow.

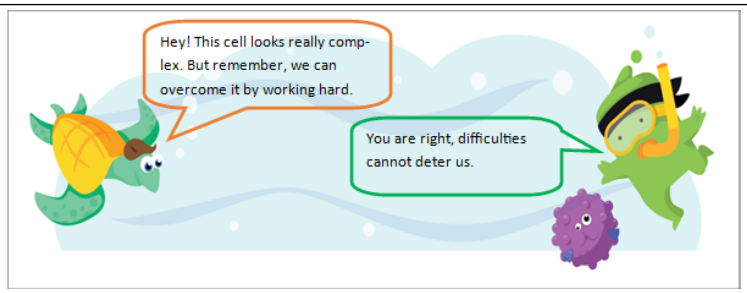

Figure 6. Example of bookmarks

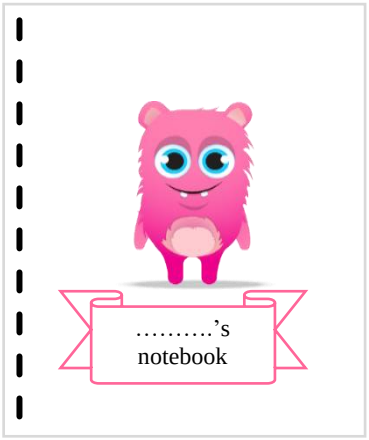

Figure 7. Example of notebook

These additional materials, which are always at students' disposal and designed according to the incremental self-theory, aim to contribute to their development of a growth mindset. Instead of these materials given directly to students in face-to-face education, posters designed as online materials were used in distance education, as seen in Figure 8.

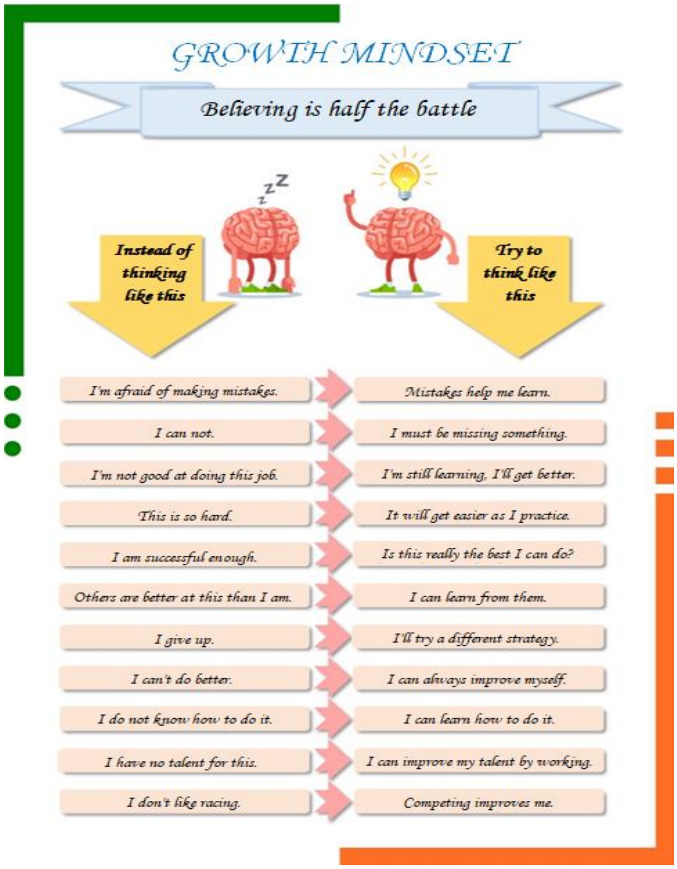

Figure 8. Poster study used in distance education

How to Conduct Lessons?

Data regarding teaching courses within the scope of the application carried out face-to-face in the first semester of the 2019-2020 academic year and with distance education in the first semester of the 2020-2021 academic year are presented comparatively in Table 5.

Table 5. Delivery of lessons

Application	Application Time (Class Hours)	Teaching
Face-to-face education	20	Instruction designed according to incremental self-theory in addition to the existing curriculum
Distance education	20	Instruction designed according to incremental self-theory in addition to the existing curriculum

According to Table 5, in addition to the curriculum determined for the relevant academic year, the courses were taught with the course teacher and the researcher, supported by activities prepared based on the incremental self-theory and materials designed in this direction. In this way, it was tried to make the students feel comfortable, and it was aimed to minimize the researcher's influence. In this context, the suggestions of the teacher, who was informed about the incremental self-theory before the application, were considered throughout the process, taking into account the knowledge and experience of the students in the class. After the application was completed, the measurement tools were applied as a post-test, and the application process was completed.

Analysis of Data

The research used CDUAAT, SCS, SLMS, and WVTF measurement tools. The scores obtained from the CDUAAT, SCS, and SLMS tools were adapted to a 100-point system to present an average score for the data collection tools used and to provide the reader with the opportunity to comment in line with a standard evaluation scale (Berk et al., 2020; Comba, 2018). Accordingly, a minimum of 0 and a maximum of 100 from CDUAAT; A minimum of 20 and a maximum of 100 points can be obtained from SCS and SLMS.

The pre-test and post-test data obtained were analyzed to examine face-to-face and distance education applications in terms of application type. To determine the statistical analysis method, normality distribution, and variance homogeneity tests were used for the data. Kolmogorov-Smirnov normality analysis test results of the data are given in Table 6.

Table 6. Kolmogorov-Smirnov normality analysis results

Scale/Test	Pre-test/ Post-test	N	$\bar{X}$	Sd	*p*
CDUAAT	Pre-test	45	40.36	1.58	.123
	Post-test	45	76.44	2.86	.002*
SCS	Pre-test	45	85.87	1.43	.079
	Post-test	45	89.18	1.84	.001*
SLMS	Pre-test	45	83.87	1.18	.200
	Post-test	45	88.71	1.37	.001*

*p<.05

According to Table 6, it was determined that the distribution of the CDUAAT, SCS, and SLMS pre-test data among the data obtained from the measurement tools used within the scope of the research was normal (p> .05). In contrast, the distribution of the CDUAAT, SCS and SLMS post-test data was not expected (p< .05). The same data sets were subjected to the variance homogeneity test and the results are given in Table 7.

Table 7. Variance homogeneity test results

Scale/Test	Pre-test/ Post-test	Levene	df1	df2	*p*
CDUAAT	Pre-test	10.322	1	43	.002*
	Post-test	16.244	1	43	.001*
SCS	Pre-test	1.977	1	43	.167
	Post-test	4.114	1	43	.049*
SLMS	Pre-test	0.100	1	43	.753
	Post-test	3.508	1	43	.068

*p<.05

According to Table 7, it can be seen that the variance of the CDUAAT pre-test, post-test, and SCS post-test data is not homogeneous (p< .05), while the variance of the SLMS pre-test, post-test, and SCS pre-test data is homogeneous (*p*> .05). When Tables 10 and 11 are examined together, it can be seen that the distribution of the pre-test data obtained with CDUAAT is normal (*p*> .05), the distribution of the post-test data is not normal (*p*< .05) and their variances are not distributed homogeneously.

When the literature is examined, the Quade test, a non-parametric test used to analyze random full-block designs based on the Quade method, is used in cases where homogeneous variance conditions are not met (Cangür et al., 2018). Qualitative data obtained from teachers are stated by direct quoting.

FINDINGS

The data collected with the measurement tools used in the research were analyzed, and the findings obtained as a result of this process are presented below, under headings and associated with the relevant research question.

Findings Regarding the First Research Question

The first research question is about determining the effect of implementing instruction based on incremental self-theory through face-to-face and distance education on students' academic achievements at CDU. Quade test was used to determine whether there was a significant difference in application type within the scope of CDUAAT scores, and the data obtained through the analysis are presented in Table 8.

Table 8. CDUAAT quade test results

Scale/Test	F	df*H*	df*E*	*p*
CDUAAT	5.283	1	43	.026

According to Table 8, it was determined that there was a statistically significant difference between students receiving face-to-face and distance education when CDUAAT pre-test scores were kept under control (p < .05). Although the Quade test does not have a precise measure within the scope of effect size, various calculation methods that can be used in some studies are reported in the literature (Mursadin, 2020). An *r*-effect value of 0.1, evaluated independently of its sign and takes a value between 0 and 1, is considered small, 0.3 is considered medium, and 0.5 is considered significant (Field, 2009). Accordingly, the *r* effect value was calculated as 0.497 (high), and the effect explains 24.7% of the total variance (r^2). The difference detected as a result of the Quade test shows that the application of materials and activities designed according to the incremental self-theory in face-to-face and distance education for students to develop a growth mindset has an impact at a level that will create a statistically significant difference within the scope of the scores obtained with CDUAAT. For the details of this detected difference, the paired comparison test results of the groups calculated within the size of the Post-Hoc test are presented in Table 9.

Table 9. CDUAAT pairwise comparison test results

Scale/Test	Comparison	df	t	*p*
CDUAAT	distance education – face-to-face education	43	-2.299	.026

According to Table 9, it can be seen that the CDUAAT academic achievement levels of students receiving face-to-face education are higher than those of students receiving distance education. It shows that the activities and materials designed in this context increase the CDU academic achievement levels of the students in the face-to-face application group at a level that creates a statistically significant difference compared to the students in the distance education application group (*p*< .05).

Findings Regarding the Second Research Question

The second research question examines the effects of face-to-face and distance education implementation of instruction designed based on incremental self-theory on students' self-confidence. The findings obtained through the Quade test applied to determine whether SCS creates a significant difference in terms of application type in both face-to-face and distance education applications are presented in Table 10.

Table 10. SCS quade test results

Scale/Test	F	df*H*	df*E*	*p*
SCS	.845	1	43	.363

According to Table 10, it was determined that there was no statistically significant difference (*p*> .05) when the SCS pre-test scores of students receiving face-to-face and distance education were kept under control. As a result of the calculations (Mursadin, 2020), the *r*-effect value was calculated as 0.163 (low), and the effect explains 2.7% of the total variance. The Quade test result shows that distance and face-to-face education instruction practices designed based on incremental self-theory do not impact at a level that will create a statistically significant difference within the framework of SCS scores. For the details of the Quade test performed, information on the paired comparison test results of the groups within the scope of the Post-Hoc test is given in Table 11.

Table 11. SCS Pairwise Comparison Test Results

Scale/Test	Comparison	df	t	*p*
SCS	distance education – face-to-face education	43	.919	.363

According to Table 11, it was determined that the self-confidence levels of students receiving distance education were higher than those of students receiving face-to-face education, but this was not at a level that would constitute a statistically significant difference ($p > .05$).

Findings Regarding the Third Research Question

The third research question examines how implementing instruction based on incremental self-theory through distance and face-to-face education affects students' motivation toward science learning. The findings obtained by the Quade test applied to determine whether the SLMS creates a significant difference in terms of application type in both face-to-face and distance education applications are presented in Table 12.

Table 12. SLMS quade test results

Scale/Test	F	df*H*	df*E*	*p*
SLMS	4.228	1	43	.046

According to Table 12, it was determined that there was a statistically significant difference between face-to-face and distance education students when the SLMS pre-test scores were kept under control ($p < .05$). As a result of the calculations (Mursadin, 2020), the *r* effect value was calculated as 0.211 (close to the medium level) and the effect explains 4.5% of the total variance. This difference from the Quade test shows that the teaching designed according to the incremental self-theory, implemented through distance or face-to-face education, has an effect at a level that creates a statistically significant difference within the framework of SLMS scores. For the details of this critical difference, the paired comparison test results of the groups calculated within the scope of the Post-Hoc test are presented in Table 13.

Table 13. SLMS paired comparison test results

Scale/Test	Comparison	df	t	*p*
SLMS	distance education – face-to-face education	43	2.056	.046

According to Table 13, the motivation levels of distance education students for learning science are higher than face-to-face education students. It shows that the activities and materials designed in this context increase students' motivation levels in the distance education group for learning science to a level that creates a statistically significant difference compared to the students in the face-to-face education group ($p < .05$).

Findings Regarding the Fourth Research Question

The fourth research question is about obtaining teachers' views on whether the teaching designed based on incremental self-theory should be implemented face-to-face or through distance education. WVTF was applied to teachers in both face-to-face and distance education applications and was reached through Microsoft Office Forms. Data obtained from WVTF are presented in Table 14.

Table 14. Teachers' views about the practice

Teacher	Application Process	View
Teacher 1	Face-to-Face Education	*"I think it positively affects students' interest, morale, and motivation in the course." "Regarding applicability, it does not take much time, and I think it is useful."*
Teacher 2	Distance Education	*"The activities can be implemented easily. I saw that it had a motivational and motivating effect on students. The students in the class where I applied the study gave feedback, saying, "I'm glad we did this study. I believe I can succeed now." "It will be beneficial, especially in classes with low motivation."*

According to Table 14, teachers stated that they found this implementation process, in which they were involved personally, beneficial for the students. They mentioned that the designed teaching can be easily implemented in face-to-face and distance education. Considering that teachers are one of the main elements of the education and training process and factors such as their experience in this context and their knowledge of the students in the classroom, their views on the practice are critical in research.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This research aims to compare the effects of the application of materials and designed activities based on the incremental self-theory in the teaching of CDU, which is included in the 7th-grade science curriculum, in face-to-face and distance education, on students' academic achievement, self-confidence, and motivation toward science learning. In addition, science teachers were both personally involved in the implementation process, and their views on the designed teaching and process were tried to be determined.

The research determined that the application of materials and design activities based on students' incremental self-theory as face-to-face and distance education had a statistically significant difference in favor of students receiving face-to-face education within the framework of CDUAAT scores. Within the scope of the Post-Hoc test applied regarding this considerable difference, it was determined that the CDU academic achievement levels of students who received face-to-face education were higher than those who received distance education. When the studies in the literature were examined, no study similar to this study could be found. However, when we look at the research that includes comparisons of face-to-face and distance education in general, Okan (2020) compares the efficiency of undergraduate students within the framework of online lessons during the pandemic period and their comparison with face-to-face lessons found that face-to-face classes are generally more efficient and effective. Ozüdoğru et al. (2021) in their research, they discussed the comparison of distance education environments and face-to-face education environments in physiotherapy and rehabilitation education during the COVID-19 pandemic. As a result of their study with college students, they found that the perception of face-to-face teaching in the general score and all sub-dimensions was significantly higher than the perception of distance education. Yiğit et al. (2012), in their study comparing the achievement of students in distance education and face-to-face education, found a significant difference in the achievement levels of the lessons within the framework of "use of basic information technologies" given in face-to-face and distance education in favor of the students receiving face-to-face education. Yakışan and Ateş (2022) found that, as a result of their research comparing the effect of listening studies conducted in face-to-face education and distance education on achievement and permanence, they discovered that face-to-face hearing studies were significantly different in terms of student achievement as well as permanence of learning compared to those conducted remotely. However, there are also studies showing that distance education is effective. As a result of the research comparing web-based distance education and face-to-face education within the framework of the "Internet Programming-2 course", Balaman (2018) stated that web-based distance education is more successful than face-to-face education in ensuring permanence and increasing achievement.

The study was investigated to determine the effect of activities designed for CDU on students' self-confidence based on incremental self-theory. As a result of the research, it was determined that the self-confidence levels of students receiving distance education were higher than those of students receiving face-to-face education, but this was not at a level that would create a statistically significant difference. As a result of the research on the views of secondary school students regarding the digital materials used in science lessons during the COVID-19 pandemic, Paşa and Çelik (2022) concluded that distance education, which has become essential due to the COVID-19 pandemic, enables students to express their ideas more efficiently compared to traditional classroom environments. They reported that it also contributed to their increase in self-confidence by providing the necessary climate for self-confidence. In his research on the adaptation of faculty members working in vocational schools during the distance education process, Öztürk (2021) stated that most participants were not affected in terms of self-confidence during the distance education process.

While the application of the materials and activities designed in the research through distance or face-to-face education did not have a statistically significant difference within the scope of SCS scores, it has been determined that the implementation of activities and materials designed according to the incremental self-theory in face-to-face and distance education has an effect at a level that creates a statistically significant difference within the framework of SLMS scores. Within the scope of the Post-Hoc test conducted regarding this considerable difference, it was determined that the motivation levels of students who received distance education for learning science were higher than those who received face-to-face education. In addition, since information and communication technologies are generally described as enjoyable by individuals, they are reported to effectively increase students' motivation for the lesson when used for educational purposes (Balaman, 2018). Yiğit et al. (2012) stated in their study that technological tools are the only common link between students and teachers who prefer not to attend synchronous classes. Researchers have examined this issue through telephone, computer, and e-mail. Processes include teacher and student communication, mutual expression of views about the lesson, teaching and directing the classes and tracking the homework. They explained that it can be carried out through technological elements.

Additionally, it has been reported that answering students' questions via message boards can effectively increase students' motivation towards the lesson (Deka & McMurry, 2006). In their research on the effects of distance education on students' academic motivation levels for Turkish lessons, Orhan and Demir (2022) stated that students were more motivated to succeed in Turkish classes in distance education. When the studies on the effectiveness of distance education in the literature were examined, studies other than the results obtained from this study were also found. In his research, Duman (2020) stated that communication decreases in distance education, and students face motivation and focus problems.

In the study, in addition to the researcher, two science teachers were also involved in the application process, and their views about the applications were taken. In face-to-face education, teacher-1 and in distance education, teacher-2 were involved. Teacher-1 expressed her opinions about the effects of face-to-face activities developed based on incremental self-theory on

students, and teacher-2 expressed her views about the impact of implementing these activities through distance education on students. Teacher 1 mentioned that the activities developed based on incremental self-theory effectively increased their interest in the lesson, motivation, and morale. She also stated that these activities take little time in the implementation phase and can benefit the students. Teacher 2 noted that the activities developed according to the incremental self-theory can be easily applied to students in teaching relevant subjects. She mentioned that these activities have a motivational and motivating effect on students. She also stated that the students loved these activities very much and that they no longer had difficulty and could succeed. She noted that these activities could be helpful, mainly in low-motivation classes.

Both teachers agreed that these activities benefitted the students and were designed according to the incremental self-theory in face-to-face and distance education. As a result, using face-to-face activities and materials designed based on incremental self-theory in CDU teaching increases students' academic achievement compared to distance education. At the same time, motivation levels for learning science are higher in distance education applications. This result may be because, in academic achievement, they can solve more problems in the classroom environment, ask questions, and do experiments and activities when necessary. In motivation, using distance education tools such as computers is enjoyable for students. They can access the activities more efficiently. They can watch them over and over again when necessary. Students' self-confidence remained the same in both face-to-face education and distance education. This result may be because some concepts in the science lesson are abstract, and students think they cannot learn these concepts and are discouraged from learning them. Another factor may be the negativities brought about by the COVID-19 pandemic process.

This study was conducted with secondary school students. Similar analyses can be performed with primary, high school, and university students, and face-to-face and distance education can be compared. Similar studies can be conducted in which the views of parents, who are essential stakeholders in education and training, are taken, especially in distance education studies. During the distance education application process of the research, some students had only one computer at home, and their classes conflicted with their siblings, causing low participation. For this reason, researchers working with distance education should consider the socio-economic status of the target audience they will apply, the nature of the technological tools they use, and their access to these tools. Within the scope of the research, it is thought that it would be beneficial to integrate the teaching, which is designed in line with the incremental self-theory, with a straightforward application process and does not interfere with the curriculum of any lesson, into other classes and subjects where students experience learning problems and low motivation.

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Statements of publication ethics

We declare that the study has no unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

Ethics committee permission for this study was obtained from the Kastamonu University Social and Human Sciences Research and Publication Ethics Committee with the decision dated on October 12, 2020, and numbered 3/14.

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