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Full Length Research Paper

The effect of design thinking on the creative thinking of physical education and sports teachers

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ABSTRACT

This study was conducted to examine the effect of design thinking on the creative thinking of physical education and sports teacher candidates. The research group of the study, which was created by using the pretest-posttest single-group experimental design, consisted of 14 women and 15 men, who were studying at Ankara University, Faculty of Sport Sciences, Physical Education and Sports Teaching Program and taking the Community Service Practices lesson in the fall semester of the 2022-2023 academic year and it consisted of 29 students in total. As a data collection tool, the “How Much You Have Created Scale” developed by Whetton and Cameron (2002) and adapted into Turkish by Aksoy (2004) and the "Demographic Information Form" prepared by the researchers were used. In this study, the Stanford design thinking model was applied to physical education and sports teacher candidates for 9 weeks in the community service practices lesson. According to the results of the analysis, it was observed that there was a significant change in the pre-test and post-test scores of the physical education and sports teacher candidates from the creative thinking scale after the application. The findings reveal that the design thinking approach is effective in developing the creative thinking of physical education and sports teacher candidates.

Keywords: Creative thinking, community service practices, design thinking, physical education and sport, teacher.

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INTRODUCTION

The word design refers to the idea and the tools used to manifest it. (Barnard, 2002). Design thinking is not a new concept. There are various definitions, principles, tools and techniques referenced by different groups (Boyle et al., 2022). There is a certain flow situation in the design process. In this flow, the idea first develops. The mentioned idea can be both a solution to an existing problem and an answer to a new problem. In order to reach a solution, research is necessary, and the mapping of the idea stage, which is the part where the needs for the solution are defined, is possible with design thinking (Kadam 2018). Although design thinking is considered a concept, it is a design-related phenomenon and an approach that many disciplines can interact with (Chasanidou et al., 2014). The design thinking approach is the way followed to aim to reach the design in a beneficial way, in which the person is centered. At the same time, it is seen as the path followed in the process until the best answer is given to the people. In order for the design thinking potential to be fully realized, it is necessary to go beyond seeing it as a process (Chesson, 2017). Brown (2008) emphasizes drawing thinking in design-oriented thinking. In this process, the product development strategy is central, along with empathy, integrative thinking and cooperation. Using design thinking, the designer tries to answer questions such as matching and sensitivity methods, people's needs, what can be applied with the help of technology and how it can be applied. There are four basic categories in line with the structure of design thinking. Brown (2008) listed these

four basic categories as follows:

1. Design thinking is human-oriented design.
2. Design thinking offers integrative thinking.
3. Design thinking is a strategy in the teaching process.
4. Design thinking includes the process stages involved in design management.

Creative thinking is focused on design thinking. Case studies focus on process-oriented ideas, accepted explanations, challenges and solutions. A user-oriented approach should be adopted in the product and service offering phase, and thus faster growth and success graphs should be created (Martin, 2009). The perspectives on design thinking and the design process show that design thinking cannot exist without creativity. This is an indication that there is a direct relationship between design thinking and creativity. Since involving people at any stage of design thinking will require people to be creative, it will be a factor that increases their potential to be creative (Girgin, 2020).

No matter which design-oriented approach model is used in the instructional design process, the most important thing is to choose at which stage the model is appropriate to be used (Brenner et al., 2016). There is a need for design-oriented thinking research in teacher education, and it is possible that the deficiency in the implementation of the practices in schools can only be overcome by design-oriented thinking, along with the theoretical findings in the science of pedagogy (Scheer et al., 2012). In addition to the development of education programs, it is necessary to organize the learning and teaching environments in a way that will improve the creative thinking skills of the students. In addition, it is known that the most important person in ensuring this is teachers (Certel and Çetinkaya, 2011). It is stated as an important point that the design-oriented approach to education and creative thinking ways are transferred by the teachers to their students (Melles et al., 2012). It is seen that educators who adopt the design-oriented approach in education argue that the design-oriented approach plays an important role in the success of students by making a positive contribution to problem-solving, working in cooperation and creative thinking (Anderson, 2012; Arcan, 2019; Skaggs et al., 2009; Watson, 2015). When the design-oriented approach is used as a constructivist learning strategy in education, it also motivates people (Bruton, 2010; Carrol, 2014).

There are many design thinking models in education. The Stanford design thinking model was used in the research. In this model, design thinking consists of five stages. These stages are; empathizing, describing, generating ideas, prototyping and testing (D. School, 2019; Tu, Liu and Wu, 2018).

1. Empathizing: This stage is the starting point of design thinking. At this stage, both the logical and emotional needs of the user group are analyzed and an attempt is made to understand them deeply and to develop insight. For this, techniques such as interviews, observation and experience are used. These insights allow for a better understanding of the context and the problem.
2. Describing: At this stage, a problem is defined based on the insights obtained in the empathy stage.
3. Generating ideas: At this stage, it is aimed to produce innovative ideas for the solution of the problem defined.
4. Prototyping: This stage consists of the realization and concretization of ideas worth trying. According to the prototype problem area, sketch, storyboard, presentation, model, animation, etc. it could be.
5. Testing: At this stage, the prototype is tested with real or representative users and stakeholders. In this process, certain methods are followed in order to develop the prototype and to determine its deficiencies and good sides. For example, the interaction of the users with the prototype is observed, interviews are conducted with the users and they are asked what they like and dislike.

Although the design thinking process may seem linear, it is iterative (Scheer et al., 2012).

Dunne and Martin (2006) design thinking approach allows students to make practical and experiential applications in universities. Thus, states that it will help university students to be ready for the environment they will encounter when they start working after graduation. Bower et al. (2013) revealed that the use of the design thinking approach in teacher education contributes to the enrichment of the content that teachers prepare for their students and the strategies they use in their lessons.

This study focused on the creative thinking skills of teacher candidates of the design thinking approach. Orlandi (2010) stated that design education develops a creative and innovative mindset and way of thinking among students.

Creativity is the process of using knowledge and originally differentiating knowledge by adding imagination (Altunya, 2018). The person starts to think actively by using the knowledge while doing sports and establishing a connection between the body and the mind. This is a situation that affects a person's creative thinking. Therefore, it will be inevitable for sports to be intertwined with creativity (Derbentoğlu, 2019). It should be aimed to develop the creative skills of not only the teachers working in the field of theoretical education but also physical education teachers who are experts in both theoretical and practical education. Physical education teachers need to focus not only on the psychomotor domain but also on the cognitive domain, taking into account the thinking processes underlying the movement, in order to improve the skill acquisition of students.
The use of the Design Thinking approach in teacher education is new (Parker et al., 2021). For this reason, studies in this field will contribute to a better understanding of the design thinking approach and to reveal its effects on teacher candidates.

This study is aimed to examine the effect of the design

thinking approach on the creative thinking of physical education and sports teacher candidates. This study is considered important in that it provides an example of how the design thinking approach can be used in the field of sports sciences and contributes to the creative thinking skills of physical education teacher candidates.

Within the framework of this research, answers to the following research questions were sought.

1. Is there a significant difference between the creativity scale pre-test scores and post-test scores of physical education and sports teacher candidates?
2. Do physical education and sports teacher candidates' scores on the creativity scale differ according to their gender?

METHOD

Research design

In this study, a pretest-posttest single-group experimental design was used to investigate the effect of physical education and sports teacher candidates' design thinking approach and designing community service projects on their creative thinking. In this design, the effect of the experimental procedure is achieved on a single group by using the same subjects and the same measurement tools as a pre-test before the application and a post-test afterward. In the design, the significance of the difference between the pretest and posttest values belonging to a single group is tested (Büyüköztürk, 2008). The reason for choosing this design is to test the effect of the procedure on the dependent variable and to interpret the findings in a cause-effect relationship. (Table 1)

Process

In this study, physical education and sports teacher candidates were asked to solve a problem of their choice for any group in society with a design-oriented thinking approach in the Community Service Practices course. The research continued for 12 weeks in the Community Service Practices course, which is a two-credit compulsory course in the physical education and sports teaching program.

The stages and guidelines that physical education and sports teacher candidates follow while carrying out their design-oriented thinking and community service projects are listed in Table 2.

The Community Service Practices course is structured with design-oriented thinking as summarized as follows:

Lesson 1 (Application of the pre-test)

In the first lesson, students were given a pre-test. It was explained to the students that they would be asked to solve a problem that concerns society by following the stages of design-oriented thinking and general information was given.

Lesson 2 (Introducing design thinking)

The stages of design thinking are explained with examples. It was stated that the students would carry out their designs with group work, and a total of six groups consisting of five members were formed. The instructions for the empathy stage, which is the first stage of the process, are given.

Lesson 3 (Empathy stage student presentation)

The students who carried out the instructions of the empathy stage made their presentations. The instructor gave feedback to the students about the stages and explained the instructions for the next stage, the define stage.

Lesson 4 (Identification stage student presentation)

The students who fulfilled the instructions of the definition stage made their presentations. The instructor gave feedback to the students about their stages and explained the instructions for the next stage, the idea generation stage.

Table 1. Experimental design of the research.

Group	Pre_test	Process	Post_test
Experimental group	HCYAS	Design thinking	THCYAS

HCYAS: The How Creative You Are Scale.

Lesson 5 (Idea generation stage student presentation)

The students who fulfilled the instructions of the idea generation stage made their presentations. The instructor gave feedback to the students about the stages and explained the instructions for the next stage, the prototyping stage. Two weeks were given to the students

Table 2. Design thinking stages and guidelines.

Stages	Guidelines	Weeks
Execution of the pre-test		1st week
Introducing design thinking		2nd week
1st stage: Empathizing	✓ Learning about user needs and identifying the problem; interviewing, observing and experiencing. ✓ To record the obtained data for analysis; recording audio, taking notes, and taking photos or videos. Analyzing conversations.	3rd week
2nd Stage: Describing	✓ Determining the design framework. Conducting auxiliary research (expert opinion on the subject, internet research, academic books, etc.) Creating the work plan.	4th week
3rd Stage: Generating ideas	✓ Generating ideas using different thinking techniques (brainstorming, brain training or idea building, etc.).	5th week
4th Stage: Prototyping	✓ Bringing the idea to life with a prototype.	6th and 7th. weeks
5th Stage: Testing	✓ Testing and developing the prototype.	8th, 9th, 10th and 11th weeks
Application of the posttest		12th week

for the prototyping phase.

Lesson 6 (Prototyping phase student presentation)

The students who carried out the instructions of the prototyping stage presented their prototypes. The instructor gave feedback to the students about the stages and explained the instructions for the next stage, the testing stage. The students were given four weeks for the testing phase.

Lesson 7 (Testing phase student presentation)

The students who fulfilled the instructions of the testing phase made their presentations. The instructor gave feedback to the students about their stages and asked them to evaluate their own designs.

Lesson 8 (Application of the post-test)

A post-test was administered to the students.

Study group

The study group of the research consists of a total of 29 students, 14 women and 15 men, who took the Community Service Practices course. These students are students studying at Ankara University, Faculty of Sports Sciences, Physical Education and Sports Teaching Program in the fall semester of the 2022-2023 academic year.

Data collection

Personal information form

It is an information form that includes the gender information of teacher candidates.

How Creative You Are Scale

It was developed by Whetton and Cameron (2002) to reveal the characteristics, values, motives and interests of students and to help identify students' highly creative personalities. The answer options for the items in the scale are I agree, I am undecided, and I do not agree. The scoring of each item is different and the lowest score of the items is -2 and the highest score is 3. The scale consists of 40 items in total. Item 40 is not in the question grading type like other items. Differently, this item contains 54 adjectives related to creativity. The score values of these adjectives on the scale are between 0

and 2, and they are taken into account in calculating the total creativity scores of the students. The Turkish adaptation of the Creative Thinking Scale was carried out by Aksoy (2004). In the adaptation study, the Cronbach Alpha internal consistency coefficient was determined as .94. If the reliability coefficient of a measurement tool is .70 and above, it means that the reliability of that measurement tool can be accepted (Bernardi, 2016).

Analysis of data

It was examined whether the pre-test and post-test scores of the physical education and sports teacher candidates from the scale showed normal distribution. The Shapiro-Wilk test was used for normality analysis, and the kurtosis and skewness values of the data were checked. According to the normality analysis, it was concluded that the data showed a normal distribution ($p > 0.05$; skewness and kurtosis = ±1.00), and accordingly, it was decided to use parametric tests. (Hair et al., 2013).

Dependent samples t-test was used to determine whether physical education and sports teacher candidates' design thinking and designing community service projects have an effect on their creative thinking. Independent samples t-test was used to reveal whether physical education and sports teacher candidates' scores on the creativity scale differ according to their gender (Pallant, 2016).

FINDINGS

In this section, the findings obtained from the analyzes carried out to test the hypotheses of the research are given.

The dependent samples t-test results, which were carried out to determine whether the difference between the creative thinking pre-test and post-test scores of physical education and sports teacher candidates is significant or not, are presented in Table 3. When Table 3 is examined, it is seen that there is a significant change in the scores of physical education and sports teacher candidates from the creative thinking scale before and after the experiment ($t(28) = -12,68$ $P = .000$, $P > 0.05$). Guidelines for interpreting the obtained value are stated as .01 = minor effect, .06 = moderate effect, .14 = large effect (Cohen, 1988). Considering that the eta squared value obtained is .85, we can conclude that the statistically significant difference between the creative thinking scores before and after the application has a large effect size. Accordingly, it can be said that after the design-oriented thinking application, there was an increase in the creative thinking of physical education and sports teacher candidates.

When Table 4 was examined, it was concluded that there was a significant difference in the scores of female physical education and sports teacher candidates from the creative thinking scale before and after the experiment ($t(13) = -10.68$, $P = .000$, $P > 0.00$). Similarly, it was concluded that there was a significant difference in the scores of male physical education and sports teacher candidates from the creative thinking scale before and after the experiment ($t(14) = -7.79$, $P = .000$, $P > 0.00$).

When Table 5 is examined, it has been revealed that the scores of female and male physical education and sports teacher candidates from the creative thinking scale increased after the design-oriented thinking application. It was concluded that women's creativity scale pre-test mean scores ($\bar{x} = 32.2$) were lower than men's pre-test mean scores ($\bar{x} = 34.8$). It was concluded that women's creativity scale post-test mean scores ($\bar{x} = 48.8$) were lower than men's post-test mean scores ($\bar{x} = 49.8$). There is no significant difference between the mean scores of female and male physical education and sports teacher candidates from the scale, both before the experiment ($t(27) = -.815$, $P = .243$, $P > 0.00$) and after the experiment ($t(27) = -.385$, $P=.862$, $P > 0.00$).

Table 3. Creativity scale pre-test and post-test scores dependent samples t-test results.

Group variable	N	$\bar{x}$	Ss	t	df	Sig.	η2
Experiment HCYAS _pre	29	33.55	8.48	-12.68	28	.000	.85
HCYAS _post	29	49.27	7.47				

Table 4. Creativity scale pre-test and post-test scores by gender dependent samples t-test results.

Group variable	N	$\bar{x}$	Ss	t	df	Sig.
Female HCYAS _pre	14	32.21	7.97	-10.68	13	.000
HCYAS _post	14	48.80	7.67			
Male HCYAS _pre	15	34.80	9.03	-7.79	14	.000
HCYAS _post	15	49.80	7.51			

Table 5. Creativity scale pre-test and post-test scores by gender ındependent samples t-test results.

Group variable	N	x̄	Ss	t	df	Sig.
Female HCYAS_pre	14	32.21	7.97	-.815	27	.243
Male HCYAS_pre	15	34.80	9.03			
Female HCYAS_post	14	48.80	7.67	-.385	27	.862
Male HCYAS_post	15	49.80	7.51			

DISCUSSION AND CONCLUSION

Unlike traditional learning methods, design thinking is a new teaching model that offers creative solutions to human-centered problems and requires interdisciplinary skills, teamwork and cooperation (Tu et al., 2018).

In this study, community service projects were carried out with design-oriented thinking in order to develop the creative thinking of physical education and sports teacher candidates. At the end of the project, the pre-test and post-test scores of the physical education and sports teacher candidates on the creative thinking scale were examined and it was observed that there was an increase in their creative thinking. The results obtained support the hypothesis of the study "The design thinking approach is effective in the significant difference between the pretest and posttest scores of physical education and sports teacher candidates from the creativity scale".

This finding obtained in the study may be due to the fact that the design thinking approach offers opportunities to develop creative thinking. Each stage of the design thinking approach includes different tasks. During the application process of the study, physical education and sports teacher candidates first followed the process of defining the problem, understanding the user and the context in which (s)he was in depth, obtaining information about emotions, thoughts and behaviors, and developing insight. They used different thinking techniques such as brainstorming, brain gymnastics, and idea construction in order to produce ideas that will create innovative solutions, and they tried to be original, not to be stuck with functions and to suspend judgments in these processes. They made the ideas produced practically and functionally. They tested the ideas they had chosen and improved their ideas further with the feedback they received. When the above processes are examined, it may be that the elimination of thinking barriers such as being stuck in the function and judgment that prevent creative thinking and providing the necessary environments for creative thinking may have supported the development of creative thinking in physical education and sports teacher candidates.

When the studies on design thinking in education are examined, design thinking to creative thinking (Rauth, et al., 2010; Nguyênet et al., 2019; Bowler, 2014; Balakrishnan, 2022; Carroll, 2014) improves problem-solving and collaboration (Anderson, 2012; Retna, 2016; Skaggs et al., 2009; Scheer et al., 2012; Watson, 2015; Caruso, 2011) is emphasized. Similarly, Balakrishnan (2022) argues that design thinking motivates students to solve problems, be open to new ideas, and be innovative and creative. Roberts (2005) stated that creativity is the ability of an individual to find new things by using their imagination while doing an activity. Design thinking contributes positively to the development of creative thinking skills as it directs students to many mental activities while solving problems. Rauth et al., (2010) state that design thinking, as a strategy using deductive reasoning, is subjective, interpretive, integrative, experimental, synthetic and dialectical, and in the sum of these, it reveals creative thinking.

There are similar studies in the literature that support the findings of our study. Nguyênet et al., (2019) stated in their study that the design thinking model improves students' creative thinking and entrepreneurship. Balakrishnan (2022), on the other hand, examined the effect of design thinking on facilitating the development of students' creativity skills and creative thinking motivation. And revealed that design thinking helps students both think creatively and increase their motivation, thus enabling them to propose and develop practical, innovative designs. Kuo et al. (2021) investigated the effect of design thinking on university students' learning motivation and creative thinking. The students in the experimental group, in which design thinking was applied, were able to look at the problem from more than one angle and produce more creative ideas. In the study, Retna (2016) found that design thinking has the potential to develop skills such as creativity, problem-solving, communication and teamwork, and contributes to students' development of empathy.

The second hypothesis of the study was expressed as “The pre-test and post-test scores of physical education and sports teacher candidates from the creativity scale differ according to their genders”. When the hypothesis was examined, there was no significant difference between the mean scores of female and male physical education and sports teacher candidates from the scale, both before and after the experiment. It was concluded that women's creativity scale pre-test mean scores were lower than men's pre-test mean scores and women's creativity scale post-test mean scores were lower than men's post-test mean scores. It was observed that there was an increase in their creative thinking after the

experiment in both groups.

When the studies in the literature are examined, which show similarities with the results of this research in the literature (Stoltzfus et al., 2011, Perdana, 2019; Zubaidah et al., 2017) and different studies (Lau and Cheung, 2010; Stephens et al., 2001; Durnacı and Ültay, 2020; Anwar et al., 2012; Awamleh et al., 2012; Hong et al., 2013; Kousoulas and Mega, 2009) has been determined.

At this point, the main reasons for the different results of the research are; cultural, environmental, and biological factors, as well as research scoring methods, data analysis approaches, etc., which can be explained as changing. In the findings of our study, men's creative thinking scores were higher than women's. This may be due to the fact that men perform better in problem-solving than women (Lin et al., 2012). At the same time, when producing something new, men activate brain networks associated with rule learning and outcome-based decision-making more than women (Abraham et al., 2014). The fact that men activate their brain networks more than women means that they can produce new things. From this perspective, men can be expected to be more creative than women.

RECOMMENDATIONS

As a result, it is thought that creative thinking, which is one of the 21st-century skills, will help teachers use their imagination, create a new product, adapt to new situations, use materials out of the ordinary and adapt to the age. For this reason, intervention studies that will develop teachers' creative thinking in the teacher training process are considered very important. In order to obtain more in-depth information for future studies and to allow pre-service teachers to reflect on their own stories in the process, mixed studies can be carried out with both quantitative and qualitative data. Such studies can also be carried out in different branches and different fields.

ETHICAL TEXT

“This article complies with journal writing rules, publication principles, research and publication ethics, and journal ethics. Responsibility for any violations that may arise regarding the article belongs to the author(s). For this study, an application was made to the Ankara University Rectorate Ethics Committee and the ethics committee approval was obtained with the decision numbered 804303.

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