ASSESSING THE IMPACT OF UTILITY VALUE INTERVENTION ON MIDDLE SCHOOL STUDENTS' SCIENCE INTEREST, UTILITY VALUE BELIEFS AND CAREER INTEREST IN SCIENCE

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

ASSESSING THE IMPACT OF UTILITY VALUE INTERVENTION ON MIDDLE SCHOOL STUDENTS' SCIENCE INTEREST, UTILITY VALUE BELIEFS AND CAREER INTEREST IN SCIENCE

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This study investigates the impact of a utility value intervention on middle school students' personal interest in science, utility value beliefs, and career interest in science. Using a quasi-experimental design, 95 seventh-grade students were divided into experimental group, which received both curriculum-oriented instruction and a utility value intervention, and control group, which received only curriculum-oriented instruction. Self-report instruments were administered as pre-test and post-test. In addition, open-ended questions were administered to obtain in-depth information about students' personal interest in science. Results showed that the utility value intervention did not significantly impact students' personal interest, utility value beliefs, or career interest in science. However, there was a significant decrease in the personal interest and utility value belief in science over time in the control groups, while there was no significant change in the experimental groups. In terms of the career interest in science variable, no change was observed in both groups over time. On the other hand, qualitative data suggested that both control and experimental groups students believed that activity-enriched science instruction could boost their interest. However, a greater number of students in the experimental groups found the content more relevant to their lives, which heightened their personal interest in science. Additionally, a larger number of students in the experimental groups attributed their increased interest specifically to the intervention, compared to those in the control groups. Concerning students articulated utility values, results revealed a significant difference between the experimental and control groups, favoring the experimental groups.

Keywords: Utility Value Intervention, Science Motivation, Task Value Beliefs, Personal Interest in Science, Utility Value Beliefs, Science Career Interest, Middle School Students

ÖZ

FAYDA DEĞER MÜDAHALESİNİN ORTAOKUL ÖĞRENCİLERİNİN FEN BİLİMLERİNE YÖNELİK İLGİ, FAYDA DEĞER İNANÇLARI VE FEN BİLİMLERİ KARİYER İLGİSİ ÜZERİNE ETKİSİNİN İNCELENMESİ

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Bu çalışma, ortaokul öğrencilerinin fen bilimlerine olan kişisel ilgisi, fayda değeri inançları ve fen bilimlerine yönelik kariyer ilgisi üzerinde fayda değeri müdahalesinin etkisini incelemektedir. Yarı deneysel bir tasarım kullanılarak, 95 yedinci sınıf öğrencisi, hem müfredat odaklı eğitim hem de fayda değeri müdahalesi alan deney grubuna ve yalnızca müfredat odaklı eğitim alan kontrol grubuna ayrıldı. Öz-bildirim veri toplama araçları, ön test ve son test olarak öğrencilere uygulandı. Buna ek olarak, öğrencilerin fen bilimlerine olan kişisel ilgisi hakkında derinlemesine bilgi edinmek için açık uçlu sorular uygulandı. Sonuçlar, fayda değeri müdahalesinin, öğrencilerin fen bilimlerine olan kişisel ilgisini, fayda değeri inançlarını ve kariyer ilgisini etkilemediğini göstermiştir. Ancak, kontrol grubunda fen bilimlerine olan kişisel ilgi ve fayda değeri inancında zamanla önemli bir azalma olurken, deney grubunda önemli bir değişiklik olmamıştır. Fen bilimlerine yönelik kariyer ilgisi değişkeni açısından ise, hem kontrol hem de deney gruplarında zamanla bir değişiklik gözlenmemiştir. Öte yandan, nitel veriler hem kontrol hem de deney gruplarındaki öğrencilerin, etkinlikle zenginleştirilmiş fen bilimleri öğretiminin ilgilerini artırabileceğine inandıklarını gösterdi. Ayrıca, deney grubundaki öğrencilerin büyük bir kısmı, fen bilimleri ders içeriğini hayatlarıyla daha alakalı bularak bu durumun fen bilimlerine olan kişisel ilgilerini artırdığını ifade etti. Buna ek olarak, deney grubundaki çoğu öğrenci, kontrol grubuna kıyasla, artan ilgilerini özellikle müdahaleye bağladı. Öğrencilerin açıkça ifade edilen fayda değerleri açısından ise, deney ve kontrol grupları arasında deney grubunun lehine anlamlı bir fark olduğu sonucu ortaya çıktı.

Anahtar Kelimeler: Fayda Değeri Müdahalesi, Fen Bilimlerine Yönelik Motivasyon, Görev Değeri İnançları, Fen Bilimlerine Yönelik Kişisel İlgi, Fayda Değeri İnancı, Fen Bilimlerine Yönelik Kariyer İlgisi, Ortaokul Öğrenciler

To my beloved mayka, Hanife

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ABBREVIATIONS

EFA: Exploratory Factor Analysis

IIQ: Individual Interest Questionnaire in Science

MoNE: Ministry of National Education

SES: Socioeconomic Status

STEM: Science - Technology - Engineering - Mathematics

UV: Utility-Value

CHAPTER 1

INTRODUCTION

The students may not feel motivated to learn a subject all the time. Unfortunately, lacking in motivation is a problem for a lot of science students. Teenagers are especially affected by this issue since many of them think science is a difficult and uninteresting subject that will never motivate them (Rennie et al., 2001). There may be many reasons underlying this situation. In this sense, according to one study (Hulleman & Barron, 2013), 90% of middle school teachers cited a lack of value for learning as one of the main obstacles to students' motivation. At this point, the question students frequently ask, “What will this information do for me in the future?” actually indicates that they are questioning the utility value of a course. This question may reflect that students do not understand how a course or information will contribute to their future lives or careers and therefore have low motivation for the courses (Hulleman & Harackiewicz, 2009). As suggested by the Expectancy-Value Model, strengthening students’ beliefs that a course will contribute to their future goals plays a critical role in increasing their interest and motivation for these courses (Eccles, 2005).

In fact, the Expectancy-Value Model provides a crucial theoretical framework for understanding and enhancing students' motivation. This model centers on students' expectations of successfully completing a task (expectancy) and their perceptions of the personal significance or value of that task (value) (Eccles & Wigfield, 2002). These two basic components shape students' motivation toward science courses and directly affect their performance in these courses. Specifically, the *expectancy component* refers to students' beliefs about successfully completing a particular task or course. This belief is influenced by factors such as past experiences, perception of ability, and expectations for success (Wigfield & Eccles, 2000). For example, if a student has been successful in science courses in the past and feels confident in these courses, they believe that they will be successful in these courses in the future, and this belief increases their motivation (Wigfield et al., 2016). Expectancy plays an important role in determining students' effort level and interest in courses (Eccles, 2005). The *value component*, on the other hand, refers to how important students think a particular course or task is for them. Value is explained by four subcomponents: intrinsic value (the course being found interesting or enjoyable), utility value (the course's potential to contribute to future goals), personal importance (the course's relevance to the student's identity), and cost (the challenges and sacrifices the course entails) (Eccles & Wigfield, 2002). Utility value, in particular, is critical for students' perceptions of how science courses will contribute to their future academic and career goals (Harackiewicz et al., 2016).

The expectancy-value model has been used in the context of science education to develop effective interventions to increase students' motivation and improve their achievement in these courses. One such intervention involves utility value intervention which is a classroom-based and interactive intervention designed to promote students establish connections between their lives and the content/topic/concept they are learning (Hulleman et al., 2010). These interventions allow students to discover how useful and important the course material is for their own lives and futures. Within the framework of the Expectancy-Value Model (Eccles, 1983; Wigfield & Eccles, 2000), students' motivation to perform a task is determined by the expectations and value perceptions of that task. Utility-value interventions specifically target the value component and encourage students to think that the course is useful. These interventions are usually carried out through written tasks that allow students to make connections between their own lives and the course material. For example, students may be asked to write about how the course material would be useful for their future careers or personal goals (Hulleman & Harackiewicz, 2009). Also, utility value intervention is one of the interventions that can be used to promote interest development and subsequent educational outcomes according to Harackiewicz and colleagues (2016). Harackiewicz and colleagues (2016) also stated that no single interest intervention is universally effective. However, Harackiewicz and colleagues(2016) stated that utility-value interventions are likely to enhance motivation for all students (e.g. Brown et al., 2015; Harackiewicz et al., 2015; Harackiewicz et al., 2012). Moreover, another study conducted by Hulleman and Harackiewicz (2009) demonstrated that the utility-value intervention notably increased personal interest in science among high school students, particularly those with low achievement expectations, and also led to an improvement in their course grades. This finding suggests that utility-value interventions can increase students' interest and improve their academic performance by allowing them to find course content personally meaningful and useful.

On the other hand, despite the limited research on the effectiveness of utility-value interventions at the middle school level, this approach appears to hold significant potential for enhancing students' personal interest in science, their task-value beliefs, and their career interests in science. Recognizing the importance of these student outcomes, this study seeks to investigate the impact of utility-value intervention on these key variables. As outlined below, *personal interest*, defined as a student's sustained and deep commitment to a particular subject (Hidi & Renninger, 2006), plays a crucial role in motivating students to engage voluntarily in the learning process and to seek knowledge about the subject. In the context of science, personal interest implies that students develop a lasting curiosity and a persistent desire to explore and understand scientific concepts and phenomena. In this sense, Deci and Ryan (2000) stated that students' motivation in the learning process is related to how they meet their interests and needs. Interest in scientific subjects can increase students' active participation in the lesson, which can encourage academic success. Also, Hidi and Renninger (2006) explain the development of interest with a four-stage model: initial interest, continuing interest, deepening interest, and fully integrated interest. This model may show how students' personal interest in science deepens and becomes permanent over time. Wigfield and Eccles (2000) examine how students' expectations of success and the values they attach to this affect academic motivation and career goals within the framework of the expectancy-value model. A high personal interest in science can help students shape their career goals in this field and develop their scientific thinking skills. These theoretical perspectives emphasize the important role of personal interest in science in students' academic success and professional development. Also, within the framework of Eccles and Wigfield's (2020) Expectancy-Value Model, students' personal interest in a subject increase when they believe that the subject is useful. In other words, if a student believes that science will contribute to their future career or daily life, this may increase the student's personal interest in science (Wigfield & Cambria, 2010). Furthermore, according to Hulleman and Harackiewicz (2009), utility value interventions increase students’ interest in and academic performance in science courses by helping them see how useful science courses are in their daily lives and future careers. Specifically, the authors found that when students were shown how science courses could be useful in their daily lives and future careers, their interest in these courses and academic performance increased significantly. In this sense, utility value interventions aim to help students see how course materials and tasks relate to the real world and their future career goals. Such interventions help students understand how science courses can contribute to their future careers and daily lives, thereby increasing their motivation for the courses. Thus, the recent study expects that utility-value intervention enhances middle school students’ personal interest in science.

Another key variable examined in this study is *utility value beliefs* which refer to the way a student perceives how a particular subject will contribute to their future life, career, or personal goals (Eccles & Wigfield, 2002). In the science domain, a student's utility-value belief in science reflects their belief in how important the knowledge and skills in this field are for their future success. According to Hulleman et al. (2010), students' utility value beliefs towards science have a significant impact on participation and motivation in classes. These beliefs affect expectations about the personal and social benefits of scientific knowledge (Eccles, 2005). When students have high utility value beliefs towards science, they can perform better in this area. In addition, utility value beliefs affect students' determination and perseverance in achieving their academic goals. These beliefs increase their ability to cope with difficulties and overcome obstacles encountered in the learning process (Eccles & Wigfield, 2002). Also, utility value beliefs towards science shape students' long-term educational and career goals. These beliefs may affect career choice and success in science and technology fields (Wigfield & Eccles, 2000). At this point, a substantial and expanding body of research has shown that utility value interventions are effective in raising utility value and enhancing academic performance among college students (for reviews, see Hulleman & Harackiewicz, 2021; Rosenzweig & Wigfield, 2016; Wigfield et al., 2017).

Considering the available literature, the current study also aimed to explore the effect of utility-value intervention on middle school students' career interests in science. By definition, career interest in science refers to students' desire and orientation to pursue a career in science or to pursue a career in this field. This interest is an important motivational factor that shapes students' interest in science-related courses, their success in these fields, and their future career plans (Lent et al., 1994). Also, according to National Research Council (2012) developing a career interest in science for middle school students is of great importance in terms of both individual development and societal needs. In this sense, the middle school period is a critical stage when students begin to determine their career preferences and areas of interest. Interest in science and being introduced to career options in this field can shape students' future career choices and academic orientations (Wang et al., 2013). Also, when middle school students are introduced to careers in the field of science, they tend to develop a desire and interest in working in these fields. A recent study by Shin et al. (2022b) investigated the effect of utility value intervention on career interest in science. The findings of the study indicated that students in the experimental condition demonstrated a more pronounced perception of the utility value of science, a heightened appreciation for the role of science in their future careers, a greater interest and sense of self-efficacy in their science classes, and a stronger inclination to pursue careers in science compared to students in the control condition. Additionally, one study showed that the interventions by parents emphasizing the benefits of STEM courses to their children were found to increase their children's interest in these courses and their likelihood of considering STEM careers in the future (Lee et al., 2020). So, these interventions may enable students to effectively answer the question, “What will this information do for me in the future?” The implementation of utility value interventions can also increase students’ interest in courses and motivation, thus better preparing them for future career goals. Therefore, students being able to find satisfactory answers to the question, “What will this information do for me in the future?” should be seen as an important step in increasing the effectiveness of the educational processes of students in science.

1.1 Purpose of the Study and Research Questions of the Study

This present study aims to examine the effect of utility value intervention on middle school students' personal interest in science, utility value beliefs, and science career interests. In line with the purpose of the study, the research questions that are intended to be answered are as follows:

Main Research Question 1

What is the effect of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone on students' personal interest in science over two time periods (before the treatment and after the treatment)?

Sub-questions:

a) Is there a change in students' personal interest in science across the two time periods (before the treatment and after the treatment)?

b) Is there a difference in the effectiveness of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' personal interest in science?

c) Does the change in students' personal interest in science over time is different for the two groups?

d) What is the personal interest in science of students who received curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone?

Main Research Question 2:

What is the effect of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone on students' utility value beliefs in science over two time periods (before the treatment and after the treatment)?

Sub-questions:

a) Is there a change in students' utility value beliefs in science across the two time periods (before the treatment and after the treatment)?

b) Is there a difference in the effectiveness of curriculum-oriented instruction and utility value intervention with respect to students' utility value beliefs in science?

c) Does the change in students' utility value beliefs in science over time is different for the two groups?

Main Research Question 3:

What is the effect of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone on students' career interest in science over two time periods (before the treatment and after the treatment)?

Sub-questions:

a) Is there a change in students' career interest in science across the two time periods (before the treatment and after the treatment)?

b) Is there a difference in the effectiveness of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' career interests in science?

c) Does the change in students' career interest in science over time is different for the two groups?

Main Research Question 4

Is there a change in the articulated utility values of students receiving curriculum-oriented instruction supported by utility value intervention during the instruction?

Main Research Question 5

Is there a change in the articulated utility values of students receiving curriculum-oriented instruction alone during the instruction?

Main Research Question 6

Is there a significant difference between students taught by curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' articulated utility values?

1.2 Definition of Important Terms

Many important terms, including utility value intervention, personal interest, utility value beliefs, and career interest in science are operationally defined in the current study.

Utility value intervention

An interactive, in-class activity called the utility-value intervention aims to assist students in drawing links between the material they are learning and their daily lives (Hulleman et al., 2010).

Personal Interest

Personal interest refers to a persistent inclination to actively interact with specific types of content (Renninger & Hidi, 2011).

Utility Value Beliefs

Utility value belief refers to the student's beliefs about how much a task, course, or information can contribute to his/her future goals or daily life within the scope of the Expectancy-Value Model. In other words, it is the student's perception of how important and useful a particular subject or course is in terms of future career choices, career plans, or life goals (Eccles & Wigfield, 2002).

Career Interest in Science

Career interest in science refers to students' desire and orientation to pursue a career in science or to pursue a career in this field. This interest is an important motivational factor that shapes students' interest in science-related courses, their success in these fields, and their future career plans (Lent et al., 1994).

1.3 The Significance of The Study

Science is a discipline that plays a critical role in the technological and scientific advancement of societies. The development of competent individuals in these fields is vital for future scientific discoveries and technological innovations (National Research Council, 2012). Students' personal interest in science increases their chances of being successful and making a career in these fields (Harackiewicz et al., 2012). Therefore, increasing students' personal interest in science and ensuring that they focus on this field is seen as an important goal both at the individual and societal levels. Students' personal interest in science enables them to spend more time and energy on courses in this field, thus increasing their success in these courses (Renninger & Hidi, 2017). Interest is also an important factor in the formation of long-term academic and professional goals. Students who develop a personal interest in science, especially at an early age, are more likely to focus on STEM (Science, Technology, Engineering, Mathematics) fields in later years (Maltese & Tai, 2011). This will contribute to the formation of a qualified workforce in STEM fields in the future. Thus, it is important to examine the effectiveness of different interventions in enhancing students’ personal interest in science. The current study aims to investigate the impact of utility-value intervention on middle school students’ personal interest in science. The utility-value intervention is a time-efficient approach that does not require expensive resources and can be implemented by teachers at any level. Thus, if its effectiveness is demonstrated, its implementation can help even underrepresented students link their learning to their personal interests and values. In fact, this approach is versatile and capable of engaging students with varying levels of interest (Harackiewicz et al., 2016).

The current study also aimed to explore the effect of the utility value intervention on students’ task value beliefs. Utility-value beliefs are students' beliefs about how a particular course or information can contribute to their future career goals (Wigfield & Eccles, 2000). Especially in science courses, developing utility-value beliefs plays a critical role in increasing students' performance and interest in these courses (Hulleman et al., 2010). For example, students who believe that science courses will benefit their future career choices show more interest in these courses and achieve higher success in these courses (Harackiewicz et al., 2012). Thus, if the utility value intervention is found to improve students’ task value beliefs, it can also indirectly influence their performance in science and their career choices.

Students’ career choices are important because the choice of a career in science directly affects the opportunities that individuals will encounter throughout their lives and their social contributions. Individuals who pursue a career in STEM fields not only improve their own economic and social situations but also contribute to the general well-being of society (National Science Board, 2018). Therefore, it is critical for more students to choose careers in science not only at the individual level but also in terms of global competitiveness (Xie et al., 2015).

Overall, it can be deduced that interventions are needed to increase students' personal interest in science, their utility value beliefs, and their career choices in this field. In fact, such interventions can have positive effects not only on short-term academic achievements but also on long-term career goals and social development (Gaspard et al., 2015). In addition, although it is not the focus of the current study, effective implementation of these interventions can contribute to reducing gender and socioeconomic disparities, which can increase the overall success of STEM fields by providing greater diversity and inclusiveness (Clark Blickenstaff*, 2005). Utility-value interventions developed within the framework of expectancy-value model stand out as a promising tool to increase motivation in these fields and strengthen students' interests that will contribute to their future careers (Shin et al., 2022b). In this context, this current study examines the effects of utility-value interventions on middle school students' personal interest in science, their utility-value beliefs, and their career choices in these fields, and aims to contribute to the related literature.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the history of the expectancy-value model, ability beliefs, expectation of success, and subjective task values were reviewed. Besides, the variables of this study, including personal interest in science, utility value beliefs toward science, and career interest in science, were discussed. The chapter also covered the utility value intervention, its implementations in related literature, and concluded with a summary.

2.1 History of The Expectancy-Value Model

The expectancy-value model is one of the theories that help determine cognitive motivation and its subheadings. Expectancy and Belief are the two key components of this model, and their respective effects on student outcomes are investigated. This idea holds that a student's understanding of expectation and belief is a prerequisite for understanding motivation. The development of the current expectancy-value model was influenced by two key viewpoints. These are the viewpoints on aspiration level offered by Lewin (1935, as cited in Schunk et al., 2014) and achievement motivation by Atkinson (1957, 1964, as cited in Schunk et al., 2014). According to Lewin (1935, as cited in Schunk et al., 2014), an individual's level of aspiration viewpoint refers to the objectives they set for themselves relying on their prior experiences and familiarity with the work at hand. The person's motivation for that work may rise or fall based on whether the objective s/he sets for himself/herself is achieved. Furthermore, a person's level of aspiration might be influenced by their prior experiences. Someone who has failed in the past might not have high goals, and as a result, s/he might not have high expectations for himself/herself in terms of finishing the task at hand according to Weiner (1992). Furthermore, the Atkinson achievement motivation perspective (1957, 1964, as cited in Schunk et al., 2014) is an additional viewpoint. Atkinson's idea is predicated on three key elements. These three are incentive value, success probability, and motives. Here, so-called *motives* are portrayed as fixed, taught individual distinctions in people. The motive for success can be divided into two categories: the motive to succeed and the motive to avoid failing. According to, Atkinson's theory (1957, 1964, as cited in Schunk et al., 2014), these two motives are unrelated to one another. The *probability of success* is this theory's second element in Atkinson’s theory. A person believes that success is possible. Even when the person expresses his or her subjective beliefs regarding the work at hand, the environment also has an impact on these beliefs. The *incentive value* of achievement is another key element in the motivation in Atkinson’s theory (1957, 1964, as cited in Schunk et al., 2014). It can be characterized as a person's sense of accomplishment pride. For instance, an individual feels greater pride in accomplishing a work and finds it more intriguing when it is assigned to him if it is difficult (Weiner, 1992; Wigfield & Eccles, 1992). Stated differently, there exists an inverse relationship between task difficulty and incentive value. However, the probability of success, the second part of the hypothesis, is inversely related to the task difficulty. Put otherwise, an individual's expectation of success is higher for easier tasks and lower for tougher tasks (Weiner, 1992). Furthermore, Atkinson's theory(1957, 1964, , as cited in Schunk et al., 2014) states that the motivation, desire, and importance placed on completing a task are different from the ideas about our ability to complete it. That is to say, just because people are capable of doing something does not mean that they will do it or that they think it would be worthwhile. Shortly, Lewin's level of aspirations (1935, , as cited in Schunk et al., 2014) and Atkinson's achievement motivation perspectives(1957, 1964, , as cited in Schunk et al., 2014) are two key early viewpoints that helped shape the contemporary expectancy-value model. Consider them as follows. Later, Eccles and others introduced the Expectancy-Value Model, which bears similarities to these beliefs (Eccles, 1984; Eccles et al., 1983; Wigfield, 1994; Wigfield & Eccles, 1992 as cited in Wigfield & Eccles, 2000). Eccles and colleagues proposed the Expectancy Value

Model of Achievement Motivation, which has the components of expectations for success and subjective task values. Figure 1 explains this paradigm along with its subcomponents.

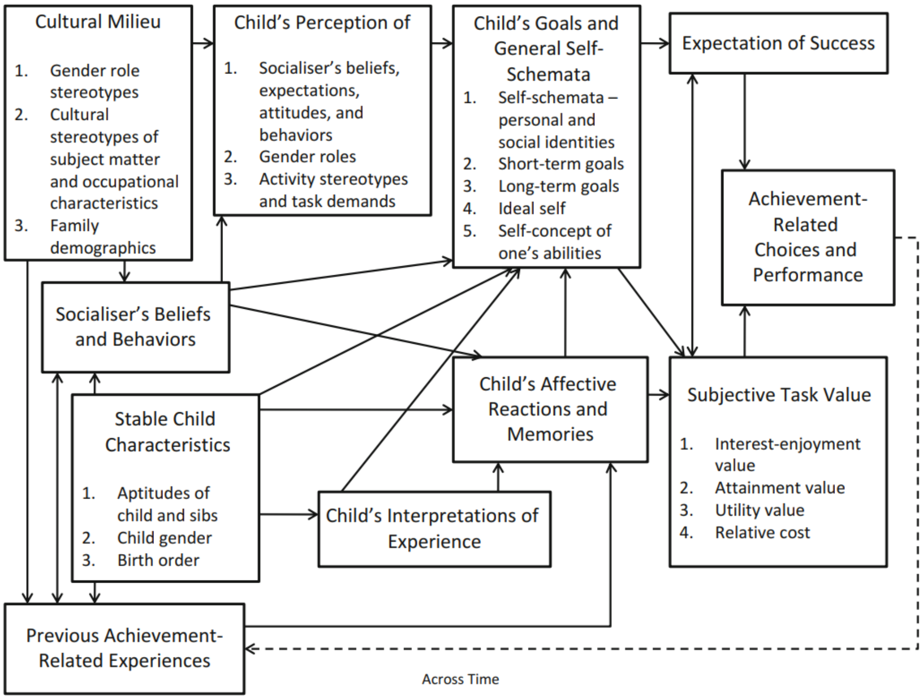

Figure 2.1 Eccles and Wigfield (2002) expectancy-value model of achievement-related choices

From "Subjective Task Value and Eccles et al. Model of Achievement-Related Choices" by J. S. Eccles in *Handbook of Competence and Motivation* (p.106) edited by A. J. Elliot and C. S. Dweck, 2005, New York: Guilford Press.

Expectations and values have a direct impact on children's success preferences, performance, effort, and continuity, as seen in Figure 2.1. Expectancies and values are also expected to be impacted by beliefs particular to a task, views of the difficulty of various activities, personal objectives, emotional memories, and children's self-schema, or the way children schematize themselves. Different social influences and an individual's prior experiences may also have an impact on these cognitive elements (e.g., Eccles, 2005; Eccles & Wigfield, 1995; Eccles et al., 1983; Meece et al., 1990; Wigfield, 1994; Wigfield & Eccles, 1992, 2000, 2002). Therefore, it is crucial to comprehend the model as well as to define the constructs in this model created by Eccles and others. In the model, there are subheadings: expectancy for success, ability beliefs, and subjective task value which were defined as detailly in the following sub-sections.

2.2 Ability Beliefs

Before saying that, there are so many definitions of ability beliefs in related literature. Some of them were given in this part. For example, Weiner (1985 as cited in Wigfield & Eccles, 2000) postulated in his attribution theory that people saw ability as a largely stable trait that they had little control over. According to Weiner (1985), the way that ability—and inability—is attributed has significant implications for motivation. While attributing failure to incapacity has a negative impact on motivation, attributing success to ability has positive consequences. In his self-worth model, Covington (1992 as cited in Wigfield & Eccles, 2000) also addressed people's ability beliefs, contending that people want to hold onto a positive feeling of ability in order to protect their self-worth. Covington (1992) shared Weiner's emphasis on perceived ability as a comparatively consistent capacity. Nonetheless, Covington (1992) pointed out developmental variations in people's ideas of ability based on developmental research on children's comprehension of the ability construct (e.g., Nicholls, 1978, 1990). Deci and Ryan (e.g., Deci & Ryan, 1985; Ryan, 1992) described the desire for competence as a fundamental human need and explained how this need is pivotal in people's pursuit of optimal stimulation and challenging tasks. These researchers used this notion to support their self-determination theory. Shortly, ability beliefs are defined as an individual's evaluation of their current proficiency in a certain task. Apart from the definition of ability beliefs, the relationship between ability belief and expectation for success, which is the other component of the expectancy-value model, should be mentioned. It is possible to conceptually distinguish between ability beliefs and expectancies for success, where ability beliefs place more emphasis on present ability and expectancies place more emphasis on future achievement. However, there is a solid empirical connection between these ideas (Eccles & Wigfield, 1995; Eccles et al., 1993).

2.3 Expectation of Success

Eccles et al. (1983 as cited in Wigfield & Eccles, 2000) explain and measure children's expectations about how well they will perform on upcoming tasks, either in the near or distant future. Numerous studies in this theoretical paradigm demonstrate that a variety of achievement behaviors, such as persistence, choice, and achievement, are positively correlated with increased expectancies for success (Eccles, 2005; Eccles et al., 1998; Wigfield & Eccles, 1992). When the literature is examined, it can be understood that expectancy for success, one of the theoretical components, is similar to Bandura's definition of self-efficacy. Self-efficacy was described by Bandura (1986 as cited in Wigfield & Eccles, 2000) as "People's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances." (p.391). The self-efficacy, expectancy for success, and outcome expectancy constructs were related to each other, but not always. For example, when discussing self-efficacy, Bandura (1997) took expectancies into account. Bandura (1997) made a distinction between outcome expectancies, or an expectation that a particular activity would result in a particular outcome, and efficacy expectations, or the belief that a person can complete a task (see also Pajares, 1996). Bandura (1997) also further claimed that efficacy expectations are more predictive of performance and choice than outcome expectations, arguing that expectancy-value theorists have traditionally concentrated on outcome expectations in their models.

2.4 Subjective Task Values

In the early stages, Feather (1982, 1988 as cited in Schunk et al., 2014) developed an expectancy-value model that combined the traditional expectancy-value model of achievement motivation with general values proposed by Rokeach (1979 as cited in Schunk et al., 2014). "Core conceptions of the desirable within every individual and society" are what Rokeach (1979) defined as values (p. 2). Also, Rokeach (1979) proposed terminal and instrumental values. These Rokeach's instrumental values paved the way for the personal values in Feather's expectancy-value model (1982, 1988). Individuals' values for particular tasks—referred to as task values in Feather's model—are presumed to be determined by their personal values. Also, the task values in Feather's model are similar to the incentive value concept in Atkinson's model, these task values can find out achievement behaviors such as choice, persistence, and actual performance. Moreover, in Atkinson's achievement motivation theory (1957, 1964, as cited in Schunk et al., 2014), while Atkinson found the concept of incentive value and the concept of expectation for success negatively related, according to Feather (1988), the concept of task value in Feather's model is positively associated with expectations.

Moving on to the achievement values section of the model, Eccles et al. (1983) identified the attainment value or importance, intrinsic value, utility value or usefulness of the activity, and cost. If mentioning about these components one by one, attainment value is defined as the importance of doing a task well enough. Cost value refers to how much participating in an activity limits doing other activities. Intrinsic value can be defined as the pleasure you get from doing a task. The last component, utility value, is a definition of how the task will benefit the individual and how compatible it is with their future plans.

a.) Interest-enjoyment value

Interest, which is characterized as people's enjoyment of a task or their innate interest in its subject matter, is one element of task value. Also, it's comparable to Deci and Ryan's (1985) intrinsic motivation theory's concept of intrinsic interest. Furthermore, the enjoyment of completing a task is more closely associated with interest than the task's results. People will be more interested in the task, stick with it longer, and have higher levels of intrinsic motivation when the interest value is high (Wigfield & Eccles, 1992, 2002).

b.) Attainment value

A task's importance is defined as its attainment value, which is comparable to Battle's (1965, 1966 as cited in Schunk et al., 2014) definition. Also, the degree to which a task enables people to confirm or refute important or central elements of their self-schemas is known as the attainment value (Wigfield & Eccles, 1992).

c.) Utility value

The usefulness of an activity for an individual in relation to their future aspirations, including career goals, is known as its utility value. Utility value is comparable to some of the extrinsic motivations for performing work in Deci and Ryan's (1985) model since it is also more closely linked to the goals of a task than to its means.

d.) Relative cost

The perceived drawbacks of performing the work are referred to as the relative cost (Wigfield & Eccles, 1992).

The utility value component, which is the focus of the current study, is elaborated upon in later sections of this thesis. Specifically, this component was examined in detail under each separate heading, addressing the variables of this study: personal interest in science, utility value belief in science, and career interest in science, as outlined below. Also, although students' personal interest in science, utility-value beliefs, and career interest in science were examined under separate headings, each variable is closely related to each other.

2.5 Personal Interest in Science

Interest is the relationship that exists between a person and an item of interest. It includes pleasant emotions, a desire to learn more about and interact with the object of interest, and a perception that the object has significance and worth for the individual. According to Renninger and Hidi (2011), interest has been conceptualized as a psychological state of situational interest as well as a drive to continue a content-related action in personal interest. Situational interest is the term used to describe concentrated attention that is sparked at a specific time by certain activities or content. Personal interest, on the other hand, refers to a persistent inclination to actively interact with specific types of content. According to Hidi and Renninger's (2006) four-phase model of interest development, an individual may develop a more enduring disposition if their situational interest is consistently stimulated. Also, Hidi and Renninger's (2006) interest theory states that a person's interest in an activity may encourage them to take part in it again. Additionally, a "well-developed" interest can encourage consistent participation in that activity (Hidi & Renninger, 2006). Furthermore, personal interest should not be confused with interest in specific topics. In the case of science, for example, personal interest in science refers to a more general interest in science (such as reading books about science, enjoying watching documentaries about science, doing research about science), while topic interest (such as being interested in the topic of pressure in physics class) can be defined as the interest felt in that science topic. That is, topic interest is actually a subset of personal interests. But, personal interests may include not only topics but also specific environments (like a scientific museum) and practices (like inquiry-based lab work) (Hoffmann, 2002; Krapp & Prenzel, 2011). After distinguishing between personal interest and topic interest, it would be meaningful to focus on how students' personal interest in science can be increased.

But before that, it should look at why having students' personal interest in science is important. Studies on students' personal interest in science during adolescence are particularly crucial because many have shown that interest in the subject decreases during school and that there is a also gender disparity (Archer et al., 2010; Bøe, 2012; Eccles et al., 1983; OECD, 2008; Osborne et al., 2003; Potvin & Hasni, 2014a, 2014b). For example, Eccles and Midgley's (1989) stated that the loss of motivation that students experience during the middle school years may be due to many different factors. These factors cover a wide range from teaching methods to social comparisons, from self-efficacy perceptions to developmental changes.

However, our efforts as teachers or researchers should aim to increase students' personal interest in science because as reported by Hidi and Harackiewicz (2000), students with personal interests are more likely to retain material and be motivated to pursue further learning.

The related literature suggests that students' interest and performance in a course can be enhanced by forming personal connections with the course material (Harackiewicz et al., 2016; Hecht et al., 2019; Hulleman & Cordray, 2009). In this context, task-value-focused interventions may increase personal interest in an activity, which can further develop as the person derives satisfaction from the activity and recognizes its potential utility. Also, it is believed that subjective evaluations of utility value influence the transition from situational to personal interest (Harackiewicz et al., 2014). It would be meaningful to research and implement interventions aimed at increasing students' task values in the classroom and utility value intervention can be of these interventions. In this sense, Schiefele (2009) emphasized the significance of connecting the natural sciences to students' experiences because doing so may spark their interest. For instance, research by Hoffmann, Lehrke, and Todt (1985) found that when physics is taught primarily through scientific laws, students are not as interested in the subject as they are when it is applied to their own lives. Thus, raising perceived task value is an effective way to boost interest and motivation, according to both the interest theory and the expectancy-value model (Harackiewicz et al., 2014). According to interest theory

(Hidi & Renninger, 2006), task values may result in heightened interest, which may subsequently have an impact on judgments about what courses to take in the future. It can be made inferences that students' personal interests are also closely related to other variables(like career choices and task value beliefs). Supporting this idea, Harackiewicz et al. (2002) and Harackiewicz and colleagues (2000) discovered that students' final choice of academic major and future course-taking over a four-year period were predicted by their interest in introductory psychology courses.

On the other hand, students who are not very interested in a task might be more receptive to an intervention that suggests a task could be valuable (i.e., have utility value) rather than enjoyable (i.e., have intrinsic value). This is because the utility value could align with their personal objectives without directly conflicting with their task experience. Ironically, interventions that specifically target intrinsic task value may undermine a person's feeling of autonomy (Deci & Ryan, 1985). However, because utility value is external, students may be more open to interventions that increase it. When students recognize the worth of a work, they may also become more involved and show greater interest in it. In fact, according to Harackiewicz and colleagues(2016), utility value intervention is one of the interventions that can be used to promote interest development and subsequent educational outcomes. In their related conceptual model, structural features, context personalization, and problem-based learning are suggested as additional interventions. Regarding the choice of utility-value intervention among these options in the current study, Harackiewicz and colleagues (2016) asserted that no single interest intervention is universally effective. However, utility-value interventions are likely to enhance motivation for all students (Brown et al., 2015; Harackiewicz et al., 2015; Harackiewicz et al., 2012). In addition, the utility-value intervention is adaptable, can work with students at different interest levels, and may even assist underrepresented students in making the connection between what they are learning and their own interests and values. This intervention has the potential to close achievement gaps that have persisted over time (Harackiewicz et al., 2016).

2.6 Utility Value Beliefs Towards Science

Moving on to the achievement values section of the model, as shown in Figure 2.1., Eccles et al. (1983) defined the attainment value or importance, intrinsic value, utility value or usefulness of the task, and cost as the various components of achievement values (Eccles et al., 1983, and Wigfield & Eccles, 1992).

Numerous earlier studies have shown that task values—aside from cost, which is negatively correlated (e.g., Conley, 2012; Flake et al., 2015)—are positively correlated with persistence and motivation in an activity (Wigfield & Cambria, 2010). However, Wigfield and colleagues (1992) view utility value as more external than these four task values since it goes beyond the work itself to include links with other tasks, activities, or objectives (Wigfield & Eccles, 1992). In this sense, only a few published studies examining interventions based on the expectancy-value framework in an educational setting were found in the current literature, and they were all utility value-focused (Acee & Weinstein, 2010; Brown et al., 2015; Harackiewicz et al., 2015; Harackiewicz et al., 2012; Hulleman & Harackiewicz, 2009; Hulleman et al., 2010; Johnson & Sinatra, 2013). Based on these studies which were utility-value focused, in this thesis study, only the utility value component was specified and mentioned in this heading. Because focusing on the utility value of students and trying to increase it also gives us insight into related areas. For example, for students to maintain their interest and commitment to science, they must believe that the field is valuable and beneficial (i.e. their utility-value) to them. This belief encourages students to have long-term goals related to science and to continue in the field (Schunk & Pajares, 2002).

After explaining why it was focused on utility value in this study, it is necessary to explain what utility value is. Specifically, utility value or usefulness value describes how an activity fits into a person's future goals. Also, while value-related valences of interest (as mentioned above) are intrinsic and closely tied to the item of interest, utility value can be defined as extrinsic value beliefs (Deci, 1992; Eccles &Wigfield,

2020). When a student attends scientific classes, for instance, not out of curiosity but rather to achieve high grades, this student acts with extrinsic motivation because the activity itself and the distant goal are independent of the actual activity. On the other hand, according to the original expectancy-value model (Eccles et al., 1983), the perception of any kind of value in an activity is likely to boost motivation to complete it. It is believed that reflecting on the personal connections that students have made between the course material and their lives will raise their perceptions of utility value.

In this sense, utility-value interventions help students better understand the contribution of science courses to their personal and professional lives. This leads students to evaluate the value and importance of these courses at a higher level. As a result, students' utility-value beliefs about science become stronger (Eccles & Wigfield, 2002). Furthermore, strong utility-value beliefs can lead students to approach science courses with greater motivation. When students perceive that science courses are compatible with their personal goals, they exert more effort and achieve higher levels of success in these courses (Schunk & Pajares, 2002).

Apart from the definitions of utility value, when looking at the studies in the relevant literature on utility value, it can be seen that it is related to many concepts. For example, one correlational study has revealed a strong relationship between self-reported utility value, situational interest, and achievement choices. Reports of task interest and enjoyment and sustained engagement in domains are closely linked to perceptions of utility value (Eccles & Wigfield, 1995; Hulleman et al., 2008; Simpkins et al., 2006). According to several studies, students who reported utility value in their course content, for instance, took more classes in related areas and thought more broadly about their schoolwork (Eccles & Wigfield, 1995; Harackiewicz et al., 2012; Husman & Lens, 1999; Jacobs & Eccles 2000; Meece et al., 1990; Wigfield, 1994).

Recent research suggests that utility interventions are effective in increasing students' utility value beliefs and in positively affecting students' academic performance. For example, in a study by Hulleman and colleagues (2010), a utility intervention with high school students enabled students to discover the personal meaning and usefulness of course material, which in turn increased students' academic performance. Also, when examining the related literature, Gaspard and colleagues (2015) recently found that utility interventions for high school students increased their utility value beliefs in mathematics and positively affected their performance in these courses. These studies suggest that utility interventions can have positive effects on both short-term and long-term academic achievement. It can be understood from this study, that there is a strong relationship between utility value beliefs and utility value interventions.

Additionally, processes of task engagement that can support learning and task performance have been linked to self-reported utility value (Bong, 2001; Hulleman et al., 2008; Simons et al., 2000, 2004). Individuals who viewed tasks as beneficial or essential for their future objectives employed deep learning techniques (Lens et al., 2001), had a desire to achieve progress (Lens & Decruyenaere, 1991), and put out more effort even when they did not enjoy their job (Sansone et al., 1992, 1999). Although this study does not directly examine the effect of utility value on students' task performance and engagement, one of its aims is to enhance students' utility value beliefs. Consequently, the findings of this study have the potential to provide important insights for improving student performance and engagement.

Furthermore, utility value has been characterized as having certain extrinsic qualities as said before because it arises from a task's association with other pursuits rather than from direct experience with the task itself, despite the fact that utility value is positively correlated with measures of interest and personal choices (Eccles and Wigfield, 2002). Activities to be implemented in the classroom to increase utility value of students’ can also be implemented by considering the extrinsic structure of utility value.

Finally, in line with the nature of the concept of utility value and the studies conducted, the effect of the implementation of utility value interventions on students' utility value beliefs was also examined in this thesis.

2.7 Career Interest Towards Science

The career choice process has always been an issue for both students and society. Also, this process is a multidimensional and vast issue, and only the importance of career choice in science in the expectancy-value model has been discussed under this heading.

In this sense, the fundamental idea of the expectancy-value model is that people's beliefs about how well they will perform in a given activity and how much they value it—that is, how much subjective value they attach to it—can explain their choices, persistence, and performance (Wigfield and Eccles, 2000). According to the Eccles et al. model (1999), students are most likely to select classes that they find highly subjectively valuable and that they believe they can master. Furthermore, Eccles et al. (1999) demonstrated that career choices are predicted by both subjective value and expectation of success. Similarly, Eccles and Wigfield (2020) in their recent study emphasized that the interaction between subjective task values and expectations for success is crucial, as these factors jointly determine performance, motivation, future course enrollment, and career decisions. Specifically, the selection of courses by upper secondary school students is frequently driven by the perceived utility of these courses for their future careers. (Angell et al., 2004; Bøe, 2012; Miller et al., 2006; Lie et al., 2010; Hutchinson et al., 2009; Lyons, 2006; Osborne and Collins, 2001). During the upper elementary school years, students begin to seriously consider their career options, which significantly impacts their long-term motivation to study and their career decisions (Hartung et al., 2005; Maltese & Tai, 2009).

Specifically, when examining the relationship between utility-value beliefs and career choices, utility-value beliefs refer to the extent to which students perceive a particular course or task to contribute to their future goals and lives (Wigfield & Eccles, 2000). When students think about how science courses will contribute to their future career goals, they are more interested in these courses, which increases their career interest in science (Hulleman et al., 2010). Also, career interest in science reflects students' desire to pursue a career in science and their interest in the field. This interest is often shaped by students' positive experiences with science, areas in which they are successful, and their curiosity about science-related topics. Utility-value beliefs would play an important role in increasing this career interest because students are more interested in science courses and tasks when they think they are useful for their future careers (Gaspard et al., 2015).

In line with these propositions based on the expectancy-value model, Simpkins et al. (2006), in their longitudinal study, examined the relationships between expectations, values, and choices in mathematics and science. A total of 227 adolescents were surveyed in order to gather data: fifth-graders reported on their involvement in extracurricular activities, while sixth and tenth-graders discussed their subjective values and expectations for success in math and science. According to the study, engagement in certain activities influenced values and expectations, which in turn predicted enrollment in science and math classes in high school. Thus, these findings support the notion that emphasizing subjective task value and expectation of success is particularly crucial, as these factors significantly influence young people's decisions to pursue STEM fields.

When it comes to examining the relationship between utility-value interventions, students' utility-value beliefs, and career interests/choices, a few studies conducted in recent years stand out. For example, in a study conducted by Hulleman and Harackiewicz (2009), it was found that when high school students were shown how science courses could be useful in daily life and their future careers, their interest in these courses and academic performance increased.

Another recent study by Shin et al.(2022b) investigated the effect of utility value intervention on career interest in science. In the result of the study, students in the experimental condition expressed a greater appreciation of the role science played in their future careers, felt that science had a greater utility value, were more interested and self-efficacious in their science classes, and had a stronger desire to pursue careers in science than students in the control condition.

Thus, the abovementioned studies suggest that students' utility-value beliefs can affect their intentions to pursue a career, especially in STEM (Science, Technology, Engineering, and Mathematics) fields. Additionally, the interventions by parents emphasizing the benefits of STEM courses to their children were found to increase their children's interest in these courses and their likelihood of considering STEM careers in the future (Lee et al., 2020).

However, there is one more point that should not be forgotten: a career choice is a dynamic process that evolves over time as expectations and personal beliefs do. As students gain experience after reaching a decision point, they may really decide to change their minds and discontinue studying STEM before graduating. In this sense, the model's expectancy-value structure does not suggest that decisions are made by carefully weighing every alternative. For instance, the interest-enjoyment value may be derived from a "gut-feeling" and has significant affective components (Bøe et al., 2011). That is, students' task value beliefs at that time may not be accurate. For example, students' age may be small and they may not think their choices accurate way. Furthermore, a child's perception of the importance of, say, an engineering education could not be founded in fact on information regarding the employability and future prospects of engineers, but rather on hearsay or stereotypes. But still despite all these possibilities, the choice of career is made based on this subjective perception of the study's utility value(Bøe et al., 2011; Bøe & Henriksen, 2013).

Finally, all these studies show that students' personal interests (science) and the task-value belief they give to the course (science-oriented) would be important in career selection. In this present study, it was aimed to investigate how this intervention affected students' personal interests in science, their task-value beliefs in science, and their career choices in science by applying a utility value intervention to them in the science course.

2.8 Utility Value Intervention

An interactive, in-class activity called the utility-value intervention aims to assist students in drawing links between the material they are learning and their daily lives (Hulleman et al., 2010). The intervention has improved learning outcomes, including course-specific performance and interest, and longer-term outcomes, like course enrollment and major persistence, across many randomized field studies.

Meanwhile, this present study utilized utility-value intervention to middle school students in order to examine the effects of these prompts on students' personal interest in science, task-value beliefs, and career interests in science. Coming to why chosen to utility value intervention as a treatment in this current study, although Harackiewicz and colleagues (2016) stated that no interest interventions are one size fits all, utility-value interventions are promising to increase motivation for all students (Brown et al., 2015; Harackiewicz et al., 2015; Harackiewicz et al., 2012).

Also, the majority of utility value intervention studies showed that the effects of the intervention were most powerful for students who were most likely to face unfavorable learning outcomes(e.g. students included those who had previously performed poorly) (Hulleman et al., 2016), had lower expectations for their success (Hulleman & Harackiewicz, 2009), or belonged to underrepresented groups in higher education (Harackiewicz et al., 2016).In addition, the utility-value intervention is adaptable, can work with students at different interest levels, and may even assist underrepresented students in making the connection between what they are learning and their own interests and values. In this sense, much of the research has indicated that high school students who have self-doubt and college students with a history of poor performance benefit most from the utility-value writing intervention (Canning & Harackiewicz, 2015; Gaspard et al., 2015; Harackiewicz et al., 2015; Hulleman et al., 2008; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009; Hulleman et al., 2016). Shortly, all the studies mentioned above also stated the effectiveness of using utility value intervention, which provides a logical reason why utility value intervention was used in this current thesis.

Before looking at the implementation of utility value intervention in science and other domains, it should look at the characteristics (like dosage and timing) of these interventions.

Timing

When to implement the utility-value intervention is also another issue. Logically, if the utility value intervention was implemented towards the middle of the semester in an academic year, it is thought that students would learn enough of the subject and thus make more connections to their daily lives, but studies in this area show that this is not true. In this sense, according to Canning et al. (2017), early assignments are especially helpful for college biology students who have a history of poor performance. So, the utility-value prompts applied in this present study were applied to the students at the end of the topic covered each week in the science class, without any time break. The application of the prompts without a long break also prevented the students from disengaging from the topic, as mentioned in the relevant literature.

Dosage

Another crucial topic was the dosage of the utility-value intervention. Actually, utility value interventions are not a one-time event because students may need multiple exposures to these interventions to truly understand the utility value of the subject covered in class. In this sense, studies in the relevant literature support this situation positively. For example, science teachers in high school who delivered the intervention more frequently during the semester had higher results of implementing intervention than those who offered it less frequently, according to research by Hulleman and Cordray (2009). Also, Hulleman and Cordray' (2009) study results were complemented by Canning et al. (2017) study which revealed implementing three utility-value assignments was more efficient than a single assignment. When the relevant literature is carefully examined and the positive effects of applying more than one intervention are taken into consideration, more than one utility value intervention was applied in this present study.

2.8.1 Utility Value Intervention Implementations

In recent years, there has been an increasing amount of literature on utility-value intervention and its effects. Some of the most obvious studies in this area were carried out by Hulleman and his colleagues. For example, Hulleman and Harackiewicz (2009) conducted research to determine whether a curriculum that is personally meaningful and relevant can boost students' motivation and learning. They carried out their study with mostly 9th-grade high school students in the biology classes. Students were asked to write under two different conditions: in the relevance condition, they had to write the connection between what they had learned in class and their real life, and in the control group, they had to write a summary of what they had learned. Students were asked to choose a topic that was being discussed in class at the time in both scenarios. Also, unlike other studies, this study uses the term relevance intervention instead of utility value intervention. At this point, it is necessary to explain why these interventions are theoretically so similar, but conceptually utility value is a subset of relevance that is concentrated on personal utility, whereas relevance is defined as a personally meaningful link to the individual (Kosovich & Hulleman, 2016). That is, relevance interventions often attempt to increase short-term motivation by focusing on students' current interests and life contexts. For example, presenting a math problem in a way that is relevant to everyday life (Ginsburg-Block et al., 2006). Utility-value interventions target long-term motivation by emphasizing the long-term application and career benefits of knowledge. This provides students with a broader perspective on future success (Harackiewicz et al., 2012).

After this explanation, when comes to the findings of the study by Hulleman and Harackiewicz (2009), students with low success expectations showed higher personal interest in science and course grades when they received a relevance intervention, which encouraged them to draw connections between what they were learning in science classes and their own lives. However, additional investigation is necessary to have a deeper comprehension of the optimal design for these treatments to ensure their successful implementation in the classroom. In this sense, another study was conducted by Hulleman et al.(2016), which is an expanded version of the study conducted by Hulleman and Harackiewicz(2009). Hulleman et al. (2016) conducted a study with university students in the 15-week introductory psychology course. The result of this study revealed that making more connections was positively correlated with expecting to do well in the course, valuing the course material, and maintaining interest, according to the study's connection frequency. Additionally, the study's findings showed that, as compared to the control condition, students randomly assigned to either utility value intervention felt more confident in their ability to understand the subject, which improved their performance in the course. Also, the students with the lowest performance levels benefited most from the utility value interventions. Looking at the gender dimension, male students who were randomly allocated to the utility value conditions who were low-performing were better over the semester than those in the control condition, who had a consistent decrease in performance.

Additionally, looking at the literature about the utility value intervention, there were many studies in different domains (like psychology, mathematics, science, etc.). In this sense, there was a study by Gaspard and colleagues (2015), a cluster-randomized controlled study was carried out, to find out if relevance interventions in the classroom could support ninth-grade students' value views in the mathematics domain (i.e., intrinsic value, attainment value, utility value, and cost). A control condition or one of two experimental conditions was randomly allocated to eighty-two classrooms. The intervention asked students to assess quotes from other students who use math in their daily lives, revising the way that utility value was fostered. In the end, students who were in either of the intervention conditions had stronger positive value beliefs. Classes in the text condition increased utility values and the quotations condition reported higher utility values, as well as attainment and intrinsic values, in comparison to the control condition. Also, there was some evidence that the intervention had greater impacts on females than on males when the results were evaluated individually for the sexes.

Another study, related to the utility-value intervention implementation, was carried out in the mathematics domain also by Kosovich and colleagues (2019). Kosovich et al study's (2019) utilized utility value intervention assignments in their study in order to support student success in community college math. This study result revealed that the intervention had a significant impact on student pass rates in double-blind experimental research with 180 participants. Subsequent investigation in terms of gender dimension showed that the intervention had little effect on women's passing rates, but it mainly increased men's. The utility value intervention can improve community college math outcomes, as the study shows.

Previous studies as mentioned above have reported a positive influence of utility value intervention on students' grades, interest, pass rates, and utility value, but Herrera's (2019) study mentioned different findings on utility value intervention. According to Herrera (2019), the study was conducted with 51 high school students, the majority of whom were 9th-grade students. An experimental condition or a control group was assigned to four biology classrooms. Throughout a four-week period, students in the control and experimental groups participated in the same lessons and activities with the exception of an intervention that took place once a week in the last thirteen minutes of class. Before writing on their own for ten minutes, the students in the intervention group talked for three minutes about how the material in class related to their own lives or the lives of people they knew. On the other hand, after spending three minutes discussing a subject they covered in class, the students in the control condition took ten minutes to individually write a summary of what they had learned. Herrera's (2019) study findings do not support the idea that students' views of utility value, personal interest in science, and academic performance were impacted by the utility value intervention. However, the study of the qualitative part showed that students were able to draw links between what they had learned in class and their daily lives.

Another recent study by Shin et al.(2022b) investigated the effect of utility value intervention on career interest in science. In this study, a science utility value intervention was implemented in 23 classes (n = 550) for fifth and sixth-grade students as part of the study. Students gained an understanding of the communal and personal value of science through five intervention sessions that included writing and other varied individual and group activities. These activities were specific to 14 common non-STEM vocations as well as the students' own desired future careers. Following the intervention, students in the experimental condition expressed a greater appreciation of the role science played in their future careers, felt that science had a greater utility value, were more interested and self-efficacious in their science classes, and had a stronger desire to pursue careers in science than students in the control condition. Also, the intervention was particularly successful in raising girls' perceptions of their own utility value, appreciation, and desire to pursue careers in science. At the end of the semester, the experimental group outperformed the control group—which had a delayed intervention—in terms of self-efficacy and interest in science. The results offer significant empirical and useful information for creating science interventions that are successful for young students.

A growing body of literature suggests that UV interventions may be beneficial for science classes. Based on the positive results of the utility value intervention on students in the study by Shin et al. (2022a), it can be said that one way to encourage performance and continuity in STEM fields may be to have students write about the utility value or personal relevance of course topics for their own lives. In this context, there was a study by Canning and colleagues(2017). In that study, Canning et al. (2017) conducted a study including 577 students in biology classes who were assigned to receive UV assignments for three units over the course of a semester. The study examined several doses of the UV intervention, such as one, two, or three UV assignments. They discovered that compared to students who did not receive any

UV assignments, those exposed to any amount of UV received better scores in the course, were more likely to enroll in the second course of the biology sequence, and were less likely to drop out of STEM. When it came to timing, students who had low performance benefited by writing a UV essay early in the semester, whereas those who had high performance profited well did it at the end of the semester. When it came to dosage, they revealed that giving students three UV assignments throughout the semester produced the best results from the intervention.

Finally, much of the available literature on utility value intervention deals with the question of how effective this implementation is in students' learning outcomes, motivations, or career choices toward science. In this sense, Hulleman and colleagues (2018, as cited in Hulleman & Harackiewicz, 2021) conducted a meta-analysis of utility-value interventions and identified 33 field studies in which 12,478 participants were randomized to either a utility-value or control condition. Their meta-analytic findings showed that the utility-value intervention increased learning outcomes—such as exam scores, grades, and pass rates at the end of the semester, and interest in the subject matter—on average.

2.9 The Summary

Briefly, this chapter focused on the theoretical framework behind the lying of the expectancy-value model and also mentioned students' personal interests, utility-value beliefs, and career interests in science from this perspective. Also, it was mentioned about the utility value intervention studies in this context. When examining the studies that applied utility value intervention in the related literature, it was obtained various findings from them.

When looking at the effect of utility-value intervention, Hulleman and Harackiewicz (2009) found that utility-value intervention increased the personal interest in science, especially for students with low achievement expectations, and increased the course grades of these students. This finding suggests that utility-value interventions can increase students' interest and improve their academic performance by allowing them to find course content personally meaningful and useful. In addition, Shin et al.'s (2022a) study revealed that utility-value intervention increased career interest in science, students valued the role of science in their future careers more and strengthened their desire to pursue a career in this field. In addition, appropriate timing and dosage appear to be critical for utility-value intervention to be effective. Hulleman and colleagues (2016) found that the effect of utility-value intervention varied depending on the frequency with which students connected to the course and that more connections increased students' interest in the course. The study by Canning and colleagues (2017) showed that implementing multiple utility-value interventions (e.g., three UV assignments) increases students' academic performance and their likelihood of continuing in STEM fields. These findings suggest that implementing the intervention in multiple doses and at the right time can have positive effects, especially on low-performing students. On the other hand, studies in the literature on utility-value interventions have generally been conducted with high school and university students. For example, the study by Hulleman and Harackiewicz (2009) was conducted with 9th-grade (high school) students, while the study by Canning and colleagues (2017) was conducted with university students. This suggests that the interventions in the available literature focused on students at higher education levels.

In summary, studies on utility-value interventions in the literature show that utility-value interventions can be effective in increasing students' interest in lessons, career choices, and utility-value beliefs, but that this effect may vary depending on timing, dosage, and target audience. These studies, which focus on high school and university students, reveal that interventions, especially in science, do not always produce the expected effect, and therefore caution should be exercised in the design of such interventions.

CHAPTER 3

METHODOLOGY

This chapter includes information about the design of the study, sample, instrumentation, treatment, data analysis procedure, ethical issues in the study, assumptions, and limitations.

3.1 Research Design

In this present study, using a quasi-experimental research design, the effects of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone applied in science classes on middle school students' personal interest in science, utility value beliefs, and science career interest were investigated.

Table 3.1 Research Design of The Study

Groups	Pretest	Treatment	Posttest
Experimental Group (2 classes)	Individual Interest Questionnaire (IIQ) in Science Utility Value Belief in Science Scale Science Career Interest Scale	Curriculum-oriented instruction supported by utility-value intervention (prompts with daily life connection in the science topic in each week)	Individual Interest Questionnaire (IIQ) in Science Utility Value Belief in Science Scale Science Career Interest Scale Science Interest Questions

Table 3.1 Research Design of The Study (continued)

Control Group (2 classes)	Individual Interest Questionnaire(IIQ) in Science Utility Value Belief in Science Scale Science Career Interest Scale	Curriculum oriented instruction (prompts with a summary about the science topic in each week)	Individual Interest Questionnaire(IIQ) in Science Utility Value Belief in Science Scale Science Career Interest Scale Science Interest Questions

As shown in Table 3.1, before the treatment, Individual Interest Questionnaire (IIQ) in Science, Utility Value Belief in Science Scale, and Science Career Interest Scale were administered to both groups. In addition, in order to obtain in-depth information about students' personal interest in science after instruction, written open-ended questions were administered. After the treatment, the same instruments were administered again, in order to investigate the effectiveness of the treatment on students' personal interest in science, utility value, and science career interest in science.

3.2 Sample

The target population of the present study was all 7th-grade students attending public schools in Ankara. The accessible population was all 7th-grade students attending public schools in Çankaya district of Ankara. Convenience sampling was utilized to select the sample considering voluntariness of participating teachers and administrative, money, and time restrictions. Accordingly, the data were collected from 4 different 7th-grade classrooms in the same public middle schools in Çankaya district in Ankara. Although there was a total of 120 students in these classes, 95 students' families allowed their children to participate in the study. Thus, the present study comprised of 95 students (51 girls and 44 boys) with a mean age of 12.22 (SD=0.442). In the study, the classes were randomly allocated to either of two instructional modes: curriculum-oriented instruction supported by utility-value intervention (experimental group) and curriculum-oriented instruction (control group). Each instructor was responsible for teaching both experimental (n =52) and control groups (n =43). Students in both instructional settings were exposed to identical syllabus-prescribed learning content.

3.3 Instrumentation

This present study consists of both quantitative and qualitative data. Quantitative data of the study were obtained by implementing the Individual Interest Questionnaire in Science (Dixon, 2014), (Rotgans, 2015), Utility-Value Belief in Science Scale (Yerdelen & Sungur, 2020), (Sungur, 2004), (Pintrich et al., 1991) and Science Career Interest Scale (Fraser, 1981), (Telli et al., 2006). Qualitative data of the study were obtained by the written open-ended Science Interest Questions (Dixon, 2014) assessing students' personal interest in science after the instruction. Also, the utility value intervention prompts were implemented in the experimental group during the study. These prompts were revised from studies in the related literature (Canning et al., 2017), (Hulleman et al., 2010) and assessed through a rubric to determine students' articulated utility values.

Before the main study, the instruments used to obtain quantitative data were pilot tested. As part of the pilot study, exploratory factor analyses and reliability analyses were conducted. The sample in the pilot study consisted of 76 middle school students (35 girls and 41 boys) with a mean age of 11.59. The following sub-sections include information about each of the instruments and its pilot study findings.

3.3.1 Individual Interest Questionnaire in Science(IIQ)

Individual Interest Questionnaire in Science was used to provide information about middle school students' personal interest in science. The original version of the instrumentation was created by Rotgans (2015) and consisted of 7 items on a 5-point Likert scale(1=not true at all to 5=very true for me). In the original version, two investigations were carried out to evaluate the validity and reliability of the developed Individual Interest Questionnaire in Science (IIQ) by Rotgans (2015). The first investigation's goal was to evaluate the IIQ's construct validity. Three samples were chosen from populations of high school students in various disciplines, including geography, history, and life sciences. The researcher chose to work with high school participants because dispositional preferences for particular disciplines seem to emerge at this time and may be important determinants of study choice after students enter universities. Also, confirmatory factor analyses were performed to evaluate the IIQ's construct validity. To evaluate the instrument's reliability, reliability tests for latent variable systems were also conducted. Three separate samples each received one administration of the IIQ. The external validity of the measure was established by structural equation modeling tests of multi-group invariance. Then, Hancock's coefficient H, which was computed as a measure of construct reliability for latent variable systems and serves as a suitable substitute for the traditional Cronbach's alpha, was found to be .87, which was enough for reliability (Hancock & Mueller, 2001 as cited in Rotgans, 2015). That is, according to the results test for multi-group invariance between the IIQ's disciplines of geography, chemistry, and history, the IIQ can be utilized validly and reliably in a range of subject areas.

In this present study, The IIQ was translated and adapted for assessing Turkish middle school students' personal interest in science. During its adaptation, the instrument was first translated by the researcher. Then, the translated version was reviewed by two experts in science education. They assessed the translated IIQ for content validity and assessed the quality of the items regarding clarity, sentence structure, and grammar. Based on the experts' suggestions one item was added to the IIQ. This item "I spend my spare time doing science related activities" was taken from Dixon's (2014) study. In addition, 4-point scale which is simpler and easier for respondents to understand and respond was suggested to be utilized. Thus, the Turkish version of the Individual Interest Questionnaire to be pilot tested consisted of 8 items on a 4-point Likert scale (1=strongly disagree to 4=strongly agree) (see Appendix A).

As part of the pilot study, exploratory factor analysis (EFA) was conducted using IBM SPSS Statistics 29. Before conducting the exploratory factor analysis (EFA) for IIQ, underlying assumptions were checked to understand whether the data in the IIQ was suitable for this analysis. The assumptions included sample size, factorability of the correlation matrix, linearity, and outliers among cases (Pallant, 2011).

1. Sample Size

The sample size must be sufficient to determine whether the existing data set is suitable for factor analysis. Pallant (2011) suggested that a factor analysis should require a minimum of 150 examples. However, some authors contend that factor analyses should consider small sample sizes. According to De Winter and colleagues (2009), a sample size of 50 or fewer may be sufficient in behavioral studies. In this present study's sample size was 76 and was considered sufficient for implementing exploratory factor analyses.

2. The Factorability of the Correlation Matrix

Pallant (2011) states that a correlation matrix ought to have a minimum of a few correlations with r=.3 or higher. If, on the other hand, no correlations are found above 3, the factor analysis for the relevant data set ought to be re-examined. In this present data, numerous correlations greater than .3 were found. Furthermore, "the Kaiser-Meyer-Olkin value should be .6 and above and Bartlett's test of sphericity should be statistically significant at p <.05" (p.187). The Kaiser-Meyer-Olkin value was 0.823 and Bartlett's test of sphericity was significant with $p<0.001$ value so this assumption is provided for this Individual Interest Questionnaire in Science (IIQ).

3. Linearity

As factor analysis relies on correlations, it requires a linear relationship among variables (Pallant, 2011). However, creating scatterplots and interpreting them for all variable pairings is impractical. Tabachnick and Fidell (2013) recommended a selective examination, termed a 'spot check,' involving some variable combinations. Absent conspicuous indications of nonlinearity, proceeding with analysis is likely justified, contingent upon possessing a sufficient sample size and a favorable ratio of cases to variables. The IIQ consists of 8 items and the sample size was 76. Thus, the sample size and cases to variables ratio, and "spot check" of the scatter plots provide support for the satisfaction of the linearity assumption

4. Outliers Among Cases

According to Pallant (2011), outliers may cause factor analysis to become sensitive. No outliers were found since there were no unusual responses or inaccurately entered extreme data. Thus, the assumption about outliers among cases was satisfied.

Thus, all of the assumptions were met before Exploratory Factor Analysis (EFA). EFA with 8 items was implemented with principal component analysis (PCA) as an extraction method and a direct oblimin rotation. In the analysis part, the number of factors was restricted to 1.

Table 3.2 presents the component matrix for the IIQ. As shown in the table, all of the values are above 0.4 implying that all of the items loaded one factor strongly. Thus, the EFA results supported the one-factor structure of the IIQ.

Table 3.2. Component Matrix[a] of Individual Interest Questionnaire in Science

	Component
	1
pilotBI2	.780
pilotBI1	.736
pilotBI4	.687
pilotBI7	.658
pilotBI8	.646
pilotBI6	.592
pilotBI3	.565
pilotBI5	.486

In addition, as a result of reliability analysis, Cronbach's alpha coefficient was found to be 0.792. Pallant (2011) states that one of the most widely used measures of internal consistency is Cronbach's Alpha coefficient, and a value greater than .7 suggests sufficient internal consistency. In the main study, Cronbach's alpha value was found to be 0.871 for the pretest and 0.832 for the post-test.

3.3.2 Utility Value Belief in Science Scale

Utility Value Belief in Science Scale was used to assess middle school students' utility value belief in science. This scale was developed by combining and revising existing scale items. Two of the items in the utility value sub-dimension of the Motivated Strategies for Learning Questionnaire, adapted into Turkish by Sungur (2004), and two items from the task value scale utilized in Yerdelen and Sungur's (2020) study were used to construct this utility value belief scale. The items used in this study were adapted for science courses and measured on a 4-point Likert scale(1=strongly disagree to 4=strongly agree) (see Appendix B).

Because the items constituting the Utility Value Belief in Science Scale were adapted from existing scales, a pilot study was conducted to examine its factor structure and internal consistency. Specifically, exploratory factor analysis (EFA) was conducted using IBM SPSS Statistics 29. Before conducting the EFA for the Utility Value Belief in Science Scale, the assumptions for EFA were checked to ensure the data's suitability for this analysis. The assumptions included sample size, factorability of the correlation matrix, linearity, and outliers among cases (Pallant, 2011).

1. Sample Size

The sample size needs to be adequate to assess whether the current data set is appropriate for factor analysis. Pallant (2011) proposed that a minimum of 150 cases should be required for a factor analysis. Some authors contend, however, that factor analyses can be conducted with a limited sample size as well. In this sense, De Winter and colleagues (2009) suggest that especially in behavioral studies, a sample size of 50 or less may be sufficient. Therefore, the sample size in the pilot study was considered adequate for conducting exploratory factor analysis

2. The Factorability of the Correlation Matrix

Pallant (2011) states that a correlation matrix ought to have a minimum of a few correlations with r=.3 or higher. If, on the other hand, no correlations are found above .3, the factor analysis for the relevant data set ought to be re-examined. In this present data, numerous correlations greater than .3 were found while looking at the associated correlation matrix. Furthermore, "the Kaiser-Meyer-Olkin value should be .6 or above and Bartlett's test of sphericity should be statistically significant at $p < .05$" (p.187). Field (2000) also stated that 0.50 should be the lower limit for the Kaiser-Meyer-Olkin test and that the data set cannot be factored for KMO≤0.50. In this present data, The Kaiser-Meyer-Olkin value was 0.571 and Bartlett's test of sphericity was significant with $p<0.001$ value so considering all these suggestions, the assumption for the Utility Value Belief in Science Scale was found to be satisfied.

3. Linearity

Factor analysis, which relies on correlations, requires a linear relationship among variables (Pallant, 2011). Although creating and interpreting scatterplots for all variable pairings is impractical, Tabachnick and Fidell (2013) recommend a selective examination known as a "spot check," which involves analyzing some variable combinations. In the absence of obvious indications of nonlinearity, it is generally acceptable to proceed with the analysis, provided there is a sufficient sample size and a favorable ratio of cases to variables. The Utility Value Belief in Science Scale consists of 4 items, and the sample size was 76. Thus, the sample size, cases-to-variables ratio, and the spot check of scatterplots support the satisfaction of the linearity assumption.

4. Outliers Among Cases

Pallant (2011) notes that outliers can render factor analysis sensitive. In this study, no outliers were identified, as there were no unusual responses or inaccurately entered extreme data. Consequently, the assumption regarding the absence of outliers among cases was satisfied.

Having satisfied all the underlying assumptions, the EFA was conducted with principal component analysis(PCA) as an extraction method and a direct oblimin rotation. In the analysis part, the number of factors was restricted to 1.

Table 3.3 displays the component matrix for the Utility Value Belief in Science Scale. As shown in the table, all of the values are above 0.4 implying that all of the items loaded one factor strongly. Thus, the EFA results supported one-factor structure of the Utility Value Belief in Science Scale.

Table 3.3 Component Matrix[a] of Utility Value Belief in Science Scale

	Component
	1
pilotFD2	.778
pilotFD1	.750
pilotFD3	.720
pilotFD4	.604

As part of the reliability analysis, Cronbach's alpha coefficient was calculated and it was found to be 0.67. A scale's Cronbach alpha coefficient should ideally be greater than.7 (DeVellis, 2003). However, the number of items in the scale has a significant impact on Cronbach's alpha values. Short scales—that is, scales with fewer than ten items—often have relatively low Cronbach values (Pallant, 2011). Thus, the reliability coefficient of 0.67 is considered to suggest an adequate internal consistency (Pomeroy, 1993; Diakidoy, Kendeou, & Ionnides, 2003). In the main study, Cronbach's alpha value was found to be 0.810 for the pretest and 0.769 for the post-test.

3.3.3 Science Career Interest Scale (SCIC)

The Science Career Interest Scale was used to assess middle school students' career interests in science. The original version of the instrumentation was created by Fraser (1981) and the purpose of the Test of Science Attitudes (TOSRA) is to assess students' attitudes toward science in seven different domains. The original version of this instrumentation consisted of 70 items on a 5-point Likert scale(1=strongly disagree to 5=strongly agree in positive items, 1=strongly agree to 5=strongly disagree in negative items). Of the seven different attitudes towards science of the Test of Science Attitudes (TOSRA), only items from the Career Interest in Science domain were used. The original version of the instrumentation was translated into Turkish by Telli and colleagues (2006). Turkish version of this scale consisted of 40 items about students' attitudes toward science in several domains on a 5-point Likert scale(1=strongly agree to 5=strongly disagree). When Telli and colleagues (2006) conducted the reliability analysis in the career sub-dimension of TOSRA, they found Cronbach’s alpha coefficient as 0.75.

In the present study, some revisions were made to the items. For example, given that the target group in this study consists of middle school students, the phrases ”'when I leave school/after leaving school” in the items were changed to “in the future”(e.g. I would like to work with people who make discoveries in science in the future). One more item was also added to the scale by the researcher (I am interested in careers in the field of science). Thus, the final version of the Science Career Interest Scale consisted of 11 items on a 5-point Likert scale(1=strongly agree to 5=strongly disagree). In the final version of the instrument, there were four negatively stated items (see Appendix C).

Since modifications were made to the items and one item was added, a pilot study was conducted. As part of the pilot study, an exploratory factor analysis was carried out to examine the factor structure. To determine whether the data from the Science Career Interest Scale was appropriate for conducting the EFA, underlying assumptions were checked before the analysis. Sample size, linearity, factorability of the correlation matrix, and outliers among the cases were among the assumptions (Pallant, 2011).

Sample size

To determine whether the current data set is suitable for factor analysis, the sample size must be sufficient. Pallant (2011) suggested that a factor analysis should require at least 150 examples. However, some writers argue that factor analyses should also consider the small sample size. In this regard, De Winter and colleagues (2009) propose that a sample size of 50 or less may be enough, particularly in behavioral studies. Thus, the sample size in the present study (n=76) appears to be sufficient to conduct EFA.

Factorability of the correlation matrix

A correlation matrix should include at least a few correlations with r=.3 or higher, according to Pallant (2011). However, the factor analysis for the appropriate data set should be reexamined if no correlations are discovered above.3. Examining the corresponding correlation matrix, many correlations larger than .3 were discovered in the current data. Additionally, "the Kaiser-Meyer-Olkin value was greater than 6, more specifically, 0.813, and Bartlett's test of sphericity was statistically significant, p <.05" (p.187). indicating that this assumption was met for this science career interest scale.

Linearity

A linear relationship between the variables is assumed because factor analysis depends on correlation (Pallant, 2011). While generating and interpreting scatterplots for all variable pairings is impractical, Tabachnick and Fidell (2013) recommend a selective examination termed a "spot check," which involves analyzing some variable combinations. In the absence of evident nonlinearity, it is generally acceptable to proceed with the analysis, provided there is a sufficient sample size and a favorable ratio of cases to variables. Given these conditions, the linearity assumption was considered to be satisfied.

Outliers among cases

Pallant (2011) states that factor analysis may become sensitive as a result of outliers. Since there were no odd responses or improperly inputted data, no outliers were discovered. As a result, the assumption regarding outliers among cases was also met.

After ensuring that all the assumptions were met the EFA with 11 items was conducted with principal component analysis (PCA) as an extraction method and a direct oblimin rotation. In the analysis part, the number of factors was restricted to 1. Table 3.4 displays the component matrix for the Science Career Interest Scale. As shown in the table, all of the values are above 0.4 implying that all of the items loaded one factor strongly. Thus, the EFA results supported the one-factor structure of the SCIC.

Table 3.4 Component Matrix[a] of Science Career Interest Scale

	Component
	1
pilotK11	.796
pilotK10	.784
pilotK2	.775
RK3	.748
pilotK5	.698
RK1	.651
pilotK6	.613
pilotK4	.589
RK7	.585
pilotK8	.515
RK9	.483

Furthermore, Cronbach's Alpha coefficient which provides a measure of internal consistency was found to be 0.870. In the main study, Cronbach's alpha value was found to be 0.877 for the pretest and 0.891 for the post-test.

3.3.4 Science Interest Questions

The qualitative data regarding students' personal interest in science was provided by written open-ended science interest questions. Science Interest Questions were sourced from the dissertation study conducted by Dixon (2014). These questions were utilized to gain a comprehensive understanding of the changes in students' personal interest in science throughout the treatment and the underlying reasons for these changes. Originally, there were two questions including "Has your interest in science changed while doing this science unit?" and "Write a justification for any change in your interest in science". After the first question, students were asked to circle one of the following responses (A) "It has increased my interest in science", or (B) "It has not changed my interest in science", or (C) "It has decreased my interest in science" The validity of the original version of this questionnaire was determined by triangulating the information from the interviews in Dixon's study(2014). In the current study, these questions were translated into Turkish by the researcher and were subsequently revised to inquire about pertinent science topics (e.g., the Force and Energy Unit and the Pure Substance and Mixtures Unit) (see Appendix D). These science interest questions were administered once as part of the immediate post-test at the end of the science unit.

3.4 Treatment

This study was conducted at a public middle school in Ankara over 9 weeks during the 2023-2024 fall and spring semesters. In all, 95 students from two different science teachers' four intact classes participated in the study. The experimental and control groups were randomly assigned to the classes. Experimental group students were taught by curriculum-oriented instruction supported by utility-value intervention, while control group students were instructed by curriculum-oriented instruction alone. The study included two experimental groups and two control groups, with each group being taught by different science teachers. Specifically, one science teacher taught the classes for one control group and one experimental group, while another science teacher taught the classes for the other control group and the other experimental group. Meetings with the teachers were held before the study to inform them about the implementation of the intervention and to introduce the writing prompts that would be given to students during the treatment. That is, all processes were explained to both teachers in the same way by the researcher at the beginning of the study.

Specifically, a month before the study began, a meeting was held with two different science teachers. In these meetings, it was agreed with both teachers that the course would be the same in the classes and that they would use the same course material in order to avoid any differences in the course processing and instruction due to the different teacher factors in both the control and experimental group classes. In addition, the teachers were informed that the course would be conducted with curriculum-based instruction in both the control and experimental group classes. It was stated that in the control group classes, prompts requiring them to write only a lesson summary at the end of the course would be distributed, whereas in the experimental group classes, prompts requiring them to write sentences that would establish a connection between the course and daily life would be distributed. In addition, in the meetings held, the purpose of the prompts, how often, in which weeks and for how long they would be applied to the students in the course, and how information would be given to the students about the study beforehand were explained to the teachers in detail. In short, the teachers were informed in detail about how the Utility Value Prompts would be applied to the students in each week's classes. In addition to discussing the implementation of the intervention in this study, teachers were provided with information on the concept of Utility Value Prompts, the findings of relevant studies in the literature, and the significance and objectives of this research.

Before the intervention, the Individual Interest Questionnaire in Science (IIQ), Utility Value Belief in Science Scale, and Science Career Interest Scale were administered to assess students' pre-existing personal interest in science, utility value beliefs related to science, and interest in science careers. Before administration, students received necessary instructions clarifying that only the researcher would have access to the data from the scales and questionnaires and that these data would not affect their grades. Following these instructions, students independently completed the scales within one class hour.

After administering the scales to both experimental and control groups, both groups received curriculum-oriented instruction. In the units of force and energy and pure substances and mixtures as part of regular coursework. Both experimental and control groups received identical instructional content for the same duration, consisting of four 40-minute lessons per week. After completing each topic in a unit, utility value interventions were implemented in the experimental group. Specifically, there were 2 topics in the unit of force and energy including force, work and energy relationship, and energy conversion, and 5 topics in the unit of pure substances and mixtures including particulate nature of matter, pure substances, mixtures, separation of mixtures, and domestic waste and recycling. After completion of each sub-topic, students in the experimental groups were asked to make a connection between the sub-topic they studied in the science lesson and their daily lives in response to written prompts (see Appendix G). For example, after the instruction about the relationship between force, work, and energy, they were asked to write an essay about how the material that they have learned about the relationship between work, force, and energy topic in the unit of Force and Energy relates to your life, or to a friend or relative. They were expected to elaborate on how the materials covered related to this topic can be used in daily life and how useful they can be. According to Hulleman et al. (2010), the utility value intervention is an interactive, in-class intervention that aims to assist students in drawing connections between the topic they are learning in their science class and their daily lives. The utility-value sub-dimension of the value sub-heading of the expectancy-value model in the relevant literature was taken into consideration while creating utility-value interventions (Wigfield & Eccles, 2000). The prompts used in the current study were adapted by the researcher by examining the related literature (Canning et al., 2017; Hulleman et al., 2010).

On the other hand, students in the control group were asked to write just a summary of the topic they studied in a given unit (see Appendix H). The prompts were applied to both groups of students after each topic in the last 10-15 minutes of the lesson. In other words, in the last 10-15 minutes of the science lesson, following the end of the lesson, the researcher asked the students to fill out prompts distributed to them. Moreover, the researcher observed the instructions in each lesson to verify that both experimental and control groups received the same instruction but they differed only in the prompts used. It was revealed during the lesson observations of the researcher that there were no major differences in the lectures throughout the process. Although there were two different teachers, the teaching techniques and course materials were the same. In both groups, the method of instruction depended on the teacher's explanations. The teachers drew drawings associated with the force and energy units on the chalkboard and wrote notes on the definitions of terms like force and potential energy. Concepts were discussed through teacher-directed questions following the teacher's explanation. The same procedures were also carried out in the other unit, pure substance, and mixtures, The students didn't do any experiments or hands-on activities related to the subjects. As a result, they refrained from fully participating in the learning process and revealing their preconceptions. To put it briefly, the majority of the instruction time was spent on teacher explanations and responding to questions from the teacher.

After the treatment, in the last week of this present study, the same scales that were applied as a pre-test at the beginning of this study were applied to the students as a post-test. In the post-test, apart from the questionnaire and scales, students were asked science interest questions. In the questions, students were asked open-ended questions about whether their personal interest in science changed throughout the study and why.

3.5 Data Analysis Procedure

Descriptive statistics were used to examine the sample's overall characteristics. For the related research questions, means, standard deviations, histograms, and values for skewness and kurtosis were also provided. The impacts of the utility value intervention on middle school students' personal interest in science, utility value beliefs in science, and career interest in science were examined using a mixed between-within-subjects ANOVA(s). The independent variable was treatment. Students' personal interest in science, utility value beliefs in science, and career interest in science were the dependent variables measured before (Time 1) and after (Time 2) the treatment. The variables were measured using self-report instruments. A separate mixed between-within-subjects ANOVA was conducted for each variable.

Also, in order to assess the analysis of the impact of writing tasks(UV prompts) applied to students, writing tasks for experimental and control groups were coded according to the articulated utility value rubric (as mentioned below in the heading of “The Articulated Utility Value Rubric-Utility Value Writing Prompts Analysis”) The texts written by the students in each prompt were evaluated with one of the scores from 0 to 3 according to the articulated utility value rubric. In other words, the articulated utility values of each student who completed 7 prompts throughout this present study were coded with this rubric for each week. Then, one-way repeated measures ANOVA was conducted to examine whether there was a change in the articulated utility values of students receiving curriculum-oriented instruction supported by utility value intervention during the treatment or not for experimental groups. Also, the Friedman Test was run to reveal whether there was a change in the articulated utility values of students receiving curriculum-oriented instruction alone during the instruction or not for control groups. In addition, to investigate whether there was a difference between experimental and control group students with respect to articulated utility values was explored through the Mann-Whitney U Test.

On the other hand, the qualitative data, in this present study, regarding students' personal interest in science was provided by written two open-ended science interest questions. Before the data analysis, the written responses of students were individually read several times to achieve a thorough comprehension of their answers. The data were analyzed individually for each student. During data analysis, inductive coding was employed. The codes were consolidated, focusing on identifying commonalities between them. Based on these commonalities, categories emerged. The data was analyzed by the researcher and an expert in science education. During data analysis, the results of each coding by the researchers were compared, and efforts were made to resolve conflicts through discussions.

The Articulated Utility Value Rubric-Utility Value Writing Prompts Analysis

Writing tasks for experimental and control groups were coded according to the utility value level stated in the prompts. Based on how particular and intimate the utility value(UV) link was to the individual (i.e., individual which means the student or a close friend or family member for students who write a letter in UV settings), the assignments were coded on a 0–4 scale in related literature (Canning et al., 2017). In Canning and colleagues' study (2017), a score of "0" on the utility or relevance scale denotes no value; a score of "1" indicates general utility or relevance applied to people in general; a score of "2" indicates general utility or relevance applied to individuals; a score of "3" indicates specific utility or relevance applied to individuals; and a score of "4" indicates a strong, specific connection to the individual that includes a deeper understanding or future application of the material. However, in this present study, this 0-4 scale rubric was revised and converted into a 0-3 point scale rubric by the researcher because “2” and “3” points in the scale had close meanings and explanations. That is, while analyzing the data, it was realized that the presence of option 2 (indicating general utility or relevance applied to individuals) does not contribute to differentiating articulated utility value levels effectively and does not lead to significant variation among students. Accordingly, in this present study, a score of “0” on the utility or relevance scale denotes no value; a score of “1” indicates general utility or relevance applied to people in general; a score of “2” indicates specific utility or relevance applied to individuals; and a score of “3” indicates a strong, specific connection to the individual that includes a deeper understanding or future application of the material. Higher scores indicated higher-quality UV connections. The UV scores from the seven prompts were averaged to get an overall assessment of articulated utility value. Two independent coders gave the same score on 95% of the prompts, demonstrating the high inter-rater reliability of this scoring criterion. After discussions, disagreements were settled.

3.6 Ethical Issues in The Study

The current study was conducted with middle school students so approval regarding the applicability of the study was received from both the Human Subjects Ethics Committee in the METU and the Ministry of National Education (MoNE). After obtaining approvals, voluntary participation forms and parental consent forms (see Appendix F) were distributed. Only students who volunteered and whose parents gave consent participated in the study. In addition, necessary permissions were obtained from the developers of the instruments used in the present study to make required modifications and adaptations to the instrument items for their utilization. (see Appendix E).

3.7 Assumptions

1) The teachers implementing the study maintained objectivity throughout the treatment.
2) The administration of the questionnaires and tests was conducted under standardized conditions.
3) Students responded to the questions with seriousness and diligence.

4) There was no interaction between students in the control and experimental groups.

3.8 Limitations

This study was limited to 95 seventh-grade students attending a public school in Çankaya district in Ankara. The findings are limited to -force and energy- and -pure substance and mixtures- units. This study can be repeated with students at different grade levels and in different science units. The data were obtained mainly through self-report instruments. Although the changes in students' personal interest in science were sought through open-ended questions together with self-report Likert-type instruments, in future studies interviews can also be conducted with students considering all variables of the study to elaborate findings.

CHAPTER 4

RESULTS

The analyses that were carried out to characterize the data and provide answers to research questions are presented in this chapter. The results were explained in with quantitative and qualitative research analyses. Firstly, The Individual Interest Questionnaire in Science, the Utility Value Belief in Science Scale, and the Science Career Interest Scale scores were the quantitative data analyzed with Mixed Between-Within Subjects ANOVA(s) and presented. After that, the Science Interest Questions answers were the qualitative data analyzed with content analysis and presented.

Furthermore, The Articulated Utility Value of Utility-Value Writing Prompts were analyzed with Repeated measures of ANOVA for experimental groups and Friedman Test for control groups. Also, the differences in the overall articulated utility value scores between experimental and control groups were analyzed with the Mann-Whitney U Test and presented lastly.

4.1 Analyses of Quantitative and Qualitative Data

4.1.1 Descriptive Statistics for The Variables of the Study

Table 4.1 displays the descriptive statistics including mean and standard deviation for personal interest in science, utility value belief in science, and career interest in science of both experimental and control groups before the treatment (Time 1) and after treatment (Time 2). Time 1 in this table denotes the period before the treatment, and Time 2 the period after the treatment. The table also presents skewness and kurtosis values used to check the normality assumption.

Table 4.1 Descriptive Statistics For The Variables of the Study

		Experimental				Control			
	Variables	M	SD	Skewness	Kurtosis	M	SD	Skewness	Kurtosis
Time 1	Personal Interest	2.30	.49	.21	.52	2.57	.78	-.013	-.56
	Utility-value Belief	2.64	.66	-.031	.09	2.92	.77	-.69	.00
	Career Interest	2.88	.78	.17	-.49	2.87	.88	.40	.59
Time 2	Personal Interest	2.29	.50	.056	.99	2.25	.66	.53	.31
	Utility-value Belief	2.66	.62	.30	.47	2.55	.64	-.09	.58
	Career Interest	2.98	.86	.006	.054	2.70	.78	-.01	-.19

As shown in Table 4.1, the mean values for personal interest in science scores were higher for control group students (M = 2.57) compared to experimental group students (M = 2.30) at Time 1. However, the mean values declined for both groups at Time 2. The decrease in mean score was more pronounced for the control group, which had a mean of 2.25 at Time 2. Although the mean scores were comparable for both groups at Time 2, the mean personal interest in science score was slightly higher in the experimental group (M= 2.29). Regarding students' utility-value beliefs in science, the mean score for the control group (M = 2.92) was higher than that of the experimental group (M = 2.64) at Time 1. However, the control group's mean value decreased to 2.55 at Time 2, while the experimental group's mean value increased to 2.66 at Time 2. In other words, following the treatment, there was a slight increase in the experimental group's utility-value belief in science scores, whereas the control group's scores declined. The next variable of this present study was concerned with career interest in science. As shown in Table 4.1, the mean scores for career interest were similar for both the experimental (M = 2.88) and control groups at Time 1 (M= 2.87). However, while the mean scores for career interest in science increased from Time 1 to Time 2 for the experimental group, they decreased for the control group over the same period.

4.1.2 Inferential Statistics for The Variables of the Study

4.1.2.1 The Mixed Between-Within Subjects ANOVA of Personal Interest in Science Variable

Assumptions

Before conducting the analysis, the assumptions for mixed between-within subjects ANOVA were verified. Normality was assessed using histograms, skewness, and kurtosis data. The histograms for all groups indicated that the scores were normally distributed. Additionally, the skewness and kurtosis values for the personal interest variable, as presented in Table 4.1, were within the acceptable range of -2 to +2 for both pretest and posttest, demonstrating univariate normality. Regarding the homogeneity of variance-covariance matrices, the Box's M test for equality of covariance matrices yielded $F(3, 8094035) = 10.54$, $p = 0.016$ (see Table 4.2.). According to Tabachnick and Fidell (2007), when sample sizes are comparable, assessing this assumption is not essential. In the present study, sample sizes were similar, with a cell size ratio of 1.21. Additionally, Pallant (2011) emphasized the high sensitivity of Box's M statistic, recommending that the probability value should exceed .001 for robust interpretation. Therefore, despite the significant result of the Box's M test at the 0.05 alpha level, a mixed between-within subjects ANOVA was conducted and interpreted, taking into account these considerations.

Table 4.2 Box's Test of Equality of Covariance of Matrices[a] of Personal Interest in Science

Box's M	10.541
F	3.431
df1	3
df2	8094035.069
Sig.	.016

Moreover, the findings are presented in Table 4.3. showed that Levene's Test of Equality of Error Variances was significant at Time 1 and non-significant at Time 2. Again, considering the sample size ratio (Tabachnick & Fidell, 2007), it was assumed that significant Levene's test result at Time 1 does not threaten the validity of the mixed between-within subjects ANOVA results.

Table 4.3 Levene's Test of Equality of Error Variances[a] of Personal Interest in Science

		Levene Statistic	df1	df2	Sig.
Time 1 Interest	Based on Mean	9.559	1	93	.003
Time 2 Interest	Based on Mean	3.203	1	93	.077

After all of the assumptions were met, the mixed between-within subjects ANOVA was conducted to find out answers to the main research question 1 and sub-questions stated in Chapter 1.

<u>Main Research Question 1</u>

What is the effect of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone on students' personal interest in science over two time periods (before the treatment and after the treatment)?
Sub-questions:

a) Is there a change in students' personal interest in science across the two time periods (before the treatment and after the treatment)?

b) Is there a difference in the effectiveness of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' personal interest in science?

c) Does the change in students' personal interest in science over time is different for the two groups?

As shown in Table 4.4., mixed between-within subjects ANOVA results showed that there was a significant change in students’ personal interest in science scores from Time 1 to Time 2 $F(1,93) = 9.210$, $p = .003$, $\eta^2 = .09$. However, treatment effect was not significant $F(1,93) = .67$, $p = 0.300$ (see Table 4.5.) indicating that there was no significant difference in the effectiveness of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' personal interest in science. The results also indicated that there was a significant interaction effect between time and treatment, $\lambda = .919$, $F(1,93) = 8.148$, $p = .005$, $\eta^2 = .08$. This finding implied that the change in personal interest in science scores from Time 1 to Time 2 was not the same for experimental and control groups.

Table 4.4 Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Time							
	Wilks' Lambda	.910	9.210[b]	1.000	93.000	.003	.090
time * treatment							
	Wilks' Lambda	.919	8.148[b]	1.000	93.000	.005	.081

Table 4.5 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1040.189	1	1040.189	1694.277	<.001
Treatment	.667	1	.667	1.086	.300
Error	57.097	93	.614		

A detailed exploration of the significant interaction effect revealed that there was a significant difference between experimental and control groups with respect to personal interest in science scores at Time 1 (see Table 4.6). As depicted in Table 4.1. the mean score for the control group was greater than that of experimental group students implying that control group students' personal interest in science was greater than experimental group students before the treatment. However, at Time 2, there was no significant difference between experimental and control group students (see Table 4.6).

Table 4.6 Pairwise comparisons of personal interest in science scores by treatment across time

Comparison			Mean Difference	s.e.	Sig.[b]
Time 1	control	experimental	.271*	.131	.041
Time 2	control	experimental	-.033	.121	.785

Further examination of the interaction effect also revealed that there was a significant change from Time 1 to Time 2 only in the control group (see Table 4.7).

Table 4.7 Pairwise comparisons of personal interest in science scores by time across treatment groups

Comparison			Mean Difference	s.e.	Sig.
control	Time 1	Time 2	.314*	.079	<.001
experimental	Time 1	Time 2	.010	.072	.894

Specifically, as shown in Figure 4.1. there was a sharp decline in control group students' personal interest in science scores from Time 1 to Time 2. On the other hand, there was no significant change in experimental group students' personal interest in science across time.

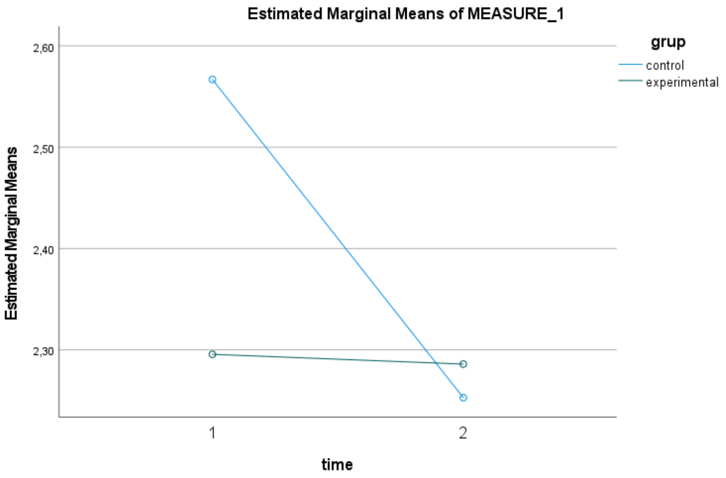

Figure 4.1. Estimated Marginal Means of Students' Personal Interest in Science

4.1.2.2 The Mixed Between-Within Subjects ANOVA of Utility-Value Belief in Science Variable

Assumptions

Prior to conducting the analysis, the assumptions for mixed between-within subjects ANOVA were verified. Normality was assessed using histograms, skewness, and kurtosis data. The histograms for all groups indicated that the scores were normally distributed. Additionally, the skewness and kurtosis values for the utility value belief in science variable, as presented in Table 4.1, were within the acceptable range of -2 to +2 for both pretest and posttest, demonstrating univariate normality. Regarding the homogeneity of variance-covariance matrices, the Box's M test for equality of covariance matrices yielded non-significant results implying that the assumption was satisfied $F(3, 8094035) = 1.06$, $p = 0.793$ (see Table 4.8).

Table 4.8 Box's Test of Equality of Covariance of Matrices[a] of Utility-Value Belief in Science

Box's M	1.060
F	.345
df1	3
df2	8094035.069
Sig.	.793

Moreover, the findings presented in Table 4.9 showed that Levene's Test of Equality of Error Variances was non-significant both at Time 1 and at Time 2. So, it can be said that the assumption was satisfied.

Table 4.9 Levene's Test of Equality of Error Variances[a] of Utility-Value Belief in Science

			Levene Statistic	df1	df2	Sig.
Time 1	Utility Value Belief	Based on Mean	1.011	1	93	.317
Time 2	Utility Value Belief	Based on Mean	.002	1	93	.961

After all of the assumptions were met, the mixed between-within subjects ANOVA was conducted to find out answers to the main research question 2 and sub-questions stated in Chapter 1.

Main Research Question 2:

What is the effect of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone on students' utility value beliefs in science over two time periods (before the treatment and after the treatment)?

Sub-questions:

a) Is there a change in students' utility value beliefs in science across the two time periods (before the treatment and after the treatment)?

b) Is there a difference in the effectiveness of curriculum-oriented instruction and utility value intervention with respect to students' utility value beliefs in science?

c) Does the change in students' utility value beliefs in science over time is different for the two groups?

As shown in Table 4.10., mixed between-within subjects ANOVA results showed that there was a significant change in students' utility value belief in science scores from Time 1 to Time 2 $F(1,93)=4.771$, $p=.031$, $\eta^2=.049$. However, the treatment effect was not significant $F(1,93)=.356$, $p=.449$ (see Table 4.11) indicating that there was no significant difference in the effectiveness of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' utility value belief in science. The results also indicated that there was a significant interaction effect between time and treatment, $\lambda=.938$, $F(1,93)=6.180$, $p=.015$, $\eta^2=.062$. This finding revealed that the change in utility value beliefs in science scores from Time 1 to Time 2 was not the same for experimental and control groups.

Table 4.10 Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Time	Wilks' Lambda	.951	4.771	1.000	93.000	.031	.049
time * treatment	Wilks' Lambda	.938	6.180	1.000	93.000	.015	.062

Table 4.11 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1367.495	1	1367.495	2221.068	<.001
treatment	.356	1	.356	.578	.449
Error	57.259	93	.616		

A detailed exploration of the significant interaction effect revealed that there was no significant difference between experimental and control groups with respect to utility value beliefs in science scores at Time 1 (see Table 4.12). Furthermore, at Time 2, there was no significant difference between experimental and control group students with respect to utility value beliefs in science scores (see Table 4.12).

Table 4.12 Pairwise comparisons of utility value beliefs in science scores by treatment across time

Comparison			Mean Difference	s.e.	Sig.[a]
Time 1	control	experimental	.285	.147	.055
Time 2	control	experimental	-.111	.131	.400

Further examination of the interaction effect also provided that there was a significant change from Time 1 to Time 2 only in the control group (see Table 4.13). Also, as depicted in Figure 4.2. there was a sharp decline in control group students' utility value beliefs in science scores from Time 1 to Time 2. On the other hand, there was no significant change in experimental group students' utility value beliefs in science across time.

Table 4.13 Pairwise comparisons of utility value beliefs in science scores by time across treatment groups

Comparison			Mean Difference	s.e.	Sig.[b]
control	Time 1	Time 2	.372*	.118	.002
experimental	Time 1	Time 2	-.024	.107	.823

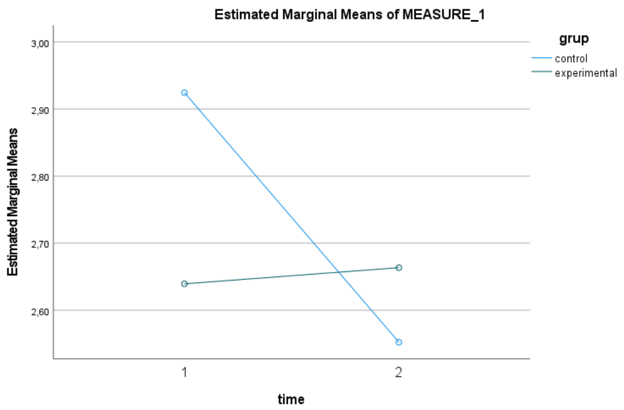

Figure 4.2. Estimated Marginal Means of Students' Utility-Value Beliefs in Science

4.1.2.3 The Mixed Between-Within Subjects ANOVA of Career Interest in Science Variable

Assumptions

Prior to conducting the analysis, the assumptions for mixed between-within subjects ANOVA were verified. Normality was assessed using histograms, skewness, and kurtosis data. The histograms for all groups indicated that the scores were normally distributed. Additionally, the skewness and kurtosis values for the career interest in science variable, as presented in Table 4.1, were within the acceptable range of -2 to +2 for both pretest and posttest, demonstrating univariate normality. Regarding the homogeneity of variance-covariance matrices, the Box's M test for equality of covariance matrices yielded non-significant results indicating that for each group, the inter-correlation patterns between the levels of time variable remain consistent $F(3, 8094035) = 3.015$, $p = 0.400$ (see Table 4.14).

Table 4.14 Box's Test of Equality of Covariance of Matrices[a] of Career Interest in Science

Box's M	3.015
F	.981
df1	3
df2	8094035.069
Sig.	.400

Moreover, the findings presented in Table 4.15 showed that Levene's Test of Equality of Error Variances was non-significant at Time 1 and at Time 2. Thus, the homogeneity of variance assumption was also verified.

Table 4.15 Levene's Test of Equality of Error Variances[a] of Career Interest in Science

		Levene Statistic	df1	df2	Sig.
Time 1 Career Interest	Based on Mean	.055	1	93	.815
Time 2 Career Interest	Based on Mean	.654	1	93	.421

After all of the assumptions were met, the Mixed between-within subjects ANOVA was run to answer to the main research question 3 and sub-questions stated in Chapter 1.

Main Research Question 3:

What is the effect of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone on students' career interest in science over two time periods (before the treatment and after the treatment)?

Sub-questions:

a) Is there a change in students' career interest in science across the two time periods (before the treatment and after the treatment)?

b) Is there a difference in the effectiveness of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' career interests in science?

c) Does the change in students' career interest in science over time is different for the two groups?

As shown in Table 4.16, mixed between-within subjects ANOVA results showed that there was no significant change in students' career interest in science scores from Time 1 to Time 2 $F(1,93) = .117$, $p = .733$, $\eta^2 = .001$. Also, the treatment effect was not significant $F(1,93) = 1.012$, $p = 0.324$ (see Table 4.17) indicating that there was no significant difference in the effectiveness of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' career interest in science.

Table 4.16 Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
time	Wilks' Lambda	.999	.117	1.000	93.000	.733	.001
time * treatment	Wilks' Lambda	.973	2.534	1.000	93.000	.115	.027

Table 4.17 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	1537.645	1	1537.645	1493.633	<.001
Treatment	1.012	1	1.012	.983	.324
Error	95.740	93	1.029		

As depicted in Table 4.16, the results also indicated that there was no significant interaction effect between time and treatment, $\lambda = .973$, $F(1,93) = 2.534$, $p = .115$, $\eta^2 = .027$. This finding implied that the change in career interest in science scores from Time 1 to Time 2 was almost the same for experimental and control groups.

4.1.3 Science Interest Questions Analyses (Qualitative Data)

The qualitative data related to students' personal interest in science was obtained through two written open-ended questions: "Has your interest in science changed while doing this science unit?" and "Write a justification for any change in your interest in science." The analysis of this qualitative data aimed to address the following sub-research question of Main Research Question 1.

The sub-question of the Main Research Question 1

d) What is the personal interest in science of students who received curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone?

When the students were asked if there had been a change in their personal interest in science, more than 50% of the students in both groups stated that there had been no change in their interest. Specifically, 49% of the students in the control group said there was no change, while 46.6% of the students in the experimental group said there was no change. In addition, while 2% of the students in the control group stated that their interest decreased, 3.4% of the students in the experimental group stated that their interest decreased. In the experimental group, 37.9% indicated increased interest. This rate was 36.7% in the control group. These findings partially agree with the mixed between within subjects ANOVA results. According to the mixed between within subjects ANOVA results, a decrease in interest was found in both groups, but while the control group's interest was significantly higher than the experimental group at the beginning, there was a significant decrease throughout the treatment. On the other hand, there was no significant change in the experimental group. Therefore, while the mixed between within subjects ANOVA results and the students' answers to the open-ended questions coincide for the experimental group, these two results do not fully support each other in the control group. On the other hand, when students were asked to explain the reasons for the question of whether their interests had changed or not, content analysis was performed on the data obtained. The factors affecting their interest were found to be instruction, content, treatment, and personal factors. Table 4.18 contains these categories and the codes that make up these categories. In addition, in the table, it is indicated in which group the codes appear and what effect they have on interest by placing a + sign in the relevant box.

Table 4.18 The Results of The Qualitative Data

		Experimental			Control		
Category	Code	Increase	Decrease	No change	Increase	Decrease	No change
Instruction	Boring			+		+	++
	Abstract						+
	Lack of activity	+		++			+
	Activity enriched				+++		
	Unenjoyable			+			
	Effective				+		
Content	Boring		++	+++			+++++
	Difficult		+	++			
	Unenjoyable			++			+++
	Enjoyable	+++++++ ++		+	++		+
	Applicability to daily life	+++++		+	+++		
	Confusing	+		+++			+
	Useless in the future			+			
	Interesting	+			+++		+++++ +
Personal factor	Liking the topics				++		
	Consistent interest	+		++++	++		++
	Negative teacher perception						+
	Disliking science			++++			
Treatment	Improved learning	+			+		
	Interest maintenance			+			+
	Effective	+			+		
	Enjoyable	+					

Table 4.18 provides the results obtained from the qualitative data. The first category indicated in this table is “instruction”. As can be seen in Table 4.18, one of the

students in the experimental group mentioned that their personal interest to science did not change because "*instruction was boring*". Also, two of the students in the experimental group indicated that their personal interest in science did not change, because they thought that there were no activities integrated into instruction. On the other hand, although one of the students in the experimental group thought that there was a lack of activity in the instruction, the student stated that his/her personal interest in science had increased. Meanwhile, while two students in the control group attribute the no change in their personal interest in science to the instruction being boring, another student in this group attributes the no change in their personal interest in science to the instruction being abstract, and another student attributes the no change in their personal interest to the science to the instruction being lacking activities. On the other hand, another three students in the control group mentioned that their personal interest in science increased because of the instruction being activity-enriched, while another student attributed the increase of his/her personal interest in science to the effective instruction. Additionally, one students in the control group reported that their personal interest decreased, explaining, "*The subjects were fun to me, but my interest decreased because the instruction was boring and stressful*.". In general, students' responses suggested that instruction enriched with activities is likely to improve students' personal interest in science.

Regarding the "content" category, a total of fifteen students in the experimental group attributed their increased personal interest in science to content being interesting (n = 1), enjoyable (n = 9), and applicable to their daily lives (n = 5). Specifically, these students also stated that when the force and energy and pure substances units were compared, they found the pure substances unit more entertaining and related to daily life. Also, eleven students stated that their personal interests did not change. For example, one student in the experimental group noted that their personal interest did not change, explaining, "*The science topics were boring and confusing for me*.". Additionally, three students in the experimental group mentioned that their personal interest had decreased because of boring and difficult science content. Meanwhile, in the control group, eight students in that group mentioned that their personal interest increased because of the science content being interesting (n =3), enjoyable (n =2), and applicable to their daily lives (n =3). Moreover, sixteen students reported their personal interest in science did not change. In detail, five of the students thought "*the science content was boring*", three of them thought that "*content was unenjoyable*" and one of them stated "*content was confusing"*, so their personal interest in science did not change. Surprisingly, six students in the control group who reported that their personal interest in science did not change indicated that they found the content to be interesting. Similarly, one student reporting that he/she found science content enjoyable indicated that there was no change in his/her personal interest in science. Overall, when compared to the experimental group, the number of students in the control group attributing the increase in their interest to applicability to daily life was less.

Concerning the "personal factor" category, one of the students in the experimental group attributed his/her increased personal interest in science because of consistent interest in science, while eight of the students in the experimental group stated their interest did not change. Specifically, one student in the experimental group mentioned that s/he has always loved science class and will continue to do so, and that is why his/her interest has increased. While 4 students who said that their personal interest in science did not change explained the reason for this by emphasizing that they were already interested in science and this interest did not change, another 4 students also explained the reason for no change in their interests as not liking science. Additionally, one of these four students attributed no change in his/her personal interest in science to dislike of science explained that his/her personal interest in science did not change by stating that s/he did not like science but utility value intervention prevented his/her existing personal interest in science from decreasing. This result was crucial for this present study. Furthermore, in the control groups, while four of the students in the control group attributed their increased personal interest in science to consistent interest in science or liking science topics, two students in the control group stated that there was no change in their personal interests because of their consistent interests and another one student reported that the reason why there was no change his/her interest was negative teacher perception.

As can be seen in the treatment part in Table 4.18, two of the students in the experimental group attributed their increased personal interest in science to the utility value intervention. Specifically, one student mentioned that the utility value intervention was effective in boosting his/her personal interest, while another student indicated that "*the utility value intervention provide me improved learning*." Additionally, one student in the experimental group noted that their personal interest did not change, explaining, "*I dislike science, but the utility value intervention helped maintain my existing interest.*" Meanwhile, a student in the control group reported that writing summaries of the topics improved his/her learning and increased his/her personal interest. Also, another student mentioned that there was a contribution of writing summaries to his/her personal interest and these writing summaries were effective in increasing his/her personal interest. On the other hand, one student in the control group noted that their personal interest did not change, explaining, "*Writing summaries did not change my interest, but helped maintain my existing interest.*". Thus, although quantitative analysis did not reveal a significant difference between experimental and control groups concerning personal interest in science after the treatment, students' responses to open-ended questions suggested that more students in the experimental group compared to the control group attributed their increased interest to the treatment.

Overall, qualitative findings indicated that both control and experimental group students thought that science instruction enriched with activities could enhance their personal interest in science. However, more students in the experimental group appeared to find the content relevant to their lives compared to those in the control group increasing their personal interest in science. Additionally, more students in the experimental group relative to the control group, attributed their increased interest in the treatment. Thus, although quantitative findings indicated that there was no significant difference between experimental and control group students with respect to a personal interest in science, qualitative findings suggest that utility value intervention accompanied by activity-rich instruction has the potential to increase students' personal interest.

4.1.4 Utility-Value Writing Prompts Analyses

In order to address the research question "Is there a change in the articulated utility values of students receiving curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone during the treatment?" Friedman Test and Repeated measures of ANOVA were conducted. In addition, the research question aiming to investigate whether there was a difference between experimental and control group students with respect to articulated utility values was explored through the Mann-Whitney U Test.

4.1.4.1 Utility-Value Writing Prompts Analyses of the Control Group

Descriptive Statistics of The Articulated Utility Values of Utility-Value Writing Prompts for Control Group

During the treatment, the control group students were asked to write a summary about each topic they studied in a given unit. A total of seven written prompts were collected. Table 4.19 displays the descriptive statistics including mean, standard deviation, sample size, skewness, and kurtosis values for articulated utility values of the control groups.

Table 4.19 Descriptive Statistics of the Articulated Utility Value of Utility-Value Writing Prompts for Control Groups

Variables	Mean	Std. Deviation	N	Skewness	Kurtosis
prompt1	.14	.351	43	2.15	2.77
prompt2	.07	.258	43	3.50	10.75
prompt3	.02	.152	43	6.55	43.00

Table 4.19 Descriptive Statistics of the Articulated Utility Value of Utility-Value Writing Prompts for Control Groups (continued)

prompt4	.07	.258	43	3.50	10.75
prompt5	.07	.258	43	3.50	10.75
prompt6	.14	.351	43	2.15	2.77
prompt7	.26	.539	43	2.06	3.56

Prompt 1, Prompt 2, Prompt 3, Prompt 4, Prompt 5, Prompt 6 and Prompt 7 asked students to make connections the relationship between force, work, and energy, the energy conversion, the particulate nature of matter, the pure substances, the mixtures, the separation of mixtures and domestic wastes and recycling topics and their daily lives, respectively. These prompts distributed every week and filled out by students. A total of 7 separate prompts were applied throughout this study. While prompt 1 is the prompt applied in the first week, prompt 7 is the prompt applied in the last week. In other words, from Prompt1 to Prompt7, prompts related to that week's science topic were applied to the students every week. The students' articulated utility value scores were obtained as a result of evaluating the utility value prompts, with the articulated utility value rubric. As shown in Table 4.19, there was a slight decrease in the mean of the articulated utility values scores from Prompt1(M=.14) to Prompt3(M=.02), whereas the mean of the articulated utility values scores slightly increased from Prompt5(M=.07) to Prompt7(M=.26).

Inferential Statistics of The Articulated Utility Values of Utility-Value Writing Prompts for Control Group

Assumptions

Prior to conducting the analysis, the assumptions for one way repeated measures of ANOVA were checked. Because the multivariate test result was interpreted, the assumption related to the multivariate test was examined. Specifically, the multivariate test requires that the difference scores are normally distributed and the individual cases constitute a random sample from the population. In order to check the normality assumption, six difference scores were computed and skewness and kurtosis values were examined. But, when looking at these six difference scores' skewness and kurtosis values (not within the range of -2 and +2) were not appropriate for normality assumption as in Table 4.20.

Table 4.20 Descriptives of the difference in the scores

		Statistic	Std. Error
diffscore1	Skewness	-.601	.361
	Kurtosis	3.460	.709
diffscore2	Skewness	-1.126	.361
	Kurtosis	2.911	.709
diffscore3	Skewness	-.299	.361
	Kurtosis	2.054	.709
diffscore4	Skewness	-.299	.361
	Kurtosis	2.054	.709
diffscore5	Skewness	.000	.361
	Kurtosis	.811	.709
diffscore6	Skewness	1.145	.361
	Kurtosis	2.965	.709

Since the assumptions were not met, the Friedman Test, a non-parametric alternative to repeated measures of ANOVA, was applied to find out the answer to the main research question 5:

Main Research Question 5

Is there a change in the articulated utility values of students receiving curriculum-oriented instruction alone during the instruction?

Table 4.21 Ranks

	Mean Rank
prompt1	4.13
prompt2	3.88
prompt3	3.72
prompt4	3.88
prompt5	3.88
prompt6	4.13
prompt7	4.37

As in Table 4.21, students' articulated utility value scores appear to be similar across the Prompts. The highest score was obtained from Prompt 7 which focused on domestic waste and recycling and the lowest score was obtained from Prompt 3 which focused on the particulate nature of matter.

Table 4.22 Test Statistics[a]

N	43
Chi-Square	11.769
Df	6
Asymp. Sig.	.067

Furthermore, as shown in Table 4.22, Friedman Test results showed that there was no significant change in the articulated utility values of students receiving curriculum-oriented instruction alone during the instruction across time (between Prompt 1(about the relationship between force, work, and energy) and Prompt 7(about domestic waste and recycling), $\chi 2$ (6, n=43)=11.769, *p*=.067).

4.1.4.2 Utility-Value Writing Prompts Analyses of the Experimental Group

During the treatment, after covering each sub-topic, students in the experimental group students were asked to make a connection between the sub-topic they studied in the science lesson and their daily lives in response to written prompts. A total of seven written prompts were collected.

Descriptive Statistics of The Articulated Utility Values of Utility-Value Writing Prompts for Experimental Groups

Table 4.23 displays the descriptive statistics including mean, standard deviation, sample size, skewness, and kurtosis values for articulated utility values of the experimental groups.

Table 4.23 Descriptive Statistics of The Articulated Utility Value of Utility-Value Writing Prompts for Experimental Groups

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
prompt1	52	1.02	.671	-.022	.330	-.689	.650
prompt2	46	.59	.686	.753	.350	-.536	.688
prompt3	49	.51	.617	.794	.340	-.305	.668
prompt4	46	1.02	.774	-.038	.350	-1.304	.688
prompt5	48	.73	.844	.560	.343	-1.371	.674
prompt6	49	1.22	.848	-.242	.340	-1.165	.668
prompt7	50	1.28	.730	.164	.337	-.093	.662
Valid N (listwise)	36						

Specifically, Prompt 1, Prompt 2, Prompt 3, Prompt 4, Prompt 5, Prompt 6 and Prompt 7 asked students to make connections the relationship between force, work, and energy, the energy conversion, the particulate nature of matter, the pure substances, the mixtures, the separation of mixtures and domestic wastes and recycling topics and their daily lives, respectively. These prompts distributed every week and filled out by students. As shown in Table 4.23, there was a slight decrease in the mean of the articulated utility values scores from Prompt1(M=1.02) to Prompt3(M=.51), whereas the mean of the articulated utility values scores slightly increased from Prompt5(M=.73) to Prompt7(M=1.28).

Inferential Statistics of The Articulated Utility Values of Utility-Value Writing Prompts for Experimental Groups

Assumptions

Prior to conducting the analysis, the assumptions for one way repeated measures of ANOVA were checked. Because the multivariate test result was interpreted, the assumption related to the multivariate test was examined. Specifically, the multivariate test requires that the difference scores are normally distributed and the individual cases constitute a random sample from the population. In order to check the normality assumption, six difference scores were computed and skewness and kurtosis values were examined. Skewness and kurtosis values were within the acceptable range of -2 and +2 as in Table 4.24.

Table 4.24 Descriptives

		Statistic	Std. Error
diffscore1	Skewness	-.101	.350
	Kurtosis	-.534	.688
diffscore2	Skewness	-.092	.340
	Kurtosis	-.133	.668
diffscore3	Skewness	.044	.350
	Kurtosis	-.014	.688
diffscore4	Skewness	.134	.343
	Kurtosis	-.643	.674
diffscore5	Skewness	-.267	.340
	Kurtosis	.681	.668
diffscore6	Skewness	.080	.337
	Kurtosis	.382	.662

After all of the assumptions were met, the Repeated Measures of ANOVA was conducted to find out answers to the main research question 4 stated in Chapter 1.

Main Research Question 4

Is there a change in the articulated utility values of students receiving curriculum-oriented instruction supported by utility value intervention during the treatment?

Table 4.25 Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Time	Wilks' Lambda	.420	6.918	6.000	30.000	<.001	.580

As seen in Table 4.25, one-way repeated measures of ANOVA results showed that there was a significant change in the articulated utility values of students receiving curriculum-oriented instruction supported by utility value intervention during the instruction (between Time 1 and Time 7), λ= .420, $F(6, 30) = 6.918$, $p = .001$, η^2= .580. As can be seen from Table 4.26, of 21 pairwise comparisons, eight highlighted in bold were statistically significant using Holm's Sequential Bonferroni procedure. Specifically, results indicated that there was a significant decline in experimental group students 'articulated utility value scores from Prompt 1(about the relationship between force, work, and energy) to Prompt 2(about energy conversion) and 3(about the particulate nature of matter). On the other hand, there was a significant increase from Prompt 2(about energy conversion) to Prompt 6(about the separation of mixtures) and 7(about the domestic waste and recycling). Similarly, there was a significant increase from Prompt 3(about the particulate nature of matter) to Prompt 4(about pure substances), 6(about the separation of mixtures), and 7(about the domestic waste and recycling). Students' articulated utility value scores were also found to increase from Prompt 5(about the mixtures) to Prompt 7(about the domestic waste and recycling). In fact, as shown in the related descriptive statistics table, the highest mean score was obtained from Prompt 7(about domestic waste and recycling).

Table 4.26 Paired Samples Tests

		Mean	SD	s.e.	t	df	Two-Sided p
Pair 1	**prompt1 - prompt2**	**.435**	**.860**	**.127**	**3.428**	**45**	**.001**
Pair 2	**prompt1 - prompt3**	**.531**	**.680**	**.097**	**5.461**	**48**	**<.001**
Pair 3	prompt1 - prompt4	.022	.906	.134	.163	45	.872
Pair 4	prompt1 - prompt5	.313	.993	.143	2.181	47	.034
Pair 5	prompt1 - prompt6	-.224	.872	.125	-1.801	48	.078
Pair 6	prompt1 - prompt7	-.260	.853	.121	-2.156	49	.036
Pair 7	prompt2 - prompt3	.133	.757	.113	1.182	44	.244
Pair 8	prompt2 - prompt4	-.439	.976	.152	-2.880	40	.006
Pair 9	prompt2 - prompt5	-.070	1.078	.164	-.424	42	.673
Pair 10	**prompt2 - prompt6**	**-.651**	**1.044**	**.159**	**-4.090**	**42**	**<.001**
Pair 11	**prompt2 - prompt7**	**-.727**	**.924**	**.139**	**-5.220**	**43**	**<.001**
Pair 12	**prompt3 - prompt4**	**-.488**	**1.055**	**.161**	**-3.036**	**42**	**.004**
Pair 13	prompt3 - prompt5	-.222	1.085	.162	-1.374	44	.176
Pair 14	**prompt3 - prompt6**	**-.717**	**1.004**	**.148**	**-4.848**	**45**	**<.001**
Pair 15	**prompt3 - prompt7**	**-.766**	**.914**	**.133**	**-5.745**	**46**	**<.001**
Pair 16	prompt4 - prompt5	.222	.902	.134	1.653	44	.105
Pair 17	prompt4 - prompt6	-.136	.979	.148	-.924	43	.360
Pair 18	prompt4 - prompt7	-.311	1.041	.155	-2.006	44	.051
Pair 19	prompt5 - prompt6	-.413	1.024	.151	-2.737	45	.009
Pair 20	**prompt5 - prompt7**	**-.596**	**1.077**	**.157**	**-3.794**	**46**	**<.001**
Pair 21	prompt6 - prompt7	-.083	1.007	.145	-.573	47	.569

The Figure 4.3. also displays the changes in mean scores across the prompts.

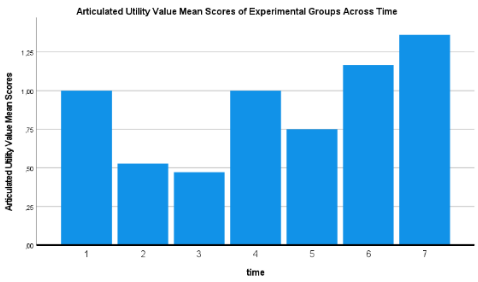

Figure 4.3. Articulated Utility Value Mean Scores of Experimental Groups Across Time

4.1.4.3 Utility-Value Writing Prompts Analyses of Both Groups (with Mann-Whitney U Test)

Inferential Statistics

In order to address the main question 6, independent sample t-tests were decided to be conducted as the appropriate inferential procedure. However, because the normality assumption was violated for the control group, the Mann-Whitney U test as the non-parametric alternative was conducted.

<u>Main Research Question 6</u>

Is there a significant difference between students taught by curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone with respect to students' articulated utility values?

Table 4.27 Ranks

	group	N	Mean Rank	Sum of Ranks
promptoverall	control	43	23.13	994.50
	experimental	36	60.15	2165.50
	Total	79		

Table 4.28 Test Statistics[a]

	Promptoverall
Mann-Whitney U	48.500
Wilcoxon W	994.500
Z	-7.238
Asymp. Sig. (2-tailed)	<.001

The z value in Table 4.28 above is -7.238, and the significance level (*p*) is *p*<.001. Since the probability value (*p*) is smaller than .05, the outcome is significant. That is, the articulated utility value scores of the control and experimental groups differed statistically significant. Also, Table 4.29 provides the median values for each group, which can be used to describe the direction of the difference (i.e., which group was higher) so it revealed experimental groups was higher.

Table 4.29 Report

	group	N	Median
promptoverall	control	43	.0000
	experimental	36	5.2143
	Total	79	1.1429

Finally, A Mann-Whitney U Test revealed that the overall articulated utility value score in the experimental group (Md = 5.2143, n = 36) is significantly higher than that of the control group (Md = 0, n =43), with a large effect size z = –7.238, $p<.001$, r = 0.815.

CHAPTER 5

DISCUSSION, RECOMMENDATIONS AND IMPLICATIONS

The current study aims to examine the effect of utility value intervention on middle school students' personal interest in science, utility value beliefs, and career interest in science. In this chapter, the results are discussed according to research questions. Also, recommendations for further studies and implications of the study are mentioned.

5.1 The Effects of Utility Value Intervention on Middle School Students' Personal Interest in Science

To address the first primary research question of this study, which examines the impact of curriculum-oriented instruction with and without utility value intervention on students' personal interest in science across two time points (pre-treatment, T1, and post-treatment, T2), the Individual Interest Questionnaire in Science (IIQ) was administered to students both before and after the treatment. The obtained data was analyzed using mixed between-within subjects ANOVA. Furthermore, to gain a deeper understanding of students' personal interest in science within both groups, their responses to open-ended interest questions were analyzed using content analysis. This qualitative data provided an interpretive context for the quantitative findings.

The findings from the mixed between-within subjects ANOVA revealed a significant change in students' personal interest in science scores between Time 1 and Time 2. However, the treatment effect was not significant, suggesting no substantial difference in the effectiveness of curriculum-oriented instruction with utility value intervention compared to curriculum-oriented instruction alone in enhancing students' personal interest in science. Additionally, the results indicated a significant interaction effect between time and treatment. A detailed examination of the significant interaction effect revealed before the treatment control group students' personal interest in science was significantly higher than that of experimental group students. However, after the treatment, there was no significant difference between the two groups. In fact, it was found that there was a significant decline in the control group students' personal interest in science from Time 1 to Time 2 while there was no change in the experimental group.

In the present study, control group students' received curriculum-oriented instruction alone and they only wrote summaries of the topics they covered in class. Thus, the findings suggest that just receiving curriculum-oriented instruction without emphasis on daily life connections to the topics has a negative impact on students' personal interest in science. On the other hand, although there was no difference between the two groups after the treatment, it appeared that the introduction of utility value intervention preserves students' pre-existing personal interest in science. Actually, although the mean scores were comparable for both groups after the treatment, the mean personal interest in science score was slightly higher in the experimental group.

However, the finding that there is no significant effect of utility value intervention on students' personal interest in science is not consistent with the available literature which suggests that students' interest and performance in a course can be enhanced by forming personal connections with the course material (Harackiewicz et al., 2016; Hecht et al., 2019; Hulleman & Cordray, 2009). In fact, a strong relationship between utility value intervention and personal interest in science has been reported in the literature. For example, Harackiewicz and colleagues (2016) stated that utility value intervention can be used to promote interest development and subsequent educational outcomes. Also, another research conducted by Hoffmann, Lehrke, and Todt (1985) revealed that students are as interested in the subjects as they are when it is applied to their own lives. Furthermore, Hulleman and Harackiewicz (2009) found that utility-value intervention increased the personal interest in science, especially for students with low achievement expectations. This finding suggests that utility-value interventions can increase students' interest and improve their academic performance by allowing them to find course content personally meaningful and useful. The researcher in the present study identified only one study consistent with the current findings: this study was conducted by Herrera (2019) in a biology class with 9th-grade students from minority and socioeconomically disadvantaged backgrounds and was found that there was no effect of the utility-value intervention on 9th-grade students' interest. Considering all the available literature, one reason the findings of this study may not align with the relevant literature could be the characteristics of the sample. The present study was conducted with middle school students from middle SES families, however; in available literature, the studies were mainly conducted at higher educational levels in different domains and with students from different backgrounds. For example, although Hulleman and Harackiewicz (2009), conducted their study with high school students in the science domain, the current study was conducted with middle school students in the same domain. Thus, it is possible to deduce that it may be difficult for middle school students to realize the real-life connections of what they learned in science classes not influencing their personal interest in science. This can be true, especially for abstract topics. In fact, in the present study, among the topics where students were asked to make connections with their daily lives, there were abstract concepts such as the particulate nature of matter and energy conversion. Actually, the topics were mainly related to physics and chemistry. Students may have particularly struggled to relate the particulate nature of matter to everyday life. Supporting this idea, as noted in a later relevant section, students' articulated utility value scores for this topic were found to be low. However, these explanations remain speculative, and future research could further investigate the effectiveness of utility-value interventions across different grade levels and topics.

Moreover, according to qualitative findings, students in both the control and experimental groups believed that science instruction enriched with activities could enhance their personal interest in science. Thus, it appeared that at the middle school level just implementing utility-value intervention may not be sufficient to increase students’ personal interest in science but the intervention should be accompanied by student-centered enjoyable activities.

In addition, qualitative findings demonstrated that a greater number of students in the experimental group perceived the content as more relevant to their lives, which increased their personal interest in science. Moreover, more students in the experimental group, compared to the control group, attributed their heightened interest to the intervention. Therefore, while the quantitative results indicated no significant difference between the experimental and control groups in terms of personal interest in science, the qualitative findings imply that utility value intervention, when combined with activity-rich instruction, has the potential to boost students' interest. Consistent with this idea, Harackiewicz and colleagues (2016) also suggested in their conceptual model, that apart from utility-value intervention, problem-based learning can also be used to enhance students’ interest.

5.2 The Effects of Utility Value Intervention on Middle School Students’ Utility Value Beliefs and Articulated Utility Values in Science

To address the second research question of this study, which investigated the impact of curriculum-oriented instruction with and without utility value intervention on students' utility value beliefs in science across two time periods (pre-treatment and post-treatment), the Utility Value Belief in Science Scale was administered to the students before and after the treatment. The mixed between-within-subjects analysis of variance results demonstrated that there was no significant difference between experimental and control groups with respect to utility value beliefs in science scores both before and after the treatment. However, results also demonstrated that there was a significant sharp decline in control group students’ task value beliefs in science from Time 1 to Time 2. Thus, it appeared that the implementation of curriculum-oriented instruction alone negatively influences students’ task value beliefs. Although there was a slight increase in experimental group students’ task value beliefs scores, it was not statistically significant. These findings are consistent with

Herrera’s (2019) study, which also found that students' perceptions of utility value, personal interest in science, and academic performance were unaffected by the utility value intervention. However, these results contrast with the majority of studies in the related literature. For example, Gaspard and colleagues (2015) showed that utility interventions for high school students increased utility value beliefs in mathematics and positively affected their performance in these subjects. Also, the study conducted by Hulleman and colleagues (2010) demonstrated that a utility intervention with high school students enabled students to discover the personal meaning and usefulness of course material, which in turn increased students' academic performance.

On the other hand, the similarity in findings between this current study and Herrera’s (2019) study may be due to the similarity of small sample size or the similarity of timing(10 minutes) for treatment. When the sample size is small, even large treatment effects can be found as non-significant. In the present study, the effect size for the treatment effect was 0.049 which is not too low. However, at this point, it is important to note that Herrera’s (2019) study was conducted with 9th-grade students from minority and socioeconomically disadvantaged backgrounds in a biology class. In contrast, the current study was conducted within the science domain with middle school students. Therefore, as suggested for the variable of personal interest in science, future research could replicate the study across different domains and with students from various backgrounds and grade levels and consider effect size together with statistical significance.

Conversely, concerning the fourth and fifth research questions, which examined whether changes occurred in the articulated utility values of students in both groups, the results revealed that while there was no change in the control group, the experimental group experienced a significant change. In addition, the Mann-Whitney U Test conducted to address the sixth research question revealed that the overall articulated utility value score in the experimental group was significantly higher than that of the control group.

Specifically, results indicated that there was a significant decline in experimental group students ‘articulated utility value scores from Prompt 1 to Prompt 2 and 3. The results revealed a significant decline in the articulated utility value scores of students in the experimental group from Prompt 1 to Prompts 2 and 3. Prompt 1 required students to connect force and energy topics to their daily lives, while Prompts 2 and 3 focused on energy conversion and the particulate nature of matter, respectively. As it has been mentioned before middle school students may find it easier to relate force and energy topics to their everyday experiences compared to more abstract concepts such as energy conversion and the particulate nature of matter. Developmentally, students might not yet be ready to fully grasp these more complex abstract topics. In fact, the lowest articulated value score was obtained on Prompt 3. Thus, one of the reasons for the decline from Prompt 1 to Prompt 2 and Prompt 3 may be the nature of the topics covered. Conversely, there was a significant increase in articulated utility value scores from Prompt 2 to Prompts 6 and 7, which addressed the separation of mixtures and domestic wastes and recycling, respectively. Additionally, a notable increase was observed from Prompt 3 to Prompts 4, 6, and 7. Prompt 4 focused on pure substances. Furthermore, students' articulated utility value scores increased from Prompt 5 to Prompt 7, with Prompt 5 pertaining to mixtures. In fact, the highest mean score was obtained for Prompt 7, the final prompt of the study, which addressed domestic waste recycling—a topic most directly connected to students' daily lives. The increase observed in students' expressed utility value scores can be attributed to the nature of the topics and students’ familiarity with the intervention. In fact, as it has been found here, students’ articulated utility values were lower for the topics that are abstract and complex, on the other hand, the scores were higher for the topics that can be readily connected to daily life. Additionally, as students became more familiar with the utility value intervention and established connections between weekly topics and their daily lives, their growing knowledge of these topics over time may have further contributed to an increase in their articulated utility values. On the other hand, there was no change in the control group concerning utility value scores. In fact, the students in the control group were asked to write only a summary of the topic they studied each week on the prompts distributed to them. Since they were not asked to make a connection between their daily lives and the topic studied, unlike the students in the experimental group, it was not expected that the articulated utility values of the students in the control group would dramatically change. But when examining prompts in each week specifically, control groups students' articulated utility value scores appear to be similar across the prompts however the highest score was obtained from Prompt 7, and the lowest score was obtained from Prompt 3. Although a similar finding was observed in the experimental group, the mean scores were higher in the experimental group. Indeed, the overall articulated utility value score in the experimental group is significantly higher than that of the control group. Thus, although the effect of the utility value intervention on students' utility value beliefs in science was not significant as revealed by between-within-subjects analysis of variance, the analysis of the utility value prompts in the current study suggested that receiving curriculum-oriented instruction supported by utility value intervention increased students' articulated utility values more than receiving curriculum-oriented instruction alone.

5.3 The Effects of Utility Value Intervention on Middle School Students' Career Interest in Science

In order to answer the third research question of this current study, which investigated the effect of curriculum-oriented instruction supported by utility value intervention and curriculum-oriented instruction alone on students' career interest in science over two time periods (before the treatment and after the treatment) is, the Science Career Interest Scale (SCIC) was applied to the students before and after the treatment. The mixed between-within subjects analysis of variance showed that there was no significant change in students' career interest in science scores across time. The treatment effect and interaction effect were also non-significant. A possible explanation for the non-significant results related to career interest in science may be that career choice is a dynamic process that evolves over time, alongside changing expectations and personal beliefs (Bøe et al., 2011). Given the complexity and variability of career decision-making, it is unlikely that this process would fully develop or that students' interest in science careers would increase significantly within the short duration of the current study. However, based on the available literature, it was expected that students' career interest in science would increase following the utility-value intervention. In fact, the expectancy-value model posits that individuals' beliefs about their potential performance in an activity, along with the subjective value they assign to it, can explain their choices, persistence, and performance (Wigfield & Eccles, 2000). Additionally, Eccles et al. (1999) found that both subjective value is one of the key predictors of career choices. In a more recent study, Eccles and Wigfield (2020) further emphasized that the interaction between subjective task values and expectations for success plays a critical role in determining performance, motivation, future course enrollment, and career decisions. Consistent with these findings and theoretical expectations, Hulleman and Harackiewicz (2009) found that high school students' interest in science courses and their academic performance increased when were shown how science courses could be useful in daily life and their future careers. Similarly, Shin et al. (2022a) found that utility-value intervention increased career interest in science, students valued the role of science in their future careers more and strengthened their desire to pursue a career in this field. However, in the present study, no direct connection was made for students between science courses and their relevance to future careers. Thus, in order to increase the effectiveness of utility-value intervention, this connection can be explicitly emphasized in future studies. In addition, the dosage of utility-value intervention implementation can be increased because implementing multiple utility-value interventions has the potential to enhance students' academic performance and their likelihood of continuing in STEM fields (Canning et al., 2017).

5.4 Implications and Recommendations

The current findings can have important implications for teachers, curriculum developers, and researchers. Specifically, mixed between-within subjects ANOVA results demonstrated that there was no significant effect of the utility-value intervention on students' personal interest in science, utility value beliefs, and career interest in science. On the other hand, students' responses to open-ended questions revealed that their personal interest can increase if utility-value intervention is accompanied by student-centered activities. Thus, it is suggested that teachers implement utility-value intervention integrating various activities that allow students to actively engage in the learning process. In addition, in order to enhance the effectiveness of utility value intervention, teachers can explicitly emphasize the relevance of abstract and complex topics to students' daily lives and their future goals more explicitly because current findings revealed that students' articulated value scores change depending on the nature of topics. Specifically, if the topic is abstract and complex such as the particulate nature of matter, articulated utility values are at lower levels, compared to topics that have a more direct connection to students' daily lives like recycling. Regarding career choices, again the relevance of the topics to their future goals and careers can also be made more explicit.

Apart from teachers, current findings can have some implications for curriculum developers as well. Results showed that there was a sharp decline in control group students who received curriculum-oriented instruction alone, with respect to personal interest in science and task value beliefs. Although, the science curriculum is student-centered, it was not implemented as intended as revealed by the researcher's informal observations and students' responses to open-ended questions. Students indicated that enriching instruction with various activities would enhance their interest. The related literature, although it is not recent, also demonstrated that the implemented curriculum is different from the written curriculum and teachers tend to provide teacher centered learning environment (Genc & Kucuk, 2003; Yangın & Dindar, 2007). Thus, curriculum developers should consider integrating utility-value intervention to curriculum, and seminars and workshops which allow teachers to develop and implement various student-centered activities should be conducted.

As mentioned before in the related part, considering current findings, the researchers in the field can replicate the present study, across different domains and with students from various backgrounds and grade levels in order to demonstrate how the results can vary based on these factors. Additionally, when considering the current findings in conjunction with existing literature, an effective strategy beyond the prompts used in this study might involve sharing quotes from other students about the utility value of the topics covered in class. These peer quotations could serve as scaffolding, helping students recognize and articulate their own values, thereby enhancing the effectiveness of the intervention (Hulleman & Harackiewicz, 2021).

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APPENDICES

DATA COLLECTION INSTRUMENTS (APPENDIX A, B, C AND D)

APPENDIX A. Fen Bilimlerine Yönelik Kişisel İlgi Ölçeği

Sevgili öğrenciler,

Fen Bilimlerine Yönelik Kişisel İlgi Ölçeği, sizin fen bilimlerine yönelik kişisel ilginizi belirlemek amacıyla hazırlanmıştır. Anket 8 maddeden oluşmaktadır. Her maddeyi dikkatli bir şekilde okuduktan sonra, sizi en iyi ifade ettiğini düşündüğünüz rakamı aşağıdaki ölçeği göz önüne alarak yuvarlak içine alınız. Unutmayın, doğru ya da yanlış cevap yoktur. Yapmanız gereken sizi en iyi tanımlayacak rakamı yuvarlak içine almanızdır.

Fen Bilimlerine Yönelik Kişisel İlgi Ölçeği	**Kesinlikle katılmıyorum**	**Katılmıyorum**	**Katılıyorum**	**Kesinlikle Katılıyorum**
1. Fen bilimleri ile ilgili konulara çok ilgi duyuyorum.	1	2	3	4
2. Okul dışında fen bilimleri ile ilgili çok şey okurum.	1	2	3	4
3. Fen bilimleri dersinden çok zevk aldığım için dersin gelmesini her zaman sabırsızlıkla beklerim.	1	2	3	4
4. Küçüklüğümden beri fen bilimlerine ilgi duyuyorum.	1	2	3	4
5. Fen bilimleri ile ilgili çok fazla televizyon programı izlerim.	1	2	3	4
6. İleride fen bilimleri ile ilgili bir meslek sahibi olmak istiyorum.	1	2	3	4
7. Fen bilimleriyle ilgili bir şey okurken ya da fen bilimleriyle ilgili televizyonda bir şey izlerken, tamamen ona odaklanırım ve etrafımda olup bitenlerin farkına varmam.	1	2	3	4
8. Boş zamanlarımı fen bilimleriyle ilgili etkinlikler yaparak geçiririm.	1	2	3	4

APPENDIX B. Fen Bilimlerine Yönelik Fayda Değer İnancı Ölçeği

Sevgili öğrenciler,

Fen Bilimlerine Yönelik Fayda Değer İnancı Ölçeği, sizin fen bilimleri dersine yönelik fayda değer inançlarınızı belirlemek amacıyla hazırlanmıştır. Ölçek, 4 maddeden oluşmaktadır. Her maddeyi dikkatli bir şekilde okuduktan sonra, sizi en iyi ifade ettiğini düşündüğünüz rakamı aşağıdaki ölçeği göz önüne alarak yuvarlak içine alınız. Unutmayın, doğru ya da yanlış cevap yoktur. Yapmanız gereken sizi en iyi tanımlayacak rakamı yuvarlak içine almanızdır.

Fen Bilimlerine Yönelik Fayda Değer İnancı Ölçeği	**Kesinlikle katılmıyorum**	**Katılmıyorum**	**Katılıyorum**	**Kesinlikle Katılıyorum**
1. Fen bilimleri dersinde öğrendiklerimin benim için faydalı olduğunu düşünüyorum.	1	2	3	4
2. Fen bilimleri dersinde öğrendiklerimi günlük hayatta uygulayabileceğimi düşünüyorum.	1	2	3	4
3. Fen bilimleri dersinde öğrendiklerimin geleceğe yönelik planlarımla ilgili olduğunu düşünüyorum.	1	2	3	4
4. Fen bilimleri dersinde öğrendiklerimin gelecekte seçmeyi düşündüğüm meslek için yararlı olduğunu düşünüyorum.	1	2	3	4

APPENDIX C. Fen Bilimleri Kariyer İlgisi Ölçeği

Aşağıda Fen Bilimlerine yönelik tutumlarla ilgili ifadeler göreceksiniz. Bu ifadelere katıldığınızı ya da katılmadığınızı ilgili seçeneği işaretleyerek belirtiniz.

		Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1.	İleride fen bilimleri alanında bilim insanı olarak çalışmak istemem.	❑	❑	❑	❑	❑
2.	İleride fen bilimleri alanında keşifler yapan insanlarla çalışmak isterim	❑	❑	❑	❑	❑
3.	İleride fen laboratuarlarında çalışmak istemem.	❑	❑	❑	❑	❑
4.	Fen laboratuarında çalışmak geçim sağlamak için ilginç bir yol olabilir.	❑	❑	❑	❑	❑
5.	Fen bilimleri alanında meslek sahibi olmak çok eğlencelidir/eğlenceli olduğunu düşünüyorum.	❑	❑	❑	❑	❑
6.	Mezun olduktan sonra fen ile ilgili konuları öğretmek isterim.	❑	❑	❑	❑	❑
7.	Meslek olarak fen bilimleri alanında bilim insanı olmak sıkıcıdır.	❑	❑	❑	❑	❑
8.	Fen bilimleri alanında bilim insanı olmak bir iş olarak ilginç olabilir.	❑	❑	❑	❑	❑
9.	Fen alanında bilim insanı olmak istemem çünkü uzun süreli eğitim gerektirir.	❑	❑	❑	❑	❑
10.	İleride fen bilimleri alanında bir mesleğe sahip olmak isterim.	❑	❑	❑	❑	❑
11.	Fen bilimleri alanındaki mesleklere ilgi duyuyorum.	❑	❑	❑	❑	❑

APPENDIX D. Fen Bilimlerine Yönelik İlgi Soruları

Fen Bilimlerine olan ilginiz değişti mi?

1) Kuvvet ve Enerji ünitesi ve Saf Madde ve Karışımlar ünitesi işlenirken fen bilimlerine yönelik ilginizde bir değişim oldu mu? Lütfen, aşağıda durumunuza uygun şıkkı işaretleyin.

a) Fen Bilimlerine olan ilgim arttı
b) Fen Bilimlerine olan ilgimde bir değişiklik olmadı
c) Fen Bilimlerine olan ilgim azaldı

2) Fen bilimlerine yönelik ilginizin değişmesinde/değişmemesinde nelerin etkili olduğunu düşünüyorsunuz? Lütfen cevabınızı Kuvvet ve Enerji ünitesi ve Saf Madde ve Karışımlar ünitesinin nasıl işlendiğini düşünerek mümkün olduğunca detaylı açıklayın.

APPENDIX E. Permissions Obtained for Data Collection Instruments

a. Permission Obtained for Original Version of IIQ

25.04.2023 19:32 METU Webmail :: Re: INSTRUMENT PERMISSION

Re: INSTRUMENT PERMISSION

Gönderen Jerome Rotgans <rotgans@gmail.com>
Alıcı e215753 <simge.soylemez@metu.edu.tr>
Tarih 2022-12-19 07:33

Individual interest questionnaire.pdf(~68 KB)

Dear Simge,

Thank your very much for your interest in our work and the IIQ (attached).

You can use the instrument without any restrictions.

All the best with your research endeavors.

Kindest regards,
Jerome

Dr. Jerome Rotgans
(Ph.D., M.Sc., B.Sc., ing. MAROF)
Professor Medical Education
Singapore (Zulu+8hrs)
(+65) 9172 5213

On 19 Dec 2022, at 02:23, e215753 <simge.soylemez@metu.edu.tr> wrote:

Dear Mr. Rotgans,

First of all, I hope you are healthy and well. I am a graduate student at Middle East Technical University, Department of Science Education. In my thesis, I work on the role of motivation in middle school students' career choices. I have read your article "Validation Study of a General Subject-matter Interest Measure: The Individual Interest Questionnaire (IIQ)" with interest. If you have permission, I plan to adapt the IIQ items in your article for middle school science class in my thesis. I will be very happy if you allow me to use items from this questionnaire. Also, I would be very happy if you provide feedback. I wish you good work.

Sincerely,

Simge SÖYLEMEZ

b. Permission Obtained for Survey 2 (for IIQ) and Questionnaire 2 (for Science Interest Questions)

25.04.2023 19:33 METU Webmail :: RE: Instrument Permission

RE: Instrument Permission

Gönderen David Palmer <david.palmer@newcastle.edu.au>
Alıcı e215753 <simge.soylemez@metu.edu.tr>, Jennifer Archer <jennifer.archer@newcastle.edu.au>
Tarih 2023-02-22 01:55

Dear Simge SÖYLEMEZ yes you have my permission.
Best wishes
David Palmer

-----Original Message-----
From: e215753 <simge.soylemez@metu.edu.tr>
Sent: Tuesday, 21 February 2023 12:53 AM
To: Jennifer Archer <jennifer.archer@newcastle.edu.au>; David Palmer <david.palmer@newcastle.edu.au>
Subject: Instrument Permission

Dear Ms. Archer and Mr. Palmer,

First of all, I hope you are healthy and well.

I am a graduate student at Middle East Technical University, Department of Science Education. In my thesis, I work on the role of motivation in middle school students' career choices and task value beliefs.

I have read your student'(Jeanette Maree Dixon) thesis which is "Investigating the Role of Situational Interest in Developing Individual Interest in Science and Self-Efficacy to Teach Science in Preservice Primary Teachers" with interest. If you have permission, I plan to adapt Questionnaire 1, Questionnaire 2, and Survey 2 in Jeanette's thesis for middle school science class in my thesis.

I will be very happy if you allow me to use these questionnaires and survey in my thesis. Also, I would be very happy if you provide feedback. I wish you good work.

Sincerely,

Simge SÖYLEMEZ

(p.s. I couldn't find the e-mail address of Jeanette Maree Dixon so if you know any contact address where I can reach her and if you inform me about it, I would be very grateful)

c. Permission Obtained for Turkish Version of MSLQ (For Utility Value Belief in Science Scale)

27.10.2023 22:21 METU Webmail :: Re: ÖLÇEK İZNİ

Re: ÖLÇEK İZNİ

Gönderen Semra Sungur <ssungur@metu.edu.tr>
Alıcı e215753 <simge.soylemez@metu.edu.tr>
Tarih 2023-10-27 13:10

Sayın Simge Söylemez,

Türkçe'ye uyarlamis olduğum Motivated Strategies for
Learning Questionnaire (Öğrenmede Güdüsel Stratejiler Anketi'nin)
fayda değer alt boyutunda yer alan maddeler ile Pre-service Science
Teachers' Conceptions of Sound: The Role of Task Value Beliefs"
başlıklı çalışmamızda görev değerini ölçmeye yönelik olarak kullandığımız maddeleri çalışmanıza uyarlayarak kullanabilirsiniz.

Çalışmanızda başarılar dilerim,
Prof.Dr. Semra Sungur

2023-10-27 13:03, e215753 yazmış:

> Sayın Prof. Dr. Semra Sungur,
>
> Ben, ODTÜ Fen Bilimleri Eğitimi yüksek lisans öğrencisi Simge
> Söylemez. Yaptığım tez kapsamında öğrencilerin fen bilimlerine yönelik
> fayda değer inançlarını incelemeyi planliyorum. Öğrencilerin fen
> bilimlerine yönelik fayda değer inançlarını ölçebilmek için izniniz
> olursa, Türkçe'ye uyarlamış olduğunuz Motivated Strategies for
> Learning Questionnaire (Öğrenmede Güdüsel Stratejiler Anketi'nin)
> fayda değer alt boyutunda yer alan maddeler ile Science Education
> International dergisinde yayımlanmış olan " Pre-service Science
> Teachers' Conceptions of Sound: The Role of Task Value Beliefs"
> başlıklı çalışmanızda görev değerini ölçmeye yönelik olarak kullanmış
> olduğunuz ölçek maddelerini kendi çalışmama uyarlayarak kullanmak
> istiyorum.
>
> İlginiz için şimdiden teşekkür ederim.
>
> Saygılarımla,
>
> Simge Söylemez

--
Prof.Dr. Semra Sungur
Dept. of Math & Sci. Educ.
Middle East Technical University
Ankara, Turkey

d. Permission Obtained for Turkish Version of TOSRA (For Science Career Interest Scale (SCIC))

Re: TEZ İÇİN ANKET İZNİ

Jale Cakiroglu göndericisinden 2023-10-26 20:14 tarihinde
Ayrıntılar

Simge merhaba,

Ölçeği tezinde kullanabilirsin. Çalışmanda başarılar diliyorum.

Jale Çakıroğlu

ODTÜ Eğitim Fakültesi

On 10/26/2023 8:11 PM, e215753 wrote:

> Sayın Prof. Dr. Jale Çakıroğlu,
> Ben, ODTÜ Fen Bilimleri Eğitimi yüksek lisans 3.sınıf öğrencisi Simge Söylemez. Yaptığım
> tez kapsamında öğrencilerin fen bilimlerine yönelik mesleklere olan ilgisini ölçmeyi
> planlıyorum. Sizin de daha önceden Türkçe'ye uyarlamış olduğunuz TOSRA'nın, Career
> Interest in Science alt boyutundaki maddeleri izniniz olursa tezim kapsamında kullanmayı
> çok isterim. Sizden geri dönüt bekliyor olacağım.
>
> İyi akşamlar ve çalışmalar dilerim.
>
> Simge Söylemez

APPENDIX F.

a. Approval Obtained from Human Subjects Ethics Committee

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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Konu: Değerlendirme Sonucu

29 KASIM 2023

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın **Semra SUNGUR**

Danışmanlığını yürüttüğünüz Simge Söylemez'in ***"FAYDA DEĞER MÜDAHALESİNİN ORTAOKUL ÖĞRENCİLERİNİN FEN BİLİMLERİNE YÖNELİK İLGİ, FAYDA DEĞER İNANÇLARI VE FEN BİLİMLERİ KARİYER İLGİSİ ÜZERİNE ETKİSİNİN"*** başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek 0521-ODTUİAEK-2023 protokol numarası ile onaylanmıştır

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan

Prof.Dr. I. Semih AKÇOMAK
Üye

Doç. Dr. Ali Emre Turgut
Üye

Doç. Dr. Şerife SEVİNÇ
Üye

Doç.Dr. Murat Perit CAKIR

Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL
Üye

Dr. Öğretim Üyesi Müge GÜNDÜZ
Üye

b. Approval Obtained from Ministry of National Education

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Sayı : E-14588481-605.99-94172097 11.01.2024
Konu : Araştırma İzni

ORTA DOĞU TEKNİK ÜNİVERSİTESİ REKTÖRLÜĞÜNE
(Öğrenci İşleri Daire Başkanlığı)

İlgi : a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2020/2 sayılı Genelgesi.
b) 20.12.2023 tarihli ve 54850036-605.01-E.549 sayılı yazınız.

Üniversiteniz Matematik ve Fen Bilimleri Eğitimi Anabilim Dalı, Fen Bilimleri Eğitimi yüksek lisans programı öğrencisi Simge SÖYLEMEZ'in, **"Fayda Değer Müdahalesinin Ortaokul Öğrencilerinin Fen Bilimlerine Yönelik İlgi, Fayda Değer İnançları ve Fen Bilimleri Kariyer İlgisi Üzerine Etkisinin İncelenmesi"** başlıklı çalışması kapsamında İlimiz Çankaya ilçesine bağlı ortaokullarda yapılacak uygulama talebi ilgi (a) Genelge çerçevesinde incelenmiştir.

Yapılan inceleme sonucunda, söz konusu araştırmanın Müdürlüğümüzde muhafaza edilen ölçme araçlarının; Türkiye Cumhuriyeti Anayasası, Milli Eğitim Temel Kanunu ile Türk Milli Eğitiminin genel amaçlarına uygun olarak, ilgili yasal düzenlemelerde belirtilen ilke, esas ve amaçlara aykırılık teşkil etmeyecek, eğitim-öğretim faaliyetlerini aksatmayacak şekilde okul ve kurum yöneticilerinin sorumluluğunda, gönüllülük esasına göre uygulanması Müdürlüğümüzce uygun görülmüş olup çalışma tamamlandıktan sonra çalışmanın bir nüshasının **30 iş günü içerisinde arge06_arastirma@meb.gov.tr adresine PDF olarak gönderilmesi** gerekmektedir.

Bilgilerinizi ve gereğini rica ederim.

Yaşar KOÇAK
Vali a.
Milli Eğitim Müdürü

Ek : Uygulama Araçları (9 Sayfa)

Dağıtım:
Gereği:
Orta Doğu Teknik Üniversitesi

Bilgi :
Çankaya İlçe MEM

Bu belge güvenli elektronik imza ile imzalanmıştır.
Adres : Belge Doğrulama Adresi : https://www.turkiye.gov.tr/meb-ebys
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c. Voluntary Participation Form

ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu araştırma, ODTÜ Matematik ve Fen Bilimleri Eğitimi Bölümü yüksek lisans öğrencisi Simge Söylemez tarafından Prof. Dr. Semra Sungur danışmanlığında yüksek lisans tezi kapsamında yürütülmektedir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Araştırmanın amacı, fayda değer müdahalesinin ortaokul öğrencilerinin fen bilimlerine yönelik ilgi, fayda değer inançları ve fen bilimleri kariyer ilgisi üzerine etkisini incelemektir.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırmaya katılmayı kabul ederseniz, size fen bilimleri dersi Kuvvet ve Enerji ünitesi, Saf Madde ve Karışımlar ve Işığın Madde ile Etkileşimi ünitesi boyunca fayda değer müdahalesi taslakları uygulanacaktır. Ayrıca, çeşitli ölçeklerle de fen bilimlerine olan ilginiz, fayda değer inançlarınız ve fen bilimleri kariyer ilginiz ölçülecektir. Tüm bunlar, fen bilimleri dersi esnasında fen bilimleri öğretmeniniz tarafından uygulanacaktır. Ölçekler ve müdahale taslakları dışında bir çalışma olmayacaktır.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız?

Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Çalışmada sizden kimlik veya kurum belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır.

Katılımınızla ilgili bilmeniz gerekenler:

Ölçekler ve müdahale taslakları, genel olarak kişisel rahatsızlık verecek sorular veya uygulamalar içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden ötürü kendinizi rahatsız hissederseniz ölçeği veya müdahale taslağını yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda ölçeği veya müdahale taslağını uygulayan fen bilimleri öğretmeninize çalışmadan çıkmak istediğinizi söylemek yeterli olacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için Prof. Dr. Semra Sungur ya da yüksek lisans öğrencisi Simge Söylemez ile iletişim kurabilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad | Tarih | İmza

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d. Parental Consent Form

Gönüllü Katılım Veli Formu

…./…./…….

Sayın Veli,

Çalışmaya göstermiş olduğunuz ilgi ve bana ayıracağınız zaman için şimdiden çok teşekkür ederim. Bu form, size yaptığım araştırmanın amacını anlatmayı ve çocuğunuzun bir katılımcı olarak haklarını tanımlamayı amaçlamaktadır.

Bu araştırma için, Millî Eğitim Bakanlığı ve ODTÜ İnsan Araştırmaları Etik Kurulundan izin alınmıştır. Araştırma, *fayda değer müdahalesinin ortaokul öğrencilerinin fen bilimlerine yönelik ilgi, fayda değer inançları ve fen bilimleri kariyer ilgisi üzerine etkisinin* incelenmesini konu alan, Prof. Dr. Semra SUNGUR danışmanlığında hazırlanacak bir yüksek lisans tezidir.

Velisi olduğunuz öğrenci ile gerçekleştirilecek çalışmada, çocuğunuzdan müdahale taslaklarının ve ölçeklerin yapılmasını isteyeceğiz. Çocuğunuzun verdiği cevaplar, sadece bilimsel bir amaç için kullanılacak ve bunun dışında hiçbir amaçla kullanılmayacak, kimseyle paylaşılmayacaktır. Sizden çocuğunuzun katılımcı olmasıyla ilgili izin istediğimiz gibi, çalışmaya başlamadan çocuğunuzdan da sözlü olarak katılımıyla ilgili rızası mutlaka alınacaktır. Çocuğunuzun isminin araştırmada kullanılması gerekecekse, bunun yerine takma bir isim kullanılacaktır. Çocuğunuz istediği çalışmadan ayrılabilir. Bu durumda çocuğunuzun cevapladığı ölçek verileri kullanılmayacaktır.

Bu bilgileri okuyup bu araştırmaya velisi olduğunuz öğrencinin gönüllü olarak katılmasını ve araştırma dâhilinde benim size verdiğim güvenceye dayanarak bu formu imzalamanızı rica ediyorum. Çocuğunuzun çalışmaya katılması ile ilgili onay vermeden önce veya onay verdikten sonra sormak istediğiniz herhangi bir durumla ilgili benimle iletişime geçebilirsiniz. İstediğiniz takdirde araştırma sonucu hakkında bilgi almak için de irtibat numaramdan bana ulaşabilirsiniz. Formu okuyarak imzaladığınız için çok teşekkür ederim.

Simge SÖYLEMEZ
ODTÜ Fen Bilimleri Eğitimi Yüksek Lisans Öğrencisi
E-posta: simge.soylemez@metu.edu.tr
Tel. No: 0544 854 2850

Öğrenci:

Velisi:

Adı, soyadı:

İmza:

APPENDIX G

Utility Value(UV) Prompts For Experimental Groups

(Prompt 1, Prompt 2, Prompt 3, Prompt 4, Prompt 5, Prompt 6 and Prompt 7, respectively)

Aşağıdaki boşluğa Kuvvet ve Enerji ünitesinde Kuvvet, İş ve Enerji İlişkisi konusuyla ilgili öğrendiklerinizin günlük hayatınızla, ya da bir arkadaşınızın/akrabanızın hayatıyla ne kadar ve nasıl ilgili olduğunu açıklayan bir yazı yazınız. Sizden beklenen Kuvvet, İş ve Enerji İlişkisi konusunda öğrendiklerinizin günlük hayatta nasıl kullanılabileceğine, günlük hayatta nasıl bir fayda sağlayabileceğine dair mümkün olduğunca detaylı bir şekilde görüşlerinizi yazmanızdır.   İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Kuvvet ve Enerji ünitesinde Enerji Dönüşümleri konusuyla ilgili öğrendiklerinizin günlük hayatınızla, ya da bir arkadaşınızın/akrabanızın hayatıyla ne kadar ve nasıl ilgili olduğunu açıklayan bir yazı yazınız. Sizden beklenen Enerji Dönüşümleri konusunda öğrendiklerinizin günlük hayatta nasıl kullanılabileceğine, günlük hayatta nasıl bir fayda sağlayabileceğine dair mümkün olduğunca detaylı bir şekilde görüşlerinizi yazmanızdır. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Maddenin Tanecikli Yapısı konusuyla ilgili öğrendiklerinizin günlük hayatınızla, ya da bir arkadaşınızın/akrabanızın hayatıyla ne kadar ve nasıl ilgili olduğunu açıklayan bir yazı yazınız. Sizden beklenen Maddenin Tanecikli Yapısı konusunda öğrendiklerinizin günlük hayatta nasıl kullanılabileceğine, günlük hayatta nasıl bir fayda sağlayabileceğine dair mümkün olduğunca detaylı bir şekilde görüşlerinizi yazmanızdır. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Saf Maddeler konusuyla ilgili öğrendiklerinizin günlük hayatınızla, ya da bir arkadaşınızın/akrabanızın hayatıyla ne kadar ve nasıl ilgili olduğunu açıklayan bir yazı yazınız. Sizden beklenen Saf Maddeler konusunda öğrendiklerinizin günlük hayatta nasıl kullanılabileceğine, günlük hayatta nasıl bir fayda sağlayabileceğine dair mümkün olduğunca detaylı bir şekilde görüşlerinizi yazmanızdır. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Karışımlar konusuyla ilgili öğrendiklerinizin günlük hayatınızla, ya da bir arkadaşınızın/akrabanızın hayatıyla ne kadar ve nasıl ilgili olduğunu açıklayan bir yazı yazınız. Sizden beklenen Karışımlar konusunda öğrendiklerinizin günlük hayatta nasıl kullanılabileceğine, günlük hayatta nasıl bir fayda sağlayabileceğine dair mümkün olduğunca detaylı bir şekilde görüşlerinizi yazmanızdır. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Karışımların Ayrılması konusuyla ilgili öğrendiklerinizin günlük hayatınızla, ya da bir arkadaşınızın/akrabanızın hayatıyla ne kadar ve nasıl ilgili olduğunu açıklayan bir yazı yazınız. Sizden beklenen Karışımların Ayrılması konusunda öğrendiklerinizin günlük hayatta nasıl kullanılabileceğine, günlük hayatta nasıl bir fayda sağlayabileceğine dair mümkün olduğunca detaylı bir şekilde görüşlerinizi yazmanızdır. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Evsel Atıklar ve Geri Dönüşüm konusuyla ilgili öğrendiklerinizin günlük hayatınızla, ya da bir arkadaşınızın/akrabanızın hayatıyla ne kadar ve nasıl ilgili olduğunu açıklayan bir yazı yazınız. Sizden beklenen Evsel Atıklar ve Geri Dönüşüm konusunda öğrendiklerinizin günlük hayatta nasıl kullanılabileceğine, günlük hayatta nasıl bir fayda sağlayabileceğine dair mümkün olduğunca detaylı bir şekilde görüşlerinizi yazmanızdır. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

APPENDIX H

Utility Value(UV) Prompts For Control Groups

(Prompt 1, Prompt 2, Prompt 3, Prompt 4, Prompt 5, Prompt 6 and Prompt 7, respectively)

Aşağıdaki boşluğa Kuvvet ve Enerji ünitesinde Kuvvet, İş ve Enerji İlişkisi konusuyla ilgili öğrendiklerinizin bir özetini yazınız. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Kuvvet ve Enerji ünitesinde Enerji Dönüşümleri konusuyla ilgili öğrendiklerinizin bir özetini yazınız. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Maddenin Tanecikli Yapısı konusuyla ilgili öğrendiklerinizin bir özetini yazınız. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Saf Maddeler konusuyla ilgili öğrendiklerinizin bir özetini yazınız. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Karışımlar konusuyla ilgili öğrendiklerinizin bir özetini yazınız. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Karışımların Ayrılması konusuyla ilgili öğrendiklerinizin bir özetini yazınız. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.

Aşağıdaki boşluğa Saf Madde ve Karışımlar ünitesinde Evsel Atıklar ve Geri Dönüşüm konusuyla ilgili öğrendiklerinizin bir özetini yazınız. İhtiyaç duyarsanız, sayfanın arkasını da kullanabilirsiniz.