A Sustainable Learning Approach: Design Thinking in Teacher Education

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Abstract

In the 21st century individuals are expected to use their knowledge to find user-centric solutions in a variety of circumstances, places and times. Design thinking is a human-centric process application compatible with 21st century skills such as innovation, creativity, problem solving, critical thinking, communication, and cooperation. Design thinking takes the theoretical structure of thinking and turns it into action. The design thinking approach is a tool to raise individuals who solve problems, question situations and create products. Design thinking asks students to solve complex problems with more than one applicable solution and evaluates the students in a flexible and dynamic structure. This study aimed to ascertain student teachers' opinions about the concept of design thinking before they started to work as teachers. The phenomenology approach, which is a qualitative research design was used in the study. The participants of this study comprised 28 student teachers in different departments of the selected faculty of education. The purposeful criterion sampling method and maximum variation sampling method were used to identify the participants. Semi-structured and non-directive focus group interviews were conducted to collect the data. During the focus group interview, the data were enriched and deepened through social interaction and group dynamics. The opinions were obtained via the focus group interviews qualitatively in accordance with the content analysis and presented through the program Maxqda-20. The results showed that student teachers saw design thinking as a flexible and dynamic structure that could facilitate high quality cooperative interaction. Also, in the changing and developing structure of a world with ever more complex problems, the student teachers found design thinking to be a strong alternative to combat challenges. The findings, additionally, indicated that looking into the concept of design thinking as a sustainable learning tool in teacher training was very important to raise students with a focus on design thinking.

Keywords: Design thinking, teacher education, sustainability, sustainable learning approach

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1. Introduction

In our times, global changes are happening in current applications in many fields. Due to novel situations arising because of these global changes, individuals need 21st century skills and talents to apply and form new knowledge, and solve new (Bellanca, 2014; Griffin & Care, 2014; Pellegrino & Hilton 2013).These skills and talents include critical thinking, creative problem solving, cooperative learning, digital literacy and multifaceted communication (Pellegrino & Hilton 2013; Trilling & Fadel 2009; Yelland, Cope & Kalantzis 2008). Design thinking is an important thinking structure that develops 21st century creativity, economic innovation and entrepreneurship skills (Allina, 2018; Beck, 2016; Pink, 2006; Sousa & Pilecki, 2018).

Design thinking has been accepted as a comprehensive pedagogical framework that encourages students to gain 21st century skills and talents (Johansson - Sköldberg, Woodilla & Çetinkaya, 2013; Koh, Chai, Benjamin & Hong, 2015; Noweski, Scheer, Büttner, von Thienen, Erdmann & Meinel, 2012; Razzouk & Shute 2012). The aim of design thinking as a learning approach is to enable innovation through the combination of creative and analytical approaches (Ambrose & Harris, 2010; Cross, 2011; Lahey, 2017; Lockwood, 2009). The design thinking model is based on four important building blocks repetitively experienced by individuals on the road to becoming design thinkers. These building blocks are that it is a human-centric approach that contains experimental processes, is based on cooperative interaction and develops metacognitive thinking skills (Goldman et al., 2012). This is why the structural elements of design thinking enables changes of ideas and creates observable epistemological perspective and instincts by changing the actions of students as design thinkers.

Design thinking has been defined in literature in many different ways. The first key concepts in the literature on Design Thinking, without the use of the term Design Thinking, were put forth but Simon (1996) who the concept as a way to tie design to the cognitive process. Cross (2011) analyses design in the context of information rather than practical application. Rowe (1991) was the first to use the term "Design Thinking" however, their use of the term is limited to architectural application. In these statements the focus is on the designer's ideas and design practices. Also, these statements were significantly expanded in the 21st century when they were tied to design management and innovation. According to Tim Brown, an important name in design thinking, design thinking:

- looks for new ideas and innovative solutions to complex problems.

- is an innovative approach that helps deal with uncertainty.

- is the process of understanding user needs, discovering solutions and ideas, and quickly and repetitively prototyping these discoveries.

- is a human-centric methodology (Brown, 2008)

Design thinking:

is a human centric approach that;

- should focus on empathy for others.

- is a movement beyond egocentric worldviews.

- is based on the designers' needs, wishes, experiences or preferences.

contains experimental processes;

- realizing that everything can be accepted as a prototype.

- adopting application and visualization as a problem-solving approach.

includes cooperative interaction;

- believing that cooperation is a key element of problem solving.

- accepting interdisciplinary cooperation

- believing that cooperation supports transformative innovation

develops metacognitive thinking skills;

- having cognitive awareness in the design thinking process

- evaluating the process in a reflective way (Goldman et al., 2012).

Design thinking is an interdisciplinary approach. Design thinking is a repetitive process that identifies problems and contains empathy. This process includes ideation, prototyping and testing solutions. Design thinking as a repetitive, dynamic and nonlinear framework was split into five stages by Brown (2008). These stages are: (1) Empathize, (2) Define, (3) Ideate, (4) Prototype, and (5) Test
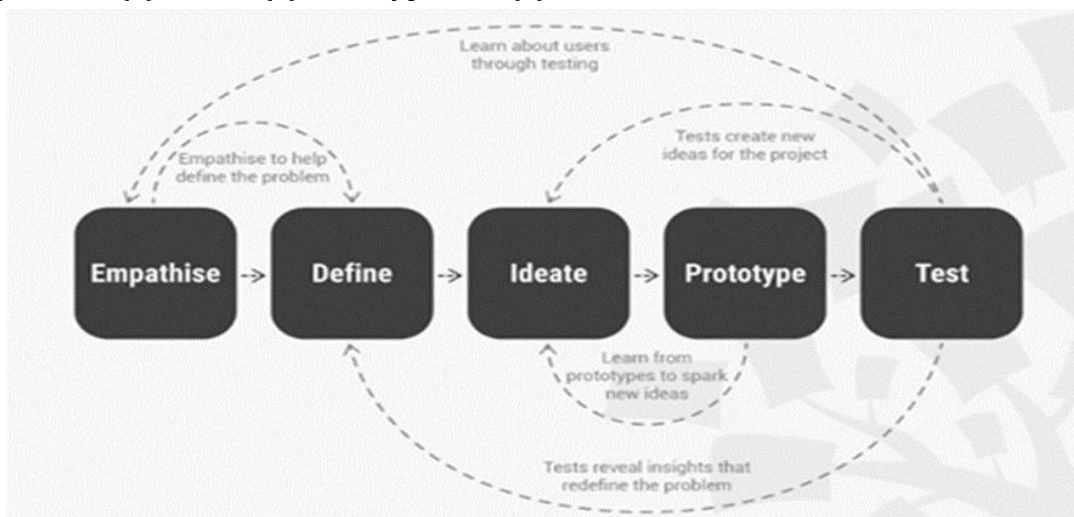
Figure 1. Design Thinking Process (Scheer, et al, 2011)

The design thinking process is not linear and allows for repetition through feedback loops (Lindberg, Meinel & Wagner,2011). The five stages are flexible and the designer may need to repeat or rethink a step at any given point. The description of the stages are as follows (Brown, 2009):

•Empathizing with stakeholders to understand the problem (interviewing or observing students or trying to put oneself in the students' shoes)

•Defining the problem (defining the problem in a comprehensive way including all facets and perspectives)

•Ideation (brainstorming, from the mundane to nature and everything in between to come up with as many potential solutions as possible),

•Prototyping (constructing a tangible model and picking a solution of which to form a model)

•Testing (testing the prototype with students to gain perspective on what works or does not work and what has to be done or redone)

Key features of design thinking:

1) User-centricity: Inclusion and centricity, the process of including the observed user needs in the design process.

2) Problem Framing: The difficulty of designing should be organized in such a way that it frames the challenge meaningfully, broadens the areas of possible solutions, and fosters the perception (Weick, Sutcliffe & Obstfeld, 2005).

3) Visualization: Visually representing the solutions after having considered many potential solutions.

4) Experimentation: Repetitive testing of some of the most likely ideas using divergent and convergent methods

5) Variety: Looking at situations from broad perspectives wherein all opinions are important (Carlgren, Rauth & Elmquist, 2016).

These qualities, while not set in stone, are presented in many of the seven stages included in design thinking models (Bereiter & Scardamalia, 2006).

1) Define: Definition of the problem.

2) Research: Gather background knowledge and find out more about the problem by observing users.

3) Ideate: Solutions that have the potential for brainstorming.

4) Prototype: Construct quick iterations of potential solutions with an emphasis on speed rather than quality using low cost materials and labour.

5) Choose: Choose a solution for the rest of the process.

6) Apply: Solutions are generated, and problem areas are determined.

7) Learn: Designers get feedback on the solution and think about what happened in the design process (Ambrose & Harris, 2010).

Design thinking is an analytical and creative process that involves forming models, experimentation and prototyping, collecting feedback and redesigning. The prototyping stage in design thinking tests available concepts and shows practitioners what is possible thanks to the design solutions (Brown & Katz, 2019).This prototyping stage gives the designers a more tangible situation to think about the problem/solutions (Papert, 1980; Papert & Harel, 1991). Using prototypes in this way helps the designers understand the proposed solution more concretely (Brown, 2008; Brown & Katz, 2019; Kelley, 2016; Straker & Wrigley, 2015).

There are many different versions of the design thinking process and in most of these approaches design thinking is not linear. Design thinking is based on cognitive skills and how designers approach problems (Cross, 2001; Lahey, 2017). In this context, it encourages the diffusion and spread of traditional "knowledge as verified truth" epistemology into "design epistemology" that focuses on creative social structure, suggestion and contextual evaluation to solve current, complex real-world problems (Tsai, Chai, Wong, Hong &Tan 2013; Rowland, 2004). This is why it is highlighted, as Mittal, Singh, Kapur, Sharma and Shamshi (2008) also discusses, that design thinking is repetitive and develops the ability to tolerate uncertain situations where there is more than one solution, meaning or explanation. As a whole, design thinking is the process of creative problem solving (Brown & Katz, 2009; Dorst, 2006; Kelley, 2016), a frame to define the challenges faced by individuals, communities and institutions and people producing with strong interaction (Dorst, 2019).

Design is, perhaps, the most fundamental of human practices. It is the factor that separates humans from humans and has been a part of all human culture and civilization (Dorst, 2019; Nelson & Stolterman, 2012). Design thinking is seen as placing simplified design practices into a ready-made mould to tackle new challenges in various environments. Education and education design in particular, has started to pay attention to integrating design thinking concepts into the models and practices in its own field. Design thinking is a problem-solving approach that reduces a series of broad design methods into a simple replicable framework that is used in an expanding number of situations to address an expanding number of challenges (Johansson-Sköldberg et al.,2013; Kimbell, 201; Liedtka, 2015; Nelson & Stolterman, 2000).

1.1. Learning approach with design thinking

The problems faced by practitioners in the field of education are complex and diverse because, it includes many areas such as designing a program, content, motivating students, and communicating with parents. This is why many challenges in education are difficult, contain many eventualities and do not have a singular solution (Bullough, 2012). The value of design thinking in the field of education has started to come up much more in teaching practices (Carlgren, 1999; Norton & Hathaway, 2015). Despite the growing interest in design thinking, there is a need to understand how design thinking can be applied within the context of teaching and learning. It is thought that design thinking can develop teachers' ability to find solutions to challenges within the education system if they see themselves as designers. For example, if we think of teachers as designers, they can analyze how they interact with the properties of the school, better understand challenges and set a path for progress. Helping students think like designers in the design thinking model, is described as a beneficial way to prepare students for life by helping students deal with difficult situations and solve complex problems they may encounter in their careers (Razzouk & Shute, 2012).

Learning with design thinking or learning through design is another design opinion in education however, the focus is on how students learn or form information through the active design process. The focus in design processes takes place an important way of structuring (Kolodner, Crismond, Gray, Holbrook & Puntambekar, 1998). Learning takes place most effectively when students are busy with designing or creating something while using and developing subject knowledge (Bereiter & Scardamalia, 2003). How students can encounter design processes, how they can take part in project-based learning and how they can experience and apply concepts in a way that is personally meaningful are all emphasised (Papert & Harel, 1991). Kafai and Peppler (2012) also connected design work to learning by focusing on play and programming. Students should take part in practices necessary for designers in building and applying to create something (Gee, 2005). The teacher still plays a central role in facilitating and guiding learning (Kalantzis & Cope, 2005), however, learning through design aims to develop students' knowledge, skills and creativity through more active, cooperative design situations.

1.2. Design thinking in teacher training

Studies conducted in the literature have put forth the importance of design as a theoretical lens for the field of education connected to teaching and learning (Kirschner, 2015; Razzouk & Shute, 2012). Teachers also use design in another critical area, problem solving approaches (Johansson-Sköldberg et a.,2013; Kimbell, 2011; Lindgaard & Wesselius, 2017).

Koehler and Mishra (2005) state that there should be learning experiences in which the teacher clearly places themselves in the role of designer. Wiggins and McTighe (2005) is a critical practice that empowers teachers as learning designers and encourages the intention of design in process of preparation for learning. In this regard, before educators put something in the curriculum into practice, they must identify the aim of doing something, therefore, this type of back design offers special guidance in teachers' work to form learning experiences, plans or units (Wiggins & McTigue, 2005).

The connection between teaching and design is not new (Dewey, 1934; Schon, 1983). However, it has been more clearly observed in recent years (Boling, 2010). Norton and Hathaway (2015) identified the growing need for design-based teacher training. Since teachers are forced to create new practices aimed towards the education aims of the 21st century, they claim that teachers are in the position of being active and creative experience designers. Teaching, beyond the traditional view of teaching practices, requires a type of complementary practice. A second type of practice for the concept of teaching practices must accept teachers as designers.

Kirschner (2015) claims that in 21st century teaching and education, a proficient teacher is a practitioner and a designer. The design aspect of what teachers do is different from traditional teaching where teachers do or apply something that exists. Instead, the teacher is seen as someone who "actively builds, invents, develops and designs school practices" (Carlgren, 1999).

In teacher training programs, tools specific to design are under the umbrella of design topics (Scheer, Noweski & Meinel, 2012). The teacher's professional capacity is crucial for the students experiences and teachers are generally faced with professional challenges for which they have to design solutions (Darling Hammond, 2003). However, teacher training has not always been able to offer teachers opportunities, models or tools to use design principles (Norton & Hathaway, 2015).

Teachers generally approach topics with the assumption that they understand a phenomenon based on their personal experiences (Skott, 2015). Therefore, it is critical to have a model that evaluates the process from the perspective of other stakeholders "empathetically".

Collins, Joseph and Bielaczyc (2004) claim that design includes aims, actions and guidance of aims related to real world problems and the solutions to these problems. Others assert that design forms a bridge between the theory and practice with fashionable solutions to open ended problems within the scope of scientific and creative activity (Hoadley & Cox, 2009). Kimbell and Julier (2012) described the applicability of design amongst occupations, concluding that most people take part in design work every day and workers in all types of contexts contribute to new solutions in the workplace. Jonassen (2000) offers a method to think about the problems of design in education. Donald Schön (1983) who places design in professional practice explains that design

practitioners are a part of human centric occupations that require an implicit practice epistemology in artistic, intuitive processes.

There is a need for design thinking that educators can use for common contextual and generally distributed practical issues in education (City, Elmore, Fiarman & Teitel, 2009). Within this context design principles enable design-based research to develop targeted and user centric innovations, followed by the application and testing og these innovations by teachers, students or stakeholders (Anderson & Shattuck, 2012). In this context, design terms such as "learning through design" or "teachers as designers" have gained importance in our time.

1.3. Significance of the study

Design thinking is an inextricable part of teaching practices for student teachers. Design approaches with repetitive processes aimed at problem solving can guide student teachers towards their own sustainable learning which is critical for vocational development (Hagger, Burn, Mutton & Brindley, 2008).

Design approach can potentially facilitate student teachers' ability to evaluate students' success in a more integrated fashion in pre-service training (Burn, Hagger, Mutton & Everton, 2003). The reason for this is, design thinking can help student teachers in expressing the rationale behind decisions and preventative measures, the factors they emphasized during planning and judgements related to the results of learning designs. Combining teacher training programs related to pedagogy based on design with design-based pedagogy, is crucial for functional skills necessary to deal with complex and unforeseeable issues.

Gaining design thinking in the pre-service stage turns the thinking habits student teachers use in creating knowledge into vocational practice (Hagger et al., 2008). Koh et al. (2015) speaks of the conceptual importance of design thinking, specifically for the education of student teachers by touching on the state of the gap between theory and practice. The design-based thinking approach comes up as a tool to raise problem solving, inquisitive individuals who create products. Design thinking asks students to solve complex problems with more than one applicable solution and evaluates their work in a flexible and dynamic structure.

In the 2023 Education Vision document published by the Ministry of National Education (MEB) the aim was set that all fundamental education institutions form "Design-Skill Workshops" that support children's cognitive, emotional and physical needs and that national standards are set (MEB,2018). The Design-Skills Workshops aimed to be formed will enable students to turn their knowledge into life skills and gain practical skills related to the children's talents. These workshops will be designed with common objectives and will be environments in which designing, creating, and building will take

place. In this context, the design thinking process must be looked into as a part of the education process and analyzed in teacher training.

1.4. Aim of the study

In this study, the concept of design thinking in teacher training is analyzed by student teachers. Student teachers' pre-service thoughts about design processes aimed towards overcoming vocational difficulties is a part of the study. The aim of this study is to identify student teachers' opinions about design thinking before they start work as teachers and to put forth conceptual schemas.

Within the scope of this study, student teachers from different departments were asked the following questions.

1. What do you know about the design thinking approach?

2. What conceptual connotations does the design thinking approach have for you?

3. What do you think about the contribution of the design thinking approach to your teaching processes?

In light of the findings of this study, it is expected that raising student teachers' awareness of design thinking and providing teachers with a road map on using this approach will be useful.

2. Method

2.1. Research Design

This study was conducted using the phenomenology design, which is a qualitative research method. The reason why the qualitative research method was adopted for this study is that qualitative research collects detailed data, enables the questioning of the questions presented to the study participants which results in a more detailed data set (Strauss & Corbin, 1990). As Merriam and Tisdell (2013) states, the qualitative model is interested in the meaning individuals attach to their experiences in society. The phenomenology design focuses on phenomena we are aware of but on which we do not have detailed information (Patton, 2014; Yıldırım & Şimşek, 2016) and it also explains individual experiences (Bloor & Wood, 2006; Creswell, 2007; Creswell, 2014). According to Creswell (2017) studies conducted in the phenomenological design are about individuals' interpretations of phenomena they experienced first-hand, and the cognitive structures formed in their minds.

Phenomenological research has two categories, descriptive and interpretive phenomenology (Giorgi, 2009). Both approaches focus on eliciting people's experiences. However, the main aim of descriptive phenomenology is to describe people's perception.

Interpretive phenomenology on the other hand, focuses on the hidden meaning in everyday structures instead of defining or extracting the core meaning of experiences (Ersoy, 2016). In this study the descriptive phenomenology design was used to present student teachers' perception of the design thinking approach.

2.2. Participants

The participants for this study were made up of 28 (15 female, 13 male) student teachers studying at different departments of Çanakkale Onsekiz Mart University Faculty of Education. All participants included in the study were volunteers. In deciding on the participants, maximum variation, and criteria sampling methods, which are purposeful criterion sampling methods were used. The purposeful sampling method offers the opportunity for in depth analysis of situations that are believed to contain a wealth of information (Yıldırım & Şimşek, 2016). In the purposeful sampling method, situations that are rich in information are chosen for detailed analysis and deeper understanding is preferred over empirical generalizations (Patton, 2014).

In this study, the maximum variation sampling method was used to finalize the participants in the study. In this context, a small group of participants were put together and maximum variety sampling was used to ensure maximum variety in the individuals insofar as diversity of opinions related to the research topic. The aim of the maximum variety sampling method is to put together a relatively small sample group while keeping the diversity of the participants' experiences related to the research phenomenon at a maximum. The aim of ensuring variety is not to make generalisations, but to identify similarities and differences and present different aspects of a problem according to variety (Yıldırım & Şimşek, 2016). According to Patton (2014), there are at least two benefits to forming a research group that shows maximum variety. These are, detailed identification of the unique aspects of each situation in the study group and ascertaining the value of the different categories that come about as a result of situations that are vastly different. Maximum variety sampling is the type of sampling in which different situations that are similar within themselves and are related to the research topic, are identified and the research is conducted on these situations (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz & Demirel, 2010).

The prerequisites for candidate students to participate in the study was that they had had classes on teaching and that they were in the third year of their course. The reason for these prerequisites was that these student teachers would be better equipped to connect design thinking and the teaching process in their own discipline. The reason for using the maximum variety sampling technique was to ensure diversity in the study group. When the participants were being picked for the study, variables such as sex and department were used as sources of diversity that would ensure variety in the data. The characteristics of the candidate students interviewed are presented in Table 1.

Table 1. Personal information about the participants in the study

Student teachers	Sex	Department	Student teachers	Sex	Department
ST1	F	Primary Education	ST15	M	Primary Education
ST2	F	Preschool Education	ST16	F	Preschool Education
ST3	M	Primary Education	ST17	F	Primary Education
ST4	F	English Language Teaching	ST18	F	Turkish Education
ST5	M	German Language Teaching	ST19	M	English Language Teaching
ST6	F	Mathematics Education	ST20	M	Science Education
ST7	M	Science Education	ST21	F	Mathematics Education
ST8	M	Social Sciences Education	ST22	F	English Language Teaching
ST9	F	Primary Education	ST23	F	Mathematics Education
ST10	F	German Language Teaching	ST24	M	Primary Education
ST11	F	Preschool Education	ST25	F	Preschool Education
ST12	F	Mathematics Education	ST26	M	Turkish Education
ST13	M	Science Education	ST27	M	Primary Education
ST14	M	Primary Education	ST28	M	Social Sciences Education

2.3. Data collection tool

The semi-structured and non-directive focus group technique was used as a data collection tool in the study. Focus group interviews elicit deeper and richer data since the data is obtained through group dynamics and social interaction (Morgan, 1997). The reason this technique was preferred, aside from the group dynamic is that data obtained through social interaction is richer and deeper (Thomas, McMillan, McColl, Hale and Bond 1995).

For the focus group interview the subjects were first put in order of importance then the characteristics of the participants of the focus group, the commonalities between the participants, the main topics to be used in the interview and the questions to be asked were identified.

The questions were formulated according to the expert opinions of two Turkish language teaching experts and two educational science experts to ensure internal and external validity. Throughout the interview process it was ensured that participants felt comfortable and answered questions truthfully and correctly. The focus group interview process was conducted face to face with the participants.

2.4. Data analysis

All the qualitative data obtained through these data collection tools were analyzed using the content analysis method. "The aim in content analysis form a meaningful

sequence that can explain the data obtained" (Büyüköztük et al., 2010; Yıldırım & Şimşek, 2016).

At the end of the process the researcher made a digital backup of all raw data to prevent any ethical issues. The answers to the open-ended survey and video recordings of the focus groups were transcribed on a computer and were not changed in any way. Draft themes were formed on separate data sets using the sub-problems of the study. In the ensuing process, the data was coded and the codes in the code list were combined under draft themes.

The opinions elicited qualitatively through the focus group interview in the study, were analyzed in accordance with content analysis on the program Maxqda-20. It is aimed to combine, organize, and interpret similar common views (codes) under common themes with the content analysis used to reach the concepts and related connections from the obtained qualitative data.

2.5. Validity-Reliability

The questions asked in the focus group interview and the observation form, which were used as qualitative data collection tools, were presented to a total of six academics (2 education sciences, 2 Turkish education, 1 preschool education and one basic education expert) in order to ensure the scope and appearance validity of the questions. The experts evaluated the appearance, content and clarity of the questions. The qualitative data collection tools were finalized according to the evaluations of the experts.

To ensure the verifiability of the study, the data findings were stated systematically and clearly. To make the study transferable, direct quotes from the student teachers participating in the study were used to show the opinions of the participants. Codes were used to replace the participants' names.

To contribute to the reliability of the study, the questions for the focus group interview were analyzed by different experts and the results were later evaluated together to evaluate any differences in opinion. No differences in opinion that could affect the results were found between the evaluators. Miles and Huberman (2015) reliability formula (Reliability=Agreement\[Agreement + Disagreement]*100) was used to calculate reliability and the result was 92%. Reliability of over 70% is considered enough to make a study reliable (Miles and Huberman, 2015).

3. Results

This part presents the qualitative findings obtained from the opinions of student teachers. The themes and codes obtained from the interviews conducted with the student teachers were modelled using the program MAXQDA-20 and the findings were presented.

3.1. What student teachers know about the design thinking approach

The themes and codes related to what student teachers know about the design thinking approach have been modelled and presented. Direct quotes were taken from the answers given by the student teachers and these quotes were interpreted. Figure 2 shows the model of the information student teachers have about the design thinking process.
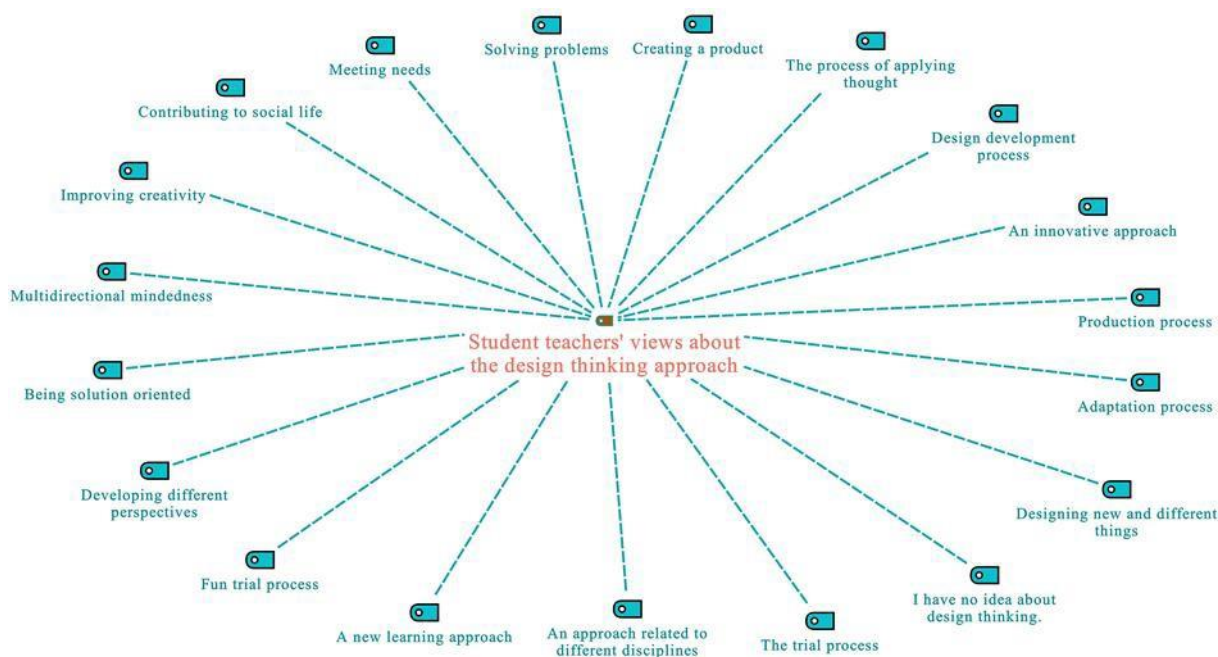

Figure 2. What student teachers know about the design thinking approach

Analysis of Figure 2 presents what student teachers know about the design thinking approach using codes. Codes that stand out are codes such as "Making a product", "Trial period", "Designing new and different things" when it comes to the stages of design thinking and codes such as "Problem solving," "Fulfilling needs", "Multifaceted thinking" when it comes to the basic paradigm of design thinking. Students also stated that design thinking was "A new learning approach", "An approach related to different disciplines", "An innovative approach". The model also represents student teachers who had no information about the design thinking approach through the code "I have no idea about design thinking".

ST2: "I have no idea about design thinking…What I do know about design thinking is that it is a way of thinking and you use design in this thinking process… Honestly, I can only say that by inferring the meaning from the name. Generally, I think this is something people who are interested in art focus on… Like I said, I'm only saying this based on what

the name makes me think of… Otherwise, I have no idea and honestly, it isn't a concept I've heard of before…"

ST15: "Design thinking is to design something new, different and unique. But while making this design it puts the needs of the people living in society at the forefront. For example, we see it every day in our social lives new and different products are advertised on social media… I can say that some of them are unique designs, produced using multiple perspectives and have been looked at in detail. This is why I think design thinking is coming up with designs, making products that make meaningful contribute to people's problems…. Actually, design thinking is not something we hear all the time in our education, but I think design thinking is the starting point for production. In some of our lessons, for example the material development lesson, we used design thinking to design materials that contribute to our students' learning…"

3.2. Student teachers' conceptual connotations about design thinking

The themes and codes of the conceptual connotations of student teachers, obtained through focus group interviews have been modelled and presented. Direct quotes were taken from the student teachers' answers and these quotes were analyzed. Figure 3 shows the model of student teachers' conceptual connotations about design thinking.
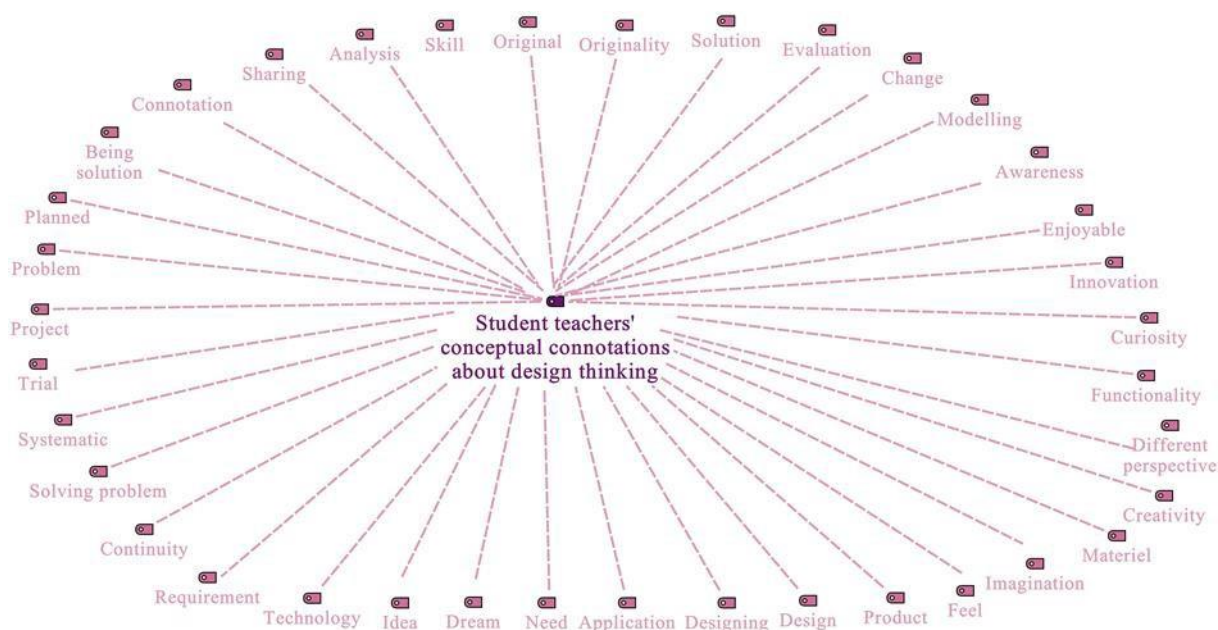

Figure 3. Student teachers' conceptual connotations about design thinking

Student teachers' conceptual connotations about design thinking have been represented in Figure three using codes. Concepts such as "Systematic", "Sustainable"

that are the basis of design thinking along with concepts related to the operating philosophy of design thinking such as "Being solution oriented", "Problem solving" and focuses of design thinking stages such as "Skill", "Design", "Trial" have been stated.

ST12: "When someone says design thinking I can list the first concept that comes to mind like this; a systematic way of thinking, problem solving, constantly trying... Actually, the first thing I think of is design... Design thinking is to develop a design, to design something... And how is this done, by trying constantly... This is why I can say that connotations related to the concept of design thinking are trying, developing a design..."

ST20: "The first connotation I have about design thinking is problem solving. Since I actually don't have much idea about design thinking and I don't have information on the topic, very few concepts come to mind. However, I can say it fulfils people's problems, needs. I can also say what is hidden in the name of the concept, which is to make a design."

The word cloud for the conceptual connotations of the student teachers was also prepared in MAXQDA-20 and presented in Figure 4. In this context, the concepts "Design", "Material", "Trial" come to the forefront of the most used concepts related to design thinking.
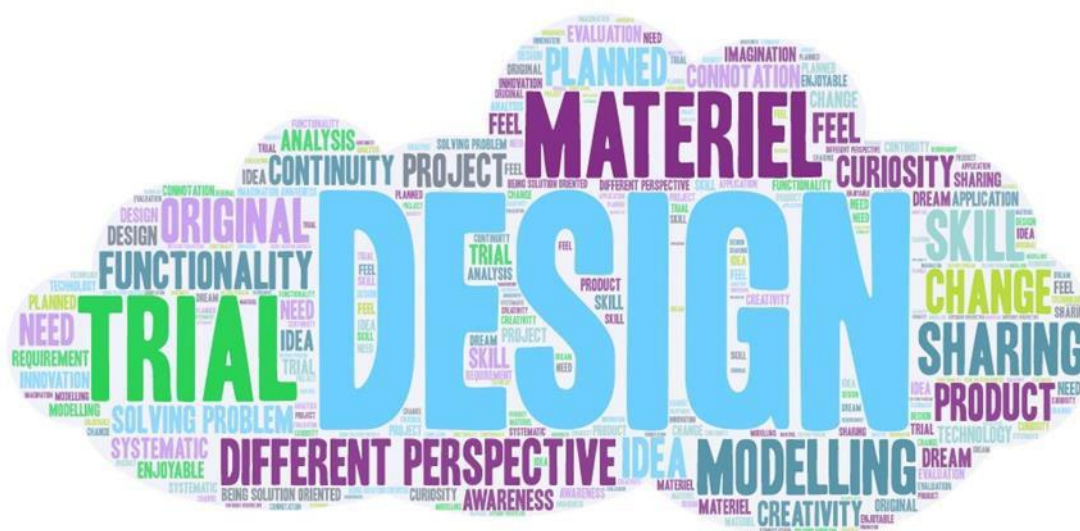

Figure 4. Word cloud of student teachers' conceptual connotations about design thinking

3.3. Student teachers' opinions about the contributions of the design thinking approach to the teaching process

The themes and codes identified in the focus group interview and that are related to the student teachers' opinions about the contributions of the design thinking approach to

the teaching process have been modelled and presented. Direct quotes were taken from the student teachers' answers and these quotes were interpreted. The model of student teachers' opinions about the contributions of the design thinking approach to the teaching process can be seen in Figure 5.
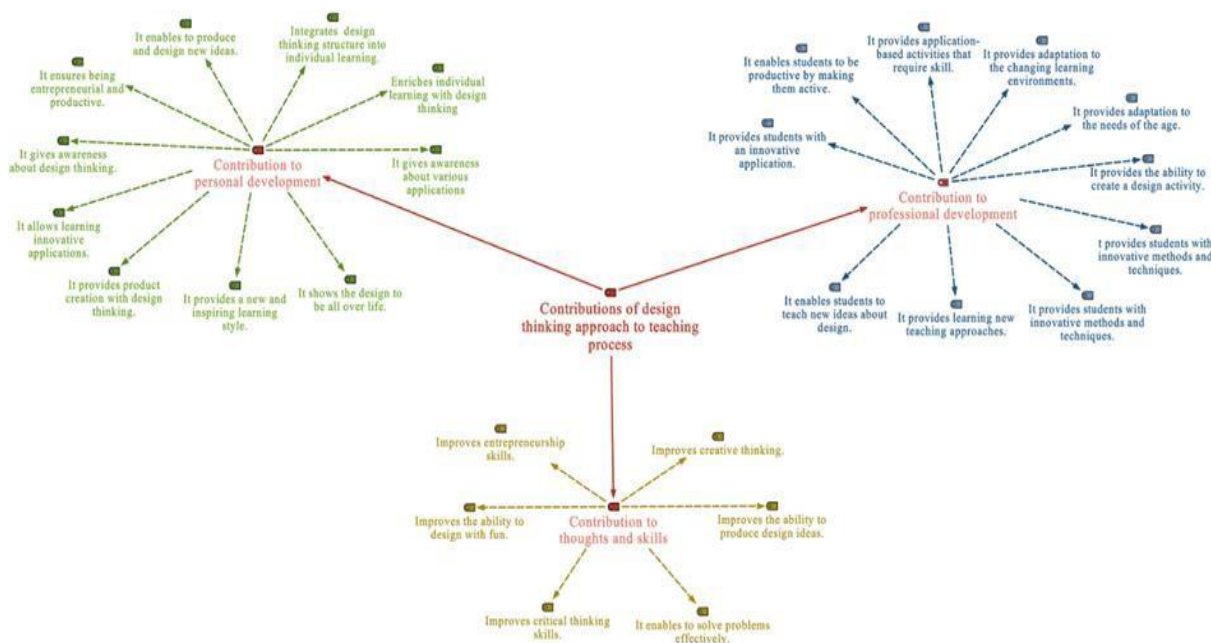

Figure 5. Student teachers' opinions about the contributions of the design thinking approach to the teaching process

Analysis of Figure 5 presents students teachers' opinions about the contributions of the design thinking approach to the teaching process in the form of codes. The student teachers' opinions were grope under three sub-themes. These sub-themes were "Contribution to professional development", "Contribution to personal development", and "Contribution to thoughts and skills". Under "Contribution to professional development" student teachers stated that design thinking "Enables professional development", "Enriches classroom activities", "Provides the ability to create design activities in the classroom", "Facilitates learning and teaching of skill and application-based activities". Under the sub-theme "Contribution to personal development" student teachers' thought design thinking "Provides a new and inspiring learning style", "Enables to produce and design new ideas", "Ensures being entrepreneurial and productive" were prevalent. When it comes to the sub-theme "Contribution to thoughts and skills", some of the opinions stated by student teachers were "Improves creative thinking", "Enables the effective solution of problems", "Improves entrepreneurship skills", and "Improves critical thinking skills".

ST22: "I believe that the design thinking approach will have a big contribution to me professionally. Especially in designing classroom activities, I think it will enable me to create an environment in which students can work individually or in a group and actually create something… I think it is a new approach that will make students active in the classroom… Vocationally when I am assigned my post, I can improve some of my students' skills, for example their creative thinking skills…"

ST18: "…Perhaps this type of approach is what we need most in education faculties because this approach will firstly contribute to ourselves greatly. If we can apply design thinking and integrate it in every aspect of our lives we will become productive, we will become entrepreneurs… We already see design all the time in our lives, we make a variety of things sometimes inspired by nature, sometimes by people. I think the greatest contribution of design thinking to the teaching process is its contribution to me, my essence, to myself individually… If I frame my life with the design thinking approach my individual learning will be richer and it will be more possible to develop new and different perspectives."

ST8: "It is clear in the name design thinking that its contribution to our thinking structure will contribute a lot to us professionally… For example, it will improve our creative thinking, enable us to think critically, enable us to make alternatives and find solutions to the problems in our lives and enables us to create. Also… it improves our entrepreneurship. I think the most important skill for a teacher to have is the ability to be an entrepreneur because the teacher is the person who must contribute to the productivity, development, solutions to the problems of the families and children in the area in which they are posted…"

4. Discussion and Conclusion

Analysis of the study results identified that student teachers' knowledge and conceptual connotations about the design thinking approach is largely based on the name "design thinking". While student teachers described design thinking as a new and interdisciplinary approach, the systematic nature of design thinking and its contribution to cognitive skills was also mentioned. In the results of the study, student teachers stated that design thinking could encourage effective cooperative interaction in a flexible and dynamic structure. They also said that design thinking was a strong alternative that could overcome the challenges of an ever changing and developing world in which problems are getting more and more complicated in social life.

Design work in education of student teachers has also started to experience significant growth (Kirschner, 2015). This is because including design thinking in their work it is quite important for helping them imagine what education could be like. Norton and Hathaway (2015) presented design-based teaching as a model for the essence of teacher training. Design thinking enables student teachers to gain practical experiences and also

accumulate knowledge on design (Kolodner, Zahm & Demery, 2015; Shaffer, 2005). In this context, gaining an understanding of design thinking in the pre-service period creates information while turning thinking habits into vocational practice (Hagger et al., 2008). Koh et al. (2015) discusses the conceptual importance of design thinking in the context of the education of student teachers and as a factor that develops entrepreneurship skills to bridge the gap between theory and application. Analysis of the study results emphasizes student teachers' opinions about the contribution of design thinking to production and the development of entrepreneurship skills.

Actually, how student teachers will develop their understanding of design thinking continues to be a pedagogical problem in literature. There is a particularly small amount of research on understanding how student teachers can enhance their awareness and capacity related to design thinking. The studies conducted are generally restricted to suggestions for educators on applications in the context of professional development (Brahms & Wardrip, 2014; Dancstep & Sindorf 2018; IDEO, 2014). In Turkey, Girgin (2019) identified that training based on the design thinking approach contributes to the professional development of teachers of various topics and that teachers are eager to learn the design process. At the end of design thinking training, teachers stated that they learnt about how to use the design thinking approach, the stages of design thinking, the process, and the logic behind design while also stated that they the stages they found most difficult were empathizing and ideation, and they found planning the timeline for the process challenging.

In this context, design thinking can be described as a type of method to guide the decision-making processes in teacher training and a professional learning process in professional life. It is thought that teachers carrying out design applications as designers both pre-service and as working teachers is important for professional development. To this end, conceptualization of the teaching of design thinking can be described as an important value in realizing activities that are appropriate for 21st century requirements. It is quite important that the role given to teachers' professional competence is realized through design thinking and that this way of thinking is presented in the context of fundamental 21st century skills. Design thinking, which is a creative way of saying a way of finding new approaches to changing and evolving social, technological and economic environments is and looks like it will continue to be one of the most current topics of our time.

Within the context of the results of this study, analysis of the design thinking approach has a tool for sustainable learning in teacher training is thought to be critical for raising students with a focus on design thinking.

5. Suggestions

Conceptualizing design in teacher training will help make design thinking more applicable for those who analyze and design teacher training from the perspective of understanding the nature of design thinking training. In this context, studies on awareness training for student teachers in different fields on the content of design thinking training, presentation of the student teachers' cognitive structures and conceptual changes about design thinking, the development of application booklets, developing content for design skill workshops to be presented to students in line with the MEB 2023 education vision document, designing the educational environment, educational program and educational materials can be suggested.

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