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ARTICLE

The Effect of Problem-Based Learning on the Creative Thinking and Critical Thinking Disposition of Students in Visual Arts Education

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Abstract

The problem-based learning (PBL) approach was implemented as a treatment for higher education visual arts students over one semester to examine its effect on the creative thinking and critical thinking disposition of these students. PBL had a significant effect on creative thinking, but critical thinking disposition was affected to a lesser degree. One possible reason for this result is that in this study, open structures were used for learning activities as a nonroutine problem-solving process to develop creative thinking. Accordingly, the results of this study indicate that PBL can help students with nonroutine problem-solving processes by maintaining uncertainty and enhancing creative thinking. However, a similar conclusion could not be reached for critical thinking disposition. Therefore, future studies regarding critical thinking disposition and the PBL approach should be conducted.

Keywords: problem-based learning, creative thinking, critical thinking disposition

Introduction

Currently, new technologies are developed at an extremely rapid rate. These new technologies can bring comfort to our everyday lives, but they also bring new challenges. Although these challenges can be solved by adapting our lives accordingly, resolving these problems is not easy because a formula to do so has not been developed. Thus, these problems can be categorized as *nonroutine* (ill-structured) problems, and solving these problems requires creative thinking skills. Creativity occurs during problem solving (Guilford, 1967) when it is necessary to discover novel solutions to problems (Cropley, 2001; Guilford & Hoepfner, 1971; Plucker, Beghetto, & Dow, 2004; Reiter-Palmon, Illies, Cross, Buboltz & Nimps, 2009) and to solve complex social problems (Wang, 2012).

However, certain difficulties can arise when solving nonroutine problems because of a lack of critical thinking. McKendree, Small, Steinning, and Conlon (2002) stated that students should possess critical thinking skills to solve new problems because they must apply appropriate reasoning. Critical thinking is more important now than ever before because of changes in our lifestyles (Halpern, 1998). Thus, developing the creative and critical thinking skills of students is vital to enable them to solve nonroutine problems in the modern world.

Creativity is necessary for the science, technology, and art that encompass everyday life (Runco, 2014). Prior studies claimed that creativity is related to finding *new* solutions to problems (Cropley, 2001). However, scholars have reached a consensus regarding the definition of creativity that is new and *useful* (Batey, 2012; Batey & Furnham, 2006; Kaufmann & Baer, 2012; Mumford, 2003; Runco, 2007) for generating new ideas, solutions, or answers (Duff, Kurczek, Rubin, Cohen & Tranel, 2013) as related to problem solving (Crilly,

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2010; Lewis, 2005; Smith, 2013). Accordingly, creative thinking is very helpful for determining new solutions to unexpected difficulties or problems.

Conversely, researchers believe that critical thinking includes making statements that support the evidence and recognizing relationships (Renaud & Murray, 2008). Numerous scholars indicate that critical thinking includes conceptualizing, analyzing, synthesizing, and evaluating information that is generated by observation, experience, reasoning, or communication (Piaw, 2010). According to Ennis (1996), "critical thinking is a process, the goal of which is to make reasonable decisions about what to believe and what to do" (p. xvii). In addition, he indicates that having a critical thinking disposition predicts critical thinking. Critical thinking includes focusing on logical decision-making (Schafersman, 1991), assessing facts, and solving problems (Chance, 1986; Halpern, 1996). Both creative thinking and critical thinking (disposition) are sensitive to problems.

Overall, a problem is defined as a difficult challenge that is faced by an individual who is attempting to reach a goal (Runco, 2014). Well-structured (routine) problems are solved by using standard techniques and applying well-known criteria (Cropley, 2001). Conversely, ill-structured (nonroutine) problems require open goals (Runco, 1994). Sockalingam and Schmidt (2011) explained that nonroutine problems challenge students' thinking and learning. Nonroutine problems differ from routine problems (e.g., Runco, 2014).

Savin-Baden and Major (2004) stated that traditional teaching can impair the problem-solving skills of students. Problem-solving skills include acquiring knowledge and understanding the characteristics of objects (Mumford, Reiter-Palmon, & Redmond, 1994). In schools, these skills can be assessed by acquiring information from students, but the characteristics of objects may be ignored. Nonroutine problem solving requires conative elements such as intentionally engaging, exerting effort, persisting to complete a task, and making choices (Jonassen, 2000). Cropley (2001) stated that nonroutine problems may be the best method of effectively teaching problem-solving skills to students. For nonroutine problem-solving processes, individuals may incorporate a wide perspective of their knowledge and the characteristics of objects to determine possible solutions. During this process, it may be easier for individuals to think creatively and critically prior to considering any distinct rules, which helps individuals gain knowledge and understand the characteristics of objects because they are open-minded when they engage in creative and critical thinking. Therefore, scholars claim that creativity is related to problem solving (e.g., Runco, 2014) and that critical thinking includes problem solving (e.g., Chance, 1986; Halpern, 1996) because both thinking skills help individuals ascertain possible solutions to problems.

Problem-Based Learning (PBL)

Problem-based learning is an ideal learning approach that teachers can use to help students determine solutions to nonroutine problems (Strobel & van Barneveld, 2009). The PBL approach is a model for constructivist learning in education. According to constructivist learning theory, learners construct their own knowledge (Hein, 1991). During the PBL process, students can work together to find solutions to complex problems (Ferreira & Trudel, 2012). Therefore, constructivist theories refer to *student-centered learning*. PBL includes student-centered learning for problem solving (Savery, 2006) and students are exposed to complex problems (Hmelo-Silver, 2004). Nonroutine problems require that learners generate alternative solutions. PBL provides opportunities for students to become responsible for their own learning, and the teacher becomes a facilitator of the learning process. For this approach, the mission of the teacher is to guide the student (Center for Gifted Education, 1997; Lambross, 2002) rather than provide information (Hmelo-Silver & Barrows, 2006). Consequently, students learn to solve problems in new ways and to reflect on their experiences when student-centered learning methods are used.

Educators want their students to acquire creative and critical thinking skills during learning activities so they can address complex problems in their everyday lives. Problem solving (Morris, Cranney, Jeong, & Mellish, 2013) and critical thinking (Kek & Huijser, 2011) are important skills for being a global citizen in a changing world. Therefore, PBL is implemented to improve students' creative thinking and critical thinking skills. For example, Chan (2013) reported that PBL increased the critical thinking and creativity of nursing students, and Nargundkar, Samaddar and Mukhopadhyay (2014) determined that PBL effectively enhances the critical thinking of business school students. Similarly, Pardamean (2012) reported that the critical thinking skills of dental students were significantly enhanced when PBL was applied. Vidic (2011) revealed that when PBL was applied, engineering students were better able to solve problems. In addition, Cheung (2011) determined that the PBL approach had a significant effect on the creative flexibility of advertising design students. Yoon, Woo, Treagust and Chandrasegaran (2014) revealed that the PBL approach had an important effect on the creative thinking skills of students in a chemistry laboratory course. In another study (Ball & Knobloch, 2004), during a PBL course, preservice teacher candidates were asked to rate the effectiveness of their PBL experience; all of the study participants confirmed that PBL helped them think more creatively. Chan (2012) concluded that the two primary outcomes of PBL are creative thinking and critical thinking. Although PBL has been implemented in numerous

education disciplines (Stalker, Cullen, & Kloesel, 2015), Mergendoller, Maxwell, and Bellisimo (2006) claimed that few studies have examined the effectiveness of this approach. In addition, other studies have claimed that few studies have analyzed the effects of PBL (Chan, 2013), and there is no consensus regarding its effectiveness (Strobel & van Barneveld, 2009). Therefore, Savery (2006) suggested that future studies should be conducted to investigate the short-term or long-term effectiveness of PBL for a wide variety of learners. In addition, he claimed that there has not been sufficient evidence regarding the adoption of this approach in various education disciplines.

Numerous scholars (e.g., Chan, 2013; Galford, Hawkins & Hertweck, 2015; Mergendoller et al., 2006; Savery, 2006; Strobel & van Barneveld, 2009) believe that examining PBL in different education disciplines for a variety of student populations is important to determine the effectiveness of this learning approach. Many teachers in the core disciplines try some learning approaches such as problem-based learning, project-based learning, and case study to activate their learners. At this point, studio learning in the visual arts can be tried as a pedagogy model in alternative learning approaches (Hetland, Winner, Veenema, & Sheridan, 2007). Brandt and colleagues (2013) stated that the studio is used to perform particular tasks in different approaches besides the design process because it is a bridge between professional and academic practices. The academic design studio is a consistent structure through the interaction of pedagogy and epistemology to create a unique learning environment. Therefore, the studio in visual arts makes an appropriate connection in terms of the learning environment for both visual arts education and PBL as an interaction of pedagogy and epistemology, respectively.

Creative and critical thinking skills are highly significant thinking skills that will be increasingly necessary because of the increase in complex problems caused by the rapid development of technology and social movements worldwide. Therefore, educators should teach these thinking skills to their students in order to enable their success as future citizens. This topic is more vital in terms of experimental study results because a consensus should be reached regarding how students can acquire these skills in various education disciplines. Therefore, PBL should be implemented in various disciplines, such as visual arts education. Two possible responses to this problem exist in the framework of creative thinking and critical thinking skills. First, these thinking skills can be acquired through PBL (e.g., Ball & Knobloch, 2004; Chan, 2009; Chan, 2013; Cheung, 2011; Nargundkar et al., 2014; Pardamean, 2012; West, Williams, & Williams, 2013; Yoon et al., 2014). Second, nonroutine problems frequently occur in the visual arts field. Cennamo and colleagues (2011) state that design problems are nonroutine problems and are appropriate for the use of PBL because these problems have potential solutions. As another response, the semiotic would be rather explanatory in terms of giving a clear idea about the design problems. Signs and relations are the two key notions of the semiotic. If there is no rational connection between the signs and relations in an emblem design, the individual perceives the meaning of the emblem as a problem. For instance, the emblem of any firm, as a symbol, includes *color*, *form*, *words*, and/or *numbers*, signs that give a sense of what the firm is like or its occupational field. However, this emblem also includes the problem of what the signs of the emblem mean to individuals (*Semiotic analysis*, n.d.). Therefore, if the number of signs (color, form, words, etc.) increases in the emblem, then the number of problems that should be solved also increases. In courses on emblem design, visual arts students learn to generate a meaningful and aesthetic symbol for an evident topic by using such design elements and principles as *color*, *line*, *form*, *shape*, *space*, *texture*, *balance*, *proportion*, *perspective*, *movement*, *pattern*, *emphasis*, *repetition*, *rhythm*, *variety*, *harmony*, and *unity.* During this design process, the role of the semiotic might be revealed spontaneously because this process would include many nonroutine problems to be solved creatively. For example, Cheung (2011) implemented a hand-sketched print advertisement with the PBL approach under the theme of "Bread Is Life" in an advertisement design course. Regarding the semiotic, he found that the artwork of students in the experimental group with PBL included more signifiers reflecting creative flexibility than the artwork of students in the control group. Therefore, the nonroutine problems establish a common learning ground for both visual arts education and the PBL approach (Brandt et al., 2013). In addition, critical thinking skills also play an important role in artwork production in terms of nonroutine problem solving in visual arts education (Hetland et al., 2007). From this perspective, the implementation of the PBL approach in visual arts education is appropriate because creative and critical thinking skills play a significant role in the production of artwork, which represents an educational outcome for students.

Critical Thinking and Creative Thinking Conditions in Visual Arts Education Using the PBL Approach

How an individual perceives artwork enables us to understand how that individual perceives the world (Freire & Macedo, 1998). The production of artwork involves solving numerous problems; therefore, the artist must first solve these problems by thinking critically and even critiquing him- or herself before the observer sees the artwork. In this manner, producing artwork is a problem-solving process (Dudek & Cote, 1994) that includes ill-structured problems (e.g., Dorst

& Cross, 2001; Lawson & Dorst, 2009) and nonroutine problems. Therefore, art education provides a basic platform for students to generate ideas by using critical thinking (Knight, 2010). Thus, artwork can include *new* things only when the nonroutine problems are solved by the student using critical thinking during the artwork's production. The original artistic creation occurs by establishing specific criteria for the process (Dudek 2012, as cited in Runco, 2014). Critical thinking is one criterion for creating art. Beyer (1995, as cited in Chang, Li, Chen, & Chiu, 2015) confirms that critical thinking includes new ideas and judgments. In addition, Chang and colleagues (2015) determined that critical thinking is helpful for inspiring students' originality and learning. Critical thinking enhances students' ideas (Treffinger, Isaksen & Dorval, 1994). If one considers that artwork is a problem (e.g., Dudek & Cote, 1994) and critical thinking is a process used for problem solving (Chang et al., 2015), then one can expect that visual arts students will benefit from a PBL environment. Prior studies have indicated that the PBL approach has had a significant effect on students' ability to comprehensively solve problems (Chan, 2013; Vidic, 2011). Thus, we can expect that the critical thinking skills of visual arts students can be improved by using the PBL approach. In addition, creative thinking skills that are used for nonroutine problem solving can be enhanced for visual arts students during the PBL process. Nonroutine problems support creativity in terms of finding novel solutions (e.g., Cropley, 2001; Guilford, 1967; Guilford & Hoepfner, 1971; Plucker et al., 2004; Reiter-Palmon et al., 2009; Torrance, 1965).

Therefore, the PBL approach may have a significant effect on the creativity and critical thinking skills of visual arts students. However, it is disappointing that few studies have considered the effects of PBL implementation on visual arts education. Galford and colleagues (2015) stated that it would be useful to determine the effects of PBL by integrating various curricula with actual classroom work. Therefore, this study examines the effect of the PBL approach on students' creative thinking and critical thinking skills in visual arts education. This study is based on a curriculum that was adapted for visual arts education using PBL. I seek to answer the following questions:

Does the PBL approach have a significant effect on the creative thinking of visual arts students at a higher education level?

Does the PBL approach have a significant effect on the critical thinking disposition of visual arts students at a higher education level?

In recent years in Turkey, the student-centered approach has been implemented in a wide range of education levels from elementary to higher education. However, various approaches can be implemented at the high school level in natural science, social sciences, music, and visual arts. There is an understandable reason for this situation. For example, more than half of the total lessons in the curriculum of natural science education includes courses related to information transfer. This situation is also valid for music and visual arts education in terms of these disciplines' main subjects. So, learning in music and visual arts education, especially in lower grades, is based on the teacher-centered approach because the teacher aims to give the information related to the main principles directly to students (MEB, National Education Ministry, 2016). In upper grades, learning tends to be student-centered in regard to practice lessons, enabling students to achieve their own artistic development. Accordingly, learning in music and visual arts education is both teacher-centered and student-centered. In contrast, learning in natural science consists of a mixed approach, such as behaviorist, cognitivist, teacher-centered, and student-centered (MEB, 2016).

For example, when visual arts students possess their own information on the course subject, the student-centered approach is used by the teacher. Otherwise, the teacher-centered approach is used in the initial stages in order to transfer essential information to students. Therefore, both approaches can be used together in visual arts higher education as follows: In the teacher-centered approach, the teacher gives students the course subject and explains it as both demonstration and oral presentation. Following this first stage, the teacher shows students artwork examples to build their own concrete understanding. In this way, the teacher gives students the required design information in concrete form and lets them create their own prototypes through drawing on paper. At the second stage, the teacher critiques the prototypes and directs students to develop them. Also, at a suitable time, the teacher gives necessary directions to students about their prototypes by showing them artwork examples from experienced artists. During this stage, the teacher often critiques students' prototypes in order to show students how to improve them. In this way, students look at their prototypes closely and they try to develop them in the next stage. After the teacher's confirmation, the prototypes of the artwork are transformed by students into the final designs. During the design process, the teacher often repeats his or her criticism of both the technical and practical aspects of the design. At the end of this process, the teacher gives students the last feedback on their artwork before scoring the artwork. In this feedback, the teacher shows students strong and weak aspects of their artwork in terms of design.

On the other hand, the student-centered approach can also be implemented by the teacher, if students have their own information about the course subject. The teacher gives students the course subject, but does not make any precise verbal explanations or give any demonstrations about using

the models of artwork related to the subject. The teacher just guides students, if necessary, showing the artwork examples at a suitable time during the learning process. Also, the teacher asks open-ended questions to remind students of general design rules as follows:

"What is the main *movement* of the artwork design?", "What does this movement look like, calm or active?", "Where is the motion of the design?", "Does it move outside of the design frame?", "What does the main figure of the artwork design look like, small or big?", "Please consider it as in *proportion* according to the size of the artwork design!", "Please consider the *composition* of the artwork design!", "What does it look like?", "Is it simple or complex?", "Please look at the contour *lines* of the artwork design!", "What do the contour lines of the artwork design look like?", "Are they strong (thick) or weak (thin)?", "Please look at the *colors* of the artwork design!", "What do the colors look like?", "Are the colors dominantly lifeless or bright?", "Please learn more about how color impacts on artwork designs!" and so on.

As a result, the teacher's choice of learning approach, teacher-centered or student-centered, does not show any change for students in terms of making progress in the curriculum related to the given course.

Beside the learning approach, students can learn more in the studio from each other on their artwork design process in terms of the learning environment. If necessary, visual arts students can also work in a compatible way with both the student-centered and teacher-centered approaches in the studio. The studio environment includes pedagogical advantages for both of these approaches as well. Therefore, the studio as learning environment is also applied in various education disciplines as a multidisciplinary approach, besides being used in visual arts education. Brandt and colleagues (2013) stated that the studio provides a common ground between professional and academic practices in terms of interaction between pedagogy and epistemology. The studio is also being used as an interdisciplinary approach, such as in web-based media (Rieber, Clinton, & Kopcha, 2016), interior design (Smith, 2016), media design (Boling, 2016), instructional design (Cennamo, 2016), communications and technology (Campbell, 2016), graphic design, painting, architecture, and fashion design (Gray, 2016).

Method

Research Design

The experimental research design of this study included a *one-group pretest-posttest* (pre-experimental). This design, which did not include a control group, was structured as follows: O1 - X - O2 represents the pretest, treatment, and observation, respectively (Y520, 2000).

Participants

The study participants were undergraduate students (N = 17) in the Visual Arts Education Department in the Education Faculty of Cumhuriyet University in Turkey during the autumn semester of 2013. The mean age of the students (10 female and 7 male) was 21.58, ranging from 20 to 24. These students were in the fifth semester of their schooling. Follow-up tests were conducted prior to the students' graduation.

Measures

Torrance Tests of Creative Thinking forms were developed by E. P. Torrance for measuring the creative thinking potential of children, adolescents, and adults (Torrance, 1966). The scoring procedures of the Torrance Tests of Creative Thinking (TTCT) Figural-B form were revised in 1984 in the third edition of the TTCT manual. This edition was used for scoring the TTCT Figural-B form that was used in this study. The TTCT analyzes subscales of *Fluency*, *Originality*, *Abstractness of* (*Titles*), *Elaboration*, *Resistance to Premature* (*Closure*), and *Creative* (*Strengths*) (Kim, 2011). The total Creative Strengths scores are added to the mean of the other five subscale scores to compute an overall creativity score. A Turkish version of the TTCT was used by Aslan (2001), who conducted reliability and validity tests. Regarding language equivalence, there was a strong positive relationship (α = .70) between the scores of the English and Turkish versions of the TTCT, which were implemented at different times for the same individuals who were fluent in both Turkish and English.

The *California Critical Thinking Disposition Inventory* was a project of the American Philosophical Association that is used to assess an individual's critical thinking skills (Facione, Facione, & Giancarlo, 1998). The original California Critical Thinking Disposition Inventory (CCTDI) was translated into Turkish and was administered by Kökdemir (2003) to 913 university students. The factor structure of the translated CCTDI's correlation between the items and the total scores was analyzed using principal component analysis, and 19 of the items were less than .20. According to the results of the analyses, the CCTDI includes 51 items with subscales for *Analyticity*, *Open Mindedness*, *Inquisitiveness*, *Self-Confidence*, *Truth Seeking,* and *Systematicity*. The translated form of CCTDI was determined to be reliable using an internal consistency coefficient (α = .88).

Data Analysis

This study used a one-way repeated-measures ANOVA to examine the data since the assumptions of parametric statistical technique were upheld. This statistical technique tests the mean scores of the measurements. The data were set on a stricter standard (α = .01) for detecting whether there was

a significant difference between the measurements by controlling the family-wise error rate (FWER) to address the probability of making one or more false discoveries or a false positive in multiple testing. The FWER is appropriate for preventing false positives (*Multiple testing,* n.d.). Therefore, to control the FWER, the alpha level for each analysis was set at $p < .01$ (e.g., Blissett & McGrath, 1996; Kim, 2011; Wang & Horng, 2002) in terms of the level of significance, such as .05 or .01 (*Multiple hypothesis testing,* n.d.). Reducing false discoveries related to significant results is a powerful alternative when many tests are performed. Therefore, controlling the FWER at α is a suitable approach for addressing type 1 errors (Verhoeven, Simonsen, & McIntyre, 2005). To analyze the TTCT subscales, the general linear model of statistical analysis was used for multiple comparisons. In addition, the Bonferroni technique was applied. The *p* value cutoff was adjusted by dividing .05 by 6, which was the number of comparisons in the subscales resulting in a *p* value cutoff of .008. When the *p* values for the comparison tests were less than .008 in this study, they were considered significant.

PBL Process

The TTCT Figural form and the CCTDI were administered as a pretest, a posttest, and a follow-up test. Each test (not including the instructions) was completed by the participating students within approximately 30 minutes. During the PBL meetings, heterogeneous student groups were presented with two PBL problem scenarios that were constructed by the author based on a consultation with experts and using an original approach. One of these problem scenarios (Ayşe) was included in this author's *dissertation* (Ulger, 2011). The topics of these problem scenarios were related to the visual arts education curriculum and focused on the students' living and education environments.

Adaptation of Visual Arts Learning into PBL

As the initial step of adaptation of visual arts learning into PBL, the visual arts education curriculum was reviewed carefully. This curriculum review was aimed at understanding how to connect course subjects in visual arts education and real-life situations to write PBL scenarios. The course subjects in the curriculum were classified to determine whether they were transformed into PBL scenarios that adhered to the educational goals of the curriculum. Previous studies of scenarios related to the PBL approach in other education disciplines were also reviewed. During this review process, many prototype scenarios were written by the author, and they were presented to experts in PBL for selection. The selected prototype scenarios were developed in accordance with the experts' suggestions. The author adapted the visual arts course subject into a PBL scenario, fictionalizing the nonroutine problem situation by considering the students' everyday lives. The nonroutine problem situations constitute a common educational ground for both visual arts learning and the PBL approach. For example, an emblem design (or poster design) as a course subject in visual arts learning requires a holistic approach to achieve the design in terms of the *signs* (symbols) and *relations* in the emblem. Visual arts students ought to make the right connections between the signs and relations in their designs as the semiotic to generate consistent meanings in terms of achievement of the design. This situation occurs in a nonroutine problem due to including many alternative ways relating to the *meanings*. Especially when these problems originate from everyday life, students are inclined to solve these nonroutine problems in new ways by generating many alternative solutions. Therefore, the aim of the PBL problem scenario connected to real life is to expose students to a nonroutine problem situation related to the course subject. For that reason, the PBL problem scenarios in the present study were written by considering both the goals of the course subject in the visual arts education curriculum and students' everyday lives. For example, the school was moved to its new building at the beginning of the 2013–2014 academic year, a situation that was used for the second PBL scenario (emblem contest). However, the *emblem design* was included in this scenario as an important course subject in visual arts learning. The motive for including the emblem contest in the scenario was based on the author's observation about visual arts students who tend to exhibit their emblem design skills in such contests. In this way, the main fiction of the PBL problem scenarios in this study was constituted by considering both the goals of the curriculum and students' everyday lives within the framework of a nonroutine problem.

The students participated in this study as part of their visual arts education coursework. Initially, poster design was taught to the students as a pre-educational activity prior to the first problem scenario. Then, the problem scenario was provided to the students. The goal of this course was to design a poster as a piece of artwork that was relevant to the topic of the problem scenario. The first problem scenario is described below.

The PBL Problem Scenario Related to Visual Arts Learning

*1. Problem Scenario (Scene): "Ay**ş**e"*

Ayşe is your best friend in your school and neighborhood. She lives with her mother, father, and five-year-old sibling. Her life changed negatively after the ban on smoking in public places because her father started smoking at home. Ayşe told her father that smoking negatively affects her sister and mother, who live

in the same house with him, but he continued to smoke. As she was dealing with this conflict, she suddenly remembered the poster contest about the dangers of smoking that was announced at school. She asked herself, "Why don't I make a poster about the harm of smoking and warn my father in an impressive manner?" After a short while, she began to feel desperate and said to you: "I'll prepare a poster that must be effective enough for my father to realize how harmful his behavior is, but I have no idea how to prepare it." You see that your friend needs guidance, and you want to help her. What will you do now?

Poster design and emblem design are primary course topics that are taught in the visual arts education curriculum. The coursework teaches the preparation, production, and presentation of poster and emblem design. First, the students are taught form, color, line, and stain traits by using design samples. In general, teachers demonstrate how the forms are established in the designs, which include a geometric, symmetric, and asymmetric dominant aesthetic plan. Subsequently, the teacher focuses on the details of the designs by comparing the differences or similarities to illustrate the students' dynamic, active, or inactive situations regarding the primary movement. If necessary, the instructor may teach the students new techniques during the production stage of the design. Therefore, this first scenario includes a course subject with a theme for the students to design. The production stage begins with a prototype design under the direction and approval of the teacher. During this process, the students present the confirmed and completed artworks to the teacher. Consequently, traditional visual arts lectures include both theoretical and practical components. The theoretical component is teacher-centered, whereas the practical component is student-centered. In general, the teacher directs the coursework. Therefore, a lecture regarding the PBL process, which provided pre-information initially regarding the course subjects and included the teacher's oral explanation and demonstration, was given by the teacher. In this manner, the traditional visual arts learning conditions were transformed into the PBL treatment as follows:

The Implementation of the PBL Approach in Visual Arts Learning

During the first meeting of the PBL process, the student groups were asked to seek the definition of the presented problem. The students were provided with a sheet of paper that asked a question; the teacher instructed the students to determine the primary problem in the scenario. This question was as follows:

- What is the problem in the scenario?

The students were asked to respond to this question by defining clear problem statements. The teacher acted as a facilitator and provided a flexible learning environment for the students to encourage them to approach the problem scenario in a collaborative manner. As a group activity, the students discussed the problem statement to determine a one-sentence response to the question. After the discussion, the primary problem of the scenario was identified and stated.

At this stage, the student groups were provided with a sheet of paper that was related to the problem scenario status; it included items for the students to respond to: "Known," "Unknown," and "Needs to be known." These titles were followed by other questions; for example, "What is known about the problem scenario?", "What is unknown about the problem scenario?", and "What should be known for problem solving?" First, student groups determined and completed the "Needed Information" to determine a solution to the problem. Subsequently, the group members shared tasks to determine the information that was needed for the next PBL meeting.

During the second meeting, the information was compiled by the group members and written on the sheet under the title of *Needed Information*. The instructions on the paper were as follows:

- Please summarize your newly obtained information!

After this stage, the student groups were asked to assess the new information, and if necessary, they were reminded to conduct additional research for more information. Therefore, the *Needed Information* sheet was completed with information that the group had compiled.

During the third meeting of the PBL process, all members of each group reviewed all of the information. After this review, the students engaged in brainstorming to explore more possible solutions to the problem. The ideas that were obtained from the brainstorming session were written by the student groups on another sheet of paper under title *Suggestions for Problem Solving*.

During the last meeting of the PBL process, the students were asked to determine a possible solution to the problem. This solution was the poster design as a component of the coursework for each student group at the end of the first part of the PBL process.

For the second part of the PBL process, the course topic was emblem design. The goal of this course was to teach the preparation of an emblem design as artwork. The problem scenario was relevant to the topic of emblem design as follows:

2. Problem Scenario (Scene): "Emblem Contest"

You attend a visual arts education program in an education faculty that was moved to its new building at the beginning of the 2013–2014 academic year. The school's administration decided to develop a new emblem that better reflects the mission and the vision of the faculty. It was also expected that this new emblem should reflect up-to-date educational facts as well. To clarify, this new emblem model must include both visual and verbal factors.

Thus, the faculty administration has planned to have an emblem contest and invited students to attend. You are interested in this contest and view it as an opportunity to flaunt your design skills. After this assessment, you decide to enter this contest, but you have no idea what to design. What will you do now?

After the presentation of the problem scenario, the PBL process steps for the first part of the PBL process were repeated. Consequently, the inferences that were obtained from the PBL meetings were discussed among the group members, and the teacher provided feedback to all of the groups at the end of each PBL meeting and instructions for the next PBL meeting. The teacher and groups held another PBL meeting within one week if doing so was needed.

The PBL process included the following stages: *defining the problem*; *known, needed, and unknown*; *determining possible solutions*; *collecting and analyzing data*; *results of analysis*; and *feedback* (Lambross, 2002). This experimental PBL treatment took 11 weeks and is illustrated as a cycle in Figure 1. The follow-up tests were administered to the same students after two semesters following the implementation of the posttests.

Teacher Facilitation

The teacher acted as a facilitator and provided a flexible learning climate for the students during the PBL treatment. Occasionally, students were able to joke around, even when the groups discussed serious ideas. The teacher frequently observed that this flexible learning environment improved the students' moods when they were learning. The teacher supported this learning climate until the end of the PBL process. When necessary, the teacher, as though a group member, joined group studies to observe the course of events during the process. In these situations, the teacher did not direct the activities of the group. The teacher often reminded the students about the primary task that was related to the PBL problem scenario and encouraged them to be open-minded by making the following statements: "Think of a unique solution to the presented problem!", "Think about how you will find a solution to this problem!", "Think freely rather than depending on one idea!", or "Think imaginatively about alternative solutions!" In addition, the teacher frequently asked the students to consider whether they had evaluated their suggestions to determine the best solution. When the students did not perform well regarding their suggestions, the teacher asked open-ended questions to facilitate the process as follows: "What do you think about your suggestion?", "What is a different suggestion for the solution to the problem?", or "What kind of idea could improve your suggestions regarding the problem solving?" In this manner, the teacher attempted to create student awareness of various suggestions regarding solutions to

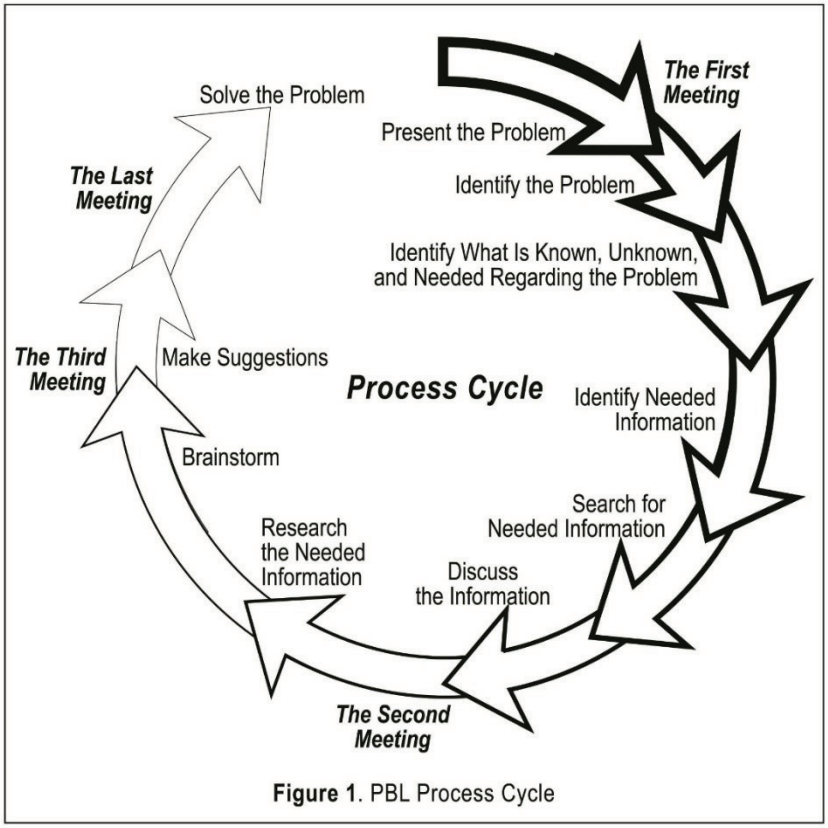

Figure 1. The PBL process cycle with implemented steps.

the problem. This process was monitored by the teacher by regularly providing feedback to prepare the students for the next PBL meeting. During the problem-solving stage, the teacher frequently asked students to evaluate their suggested solutions by focusing on the status of the artwork and to determine whether there were missing elements. Therefore, the artwork included problem solving, and the students were asked to determine the best methods to use to develop the artwork.

As preparation prior to the PBL meetings, the teacher developed a PBL guide plan that included open-ended questions related to the process stages to ask the students. In this manner, the teacher asked the students to think openly about problem solving. In addition, the teacher provided a plan for the student groups that was written on a sheet of paper and included each process stage title such as *Defining the Problem*. During the meeting, the student groups discussed the instructions and determined the best response.

Finally, the teacher used two check forms to observe the students during the PBL process. One of these forms was completed by the teacher while observing each student in group study. The second form was completed by all of the students. On this form, each student observed both him- or herself and all other group members. This second form was used to make the students aware of the process and to ensure that they all effectively contributed to each part of the process. Each student group provided the teacher a portfolio file that was related to the PBL process including all of the stages for each problem scenario. The teacher monitored the entire PBL process through these forms and portfolio files to determine which student (or student group) needed support to address weaknesses.

Results

The Results of the Research Questions

The ANOVA detected a significant difference for creative thinking [F (2, 32) = 21.19, (p < .001)], but no difference for critical thinking disposition [F (2, 32) = 1.40, (p = .260)]. The effect size of the PBL treatment on creative thinking can be assessed as medium (η^2 = .57). The results of repeated measures pairwise comparisons indicated that the creative thinking posttest scores were significantly different from the pretest (p = .001) and follow-up test scores (p < .001). Conversely, there was no significant difference between the pretest and the follow-up test (p = .148) of creative thinking. The mean scores of the pretest, posttest, and follow-up test for creative thinking and critical thinking disposition are presented in Table 1.

The ANOVA detected a significant difference between the repeated measures of the posttest measurement regarding creative thinking (Table 2).

Significant differences among the measurements of the pretest, posttest, and follow-up test were found for the creative thinking subscales of Fluency, Originality, Titles, Elaboration, Closure, and Strengths. The significant differences

Table 1. Descriptive statistics for TTCT and CCTDI.

		Pretest		Posttest		Follow-Up Test	
Measurements	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*
TTCT	17	11.34	4.02	16.44	5.26	9.64	3.37
CCTDI	17	216.64	19.37	223.00	14.39	218.17	14.14

Table 2. One-way ANOVA for repeated measures of TTCT and CCTDI.

	Source	Sum of Squares	*df*	Mean Square	*F*	*p*	η^2
TTCT	Between Subjects	563.340	16	35.209			
	Measurement	426.020	2	213.010	21.195	< .001	.57
	Error	321.606	32	10.050			
	Total	1310.966	50				
CCTDI	Between Subjects	8262.157	16	516.385			
	Measurement	373.804	2	186.902	1.405	.260	.08
	Error	4258.196	32	133.069			
	Total	12894.157	50				

were in favor of the posttest for Closure, F (2, 32) = 21.410, p < .001; Strengths, F (2, 32) = 30.638, p <.001; and Titles, F (2, 32) = 6.868, p = .003. However, there were no significant differences among the measurements of the pretest, posttest, and follow-up test for Fluency, F (2, 32) = .215, p = .80; Originality, F (2, 32) = 1.904, p = .165; and Elaboration, F (2, 32) = 2.041, p = .146 (Table 3 and Table 4).

Discussion

The results of this study as related to the Turkish sample indicate that the PBL approach has a significant positive effect on students' creative thinking in visual arts education. However, the PBL approach has a smaller effect on critical thinking

Table 3. Descriptive statistics for the TTCT subscales.

Tests	Fluency		Originality		Titles		Elaboration		Closure		Strengths	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pretest	17.47	6.79	9.64	5.23	2.00	2.44	9.76	2.43	4.70	2.84	2.70	1.96
Posttest	18.70	9.17	11.47	6.26	3.70	3.61	10.64	2.47	8.35	4.09	5.82	2.85
Follow-Up Test	18.47	8.08	8.64	4.44	1.11	1.93	9.17	1.94	2.05	1.98	1.29	1.40

Table 4. One-way ANOVA for repeated measures of TTCT subscales.

	Source	Sum of Squares	*Df*	Mean Square	*F*	*p*	η^2
Fluency	Between Subjects	2043.294	16	127.706			
	Measurement	14.627	2	7.314	.215	.807	.013
	Error	1086.706	32	33.960			
	Total	3144.627	50				
Originality	Between Subjects	796.353	16	49.772			
	Measurement	69.686	2	34.843	1.904	.165	.106
	Error	585.647	32	18.301			
	Total	1451.686	50				
Titles	Between Subjects	228.157	16	14.260			
	Measurement	58.863	2	29.431	6.868	.003*	.300
	Error	137.137	32	4.286			
	Total	424.157	50				
Elaboration	Between Subjects	107.373	16	6.711			
	Measurement	18.627	2	9.314	2.041	.146	.113
	Error	146.039	32	4.564			
	Total	272.039	50				
Closure	Between Subjects	206.588	16	12.912			
	Measurement	339.569	2	169.784	21.410	<.001	.572
	Error	253.765	32	7.930			
	Total	799.922	50				
Strengths	Between Subjects	128.157	16	8.010			
	Measurement	182.627	2	91.314	30.638	<.001	.657
	Error	95.373	32	2.980			
	Total	406.157	50				

disposition, and the results are insignificant. These results are consistent with those of Cheung (2011) and other prior studies (e.g., Chan, 2013; Nargundkar et al., 2014; Pardamean, 2012; Vidic, 2011; Yoon et al., 2014) that were conducted in various education disciplines. Therefore, PBL can have a significant effect on the creative thinking development of students in visual arts education as well. Considering this effect, the development of creative thinking appears to be a common feature of the PBL approach including visual arts education in Turkey. This development could occur because nonroutine problem scenarios that are related to the real world include prominent factors of PBL such as *group study*, *motivation*, *teacher facilitation*, and *learning environment*. For example, the learning environment can be improved more by student-centered learning in PBL processes than by traditional methods. Pithers and Soden (2000) stated that student-centered education is more effective for developing thinking skills. Galford and colleagues (2015) stated that PBL can help students adjust to working environments. In addition, this result also supports the idea that the studio in the visual arts could be an appropriate learning environment for the PBL process (Brandt et al., 2013; Hetland et al, 2007).

Conversely, prior studies have demonstrated that teachers' verbal encouragement enhanced students' performance on difficult tasks (Guéguen, Martin, & Andrea, 2015). In addition, one study indicated that creative students engaged in more favorable behaviors when there was teacher encouragement than did students who lacked creativity (Sarsani, 2007). Therefore, teacher facilitation may encourage students during the process. However, nonroutine problems that are related to the real world are a primary component of the PBL approach. Although visual arts students encounter nonroutine problems while they create artwork (for example, transforming a real-world visuality from three dimensions into two dimensions on paper), visual arts students in the PBL treatment would likely need to spend more effort on the artwork in the thinking and designing stages than students in traditional teaching methods. In this study, the artwork addressed a real-world problem. The students were perhaps more willing to address these problems since the nonroutine problems involved real-world conditions and a new conflict. The visual arts students performed well on the problem-solving processes that were included in the PBL treatment. The visual arts students performed well during the real-world analysis of the problem scenarios (Williamson, 2011). Siegler (1989) indicated that the most effective method of developing thinking skills is to address new problems. In addition, he claimed that routine problems organize solution mechanisms, but nonroutine problems result in the development of new mechanisms in the cognitive process. Runco (1994) stated that problem solving that is related to the real world requires open goals. This openness leads to divergent thinking (Urban, 1995). Therefore, the most important factor for instilling creativity is being open to new experiences (Florida, 2014). Hmelo-Silver and Barrows (2006) stated that students who learned under PBL curricula were better able to apply their knowledge than students who learned under traditional curricula. Open-ended activities in learning play a significant role in developing students' problem-solving abilities (Loweless, Burton, & Turvey, 2006). Sternberg (2012) stated that the essay tests that are scored by correct answers may discourage students' creativity. However, when teaching, a lesson that begins with a problem is more effective than traditional learning activities (e.g., Pithers & Soden 2000). PBL can be highly effective for developing visual arts students' creative thinking skills when considering the importance of nonroutine problems as open structures that are related to real-world conditions. Therefore, this result indicates that the nonroutine problem (and solving process) is centered in the connection between the PBL process and visual arts education. This result is also consistent with the view of Brandt and colleagues (2013), who emphasized that nonroutine problems create a common learning ground for the PBL process and visual arts education.

The overall level of the effect of the PBL treatment on the visual arts students' creative thinking was medium (η^2 = .57), which indicates that PBL that includes a nonroutine problem-solving process with training techniques such as brainstorming, group study, and PBL stages (defining the problem; known, needed, and unknown; determining the possibility of solutions, etc.) can enhance the creative thinking development of visual arts students at a moderate level. The PBL stages are similar to stair steps and allow students to clearly understand the entire process. Students generally possess more opportunities to achieve success at any step of the process. In addition, brainstorming is an open technique that can be highly effective for creative thinking. Openness predicts creativity in the arts field (Kaufman et al., 2016).

Another reason for these results is that the study used a nonroutine problem scenario that was related to real-world conflicts. This type of scenario provides more opportunities for students to determine new solutions to problems. In addition, group study can significantly contribute to visual arts students' performance and motivation. In this manner, certain ambiguities in real-world problems are highlighted during long group discussions, which can have a positive effect on creative thinking development. Increasing ambiguity is necessary for the students to become creative (e.g., Sternberg, 2003). Students have confirmed that compared to other types of problems, real-world problems encourage them to use divergent thinking in the problem-solving process (e.g., Williamson, 2011). Overall, I propose that the primary effect of the PBL approach on the creative thinking of visual arts

students is realized by using real-world problem scenarios.

The students' creative thinking was significantly improved in this study's PBL treatment, particularly for the subscales of Closure, Strengths, and Titles. The largest effect size (η^2 = .66) of the PBL treatment is for the Strengths subscale. The Closure (η^2 = .57) and Titles (η^2 = .30) subscales represent the second and third largest effect sizes, respectively.

Closure refers to intellectually probing (Kim, 2011) while remaining open to uncertainty (Cha´vez-Eakle, Eakle, & Cruz-Fuentes, 2012). This ability allows students to recognize problems by remaining open to uncertainty. Students with closure skills are more sensitive to problems and open-ended questions. Therefore, the PBL approach may help visual arts students remain open to uncertainty during non-routine problem-solving processes. In addition, this process was supported by the teacher, who frequently asked open-ended questions. Kim (2008) emphasized that creative students enjoy the uncertainty of unknown things. Therefore, PBL may provide students new opportunities to think, unless the solution depends on a fixed idea within this uncertainty. This situation can be very useful for determining new solutions to problems. Under normal conditions, individuals are uncomfortable with uncertainty (Basadur, 1994). Students are taught to use logic to determine solutions to routine problems, which generally have either a right or wrong answer in traditional education. Therefore, thinking without depending on a specific idea supported by the PBL process can lead to the development of closure skills in visual arts students.

The visual arts learning environment is consistent with the PBL process in terms of supporting the results of this study. For example, visual arts teachers frequently ask students open-ended questions during lectures. Teachers want students to improve their artwork by comparing their prior skill level to their current level. This review allows students to think broadly and determine any missing elements. The processes of developing and producing artwork may include uncertainty. This type of learning environment can nurture students' openness to uncertainty by probing the artwork. Therefore, it is possible that the visual arts students were able to easily address the open-ended problems in the PBL process by remaining open to uncertainty. Kaufman and colleagues (2016) stated that openness in the arts should be supported. In addition, uncertainty is essential for creativity (Sternberg, 2003). By encouraging openness and uncertainty, PBL can meet the needs of students in a visual arts learning environment. Open goals that are used in education can be provided by using PBL techniques such as brainstorming, teacher facilitation, and self-directed learning. Brainstorming supports possible responses to problems (Strom & Strom, 2002). Rietzschel, Nijstad, and Stroebe (2014) stated that brainstorming promotes the development of creative ideas. This type of open technique can easily incorporate real-world problems as in PBL for the creative thinking development of visual arts students. Williamson (2011) stated that students accept the value of open learning experiences during discussions and projects in terms of encouraging divergent problem solving, particularly when real-world problems are used. In the present study, the possible effect of the PBL approach on closure is consistent with open structures and training techniques that are supported by PBL.

The Strengths subscale of creative thinking includes articulate storytelling, movement and action, synthesis of incomplete figures, emotional expression, synthesis of lines or circles, fantasy, unusual visualization, internal visualization, extending or breaking boundaries, richness of imagery, colorfulness of imagery, and expressiveness of titles. Although these strengths are complex, these features can be accepted as a rich aspect of creative thinking. Strengths include a new perspective, and the PBL approach provides students with more opportunities to analyze problems from different perspectives to develop new solutions. This situation is also vital for creative thinking development because creativity needs novelty (e.g., Guilford, 1976) and new perspectives. Strengths, which represent the richness aspect of creative thinking, must be considered a different perspective for problem solving. Torrance (1966) claimed that creativity is sensitive to problems. A sensitive individual perceives problems as irregular things, and she or he needs different perspectives of sight to transform problems from an irregular form to a regular form during the problem-solving process. I propose that the discipline of visual arts education is an appropriate learning environment for the PBL process in terms of students who perceive certain conflict conditions as irregular when they create artwork. Visual arts teachers often direct students to "see more" or "look in detail" in terms of visuality to draw attention to irregularities. During these learning circumstances, the teacher will likely encourage and motivate students and ask them to evaluate their artwork frequently during the production of the artwork. Therefore, it can be expected that visual arts students will spend more visual effort on problem solving because they are not comfortable with irregularity. The efforts of visual arts students will increase significantly during the PBL process in terms of considering alternative solutions to nonroutine problems by transforming irregular problems into regular ones.

Williamson (2011, as cited in Feist, 1999) stated that personality traits of artists include emotional instability as well as less sociability and acceptance of group norms. When these traits are considered for visual arts students, irregular things may cause certain unbalanced conditions. In this situation, students would be forced to establish a balance between irregular and regular things to create a hemostatic balance. Strengths

can be a strong indicator of innovative and adaptive creative thinking styles (Ulger, 2016); therefore, the PBL approach may provide a favorable educational environment for establishing a balance between innovative and adaptive creative thinking styles of visual arts students. From this perspective, irregularities can easily be transformed into an innovative aspect. Irregularity includes the potential for transforming a new problem into a regular problem. Regularity represents the adaptive aspect for maintaining the status quo. Therefore, visual arts students may tend to establish a balance in favor of innovative aspects because PBL provides more opportunities to do so during the problem-solving process. Sensitivity to a problem will enhance the development of the Strengths subscale, as noted in this study. This result is consistent with one prior study (Kim, 2006) regarding the innovative and adaptive aspects of creative thinking. Therefore, I propose that PBL can act as a strong bridge between innovative and adaptive creative thinking styles of visual arts learners.

The Titles subscale was also found to be significant in this study. This result indicates that the scores for titles may have increased significantly during the PBL treatment. According to Kim (2011), Titles refers to abstract thinking, synthesis, and an organizational thinking process for capturing the essence of information. She determined that the score for Titles has a positive relationship with verbal intelligence scores. In addition, Cho, Nijenhuis, van Viannen, Kim, and Lee (2010) determined that there is a significant relationship between intelligence and Titles. Accordingly, Titles include abstract thinking that tends to be verbal and logical rather than visual. Galford and colleagues (2015) stated that the PBL approach may improve students' listening skills. Listening includes verbal codes (Olejnik, 1978), and this situation may also be valid for verbal skills. The participating students in this study pursued intensively visual courses; therefore, the results may indicate that the students' verbal and reasoning skills may enhance creativity during the PBL treatment. Regarding creativity, this result is supported by Palmiero, Nakatani, Raver, Belardinelli, and Leeuwen (2010), who determined that individuals' verbal skills have a positive effect on their verbal creativity skills. In terms of educational outcomes, the PBL approach may support significant verbal and logical outcomes for students in visual arts education. The effect of PBL on the Titles subscale seems to be meaningful; this result may have occurred because traditional outcomes for this type of education involve visuality more than verbality. Another reason for this result is that PBL training techniques, such as brainstorming and group discussions, represent techniques that are used in visual arts education. Accordingly, these training techniques contribute to students' verbal and reasoning skills more than traditional learning activities. For example, brainstorming is used to generate more ideas (Cuivenor & Else, 1997) and is a verbal exercise. Similarly, group discussion as well as other educational techniques that are used for PBL can contribute to students' verbal and reasoning skills. Visual skills may be transformed into verbal and reasoning skills during visual arts learning because the visual domain interacts with the verbal domain in cognitive processes (Ulger, 2015). Creative thinking occasionally appears as a transformational skill. Therefore, the development of the visual arts students' creative thinking subscales may occur at various progressive levels during PBL. The results of this study indicate that the verbal and logical outcomes may be additional significant benefits that can be obtained through PBL. The size of the effect of PBL on students' creative thinking skills may be closely related to the training techniques that are used for PBL. Furthermore, this effect may be related to the participants' ability to use these techniques.

This result regarding the subscales may also indicate that visual arts students need to use both visual (strengths) and intellectual (titles, closure) skills in problem solving during the PBL process. This could be explained by the semiotic term in which the *signs* and *relations* are the two keys. If we consider that the visual and intellectual can be referred to signs and relations respectively, the visual arts students in PBL can solve nonroutine problems by making a connection between the signs and relations regarding the semiotic. From this perspective, this result is also supported in terms of the learning environment by Brandt and colleagues (2013). They stated that the studio as learning environment is a bridge between professional and academic practices. Correspondingly, PBL regarding the learning approach can be another bridge to connect between innovative and adaptive creative thinking styles of learners in the production of artwork. Brandt and colleagues (2013) also added that the studio is grounded in the relationship among design, environment, and social practice. For instance, the uncertainties provided by the studio in the interior design discipline are necessary for students in regard to what they can do as designers (Smith, 2016, pp. 69–70). In this manner, as scholars suggested, the studio has the inclination to give point to creative aspects of design (Gray & Smith, 2016, p. 266). For example, the studio in the web-based media discipline constitutes higher creative skills of students (Rieber et al., 2016, p. 53) because informal learning occurs spontaneously in the studio, which affects students' learning the same as in the instructional design discipline (Shwier, 2016, pp. 29–33). From this perspective, PBL with real-life conflicts can provide an important contribution to the creative thinking development of students in the studio of the visual arts education within this conceptual framework.

Regarding critical thinking disposition, the results did not indicate a significant difference between the measurements

that were used in this study. According to Ennis (1996), critical thinking and critical thinking disposition are similar because the basic elements of critical thinking are embedded in critical thinking disposition. Therefore, the results of this study are supported by Pardamean (2012), who reported that there was no significant effect of PBL on university students' critical thinking in the context of dental education. However, the results of this study are not supported by other studies regarding nursing and business education (e.g., Chan, 2013; Nargundkar et al., 2014). Teaching critical thinking to students (Peterson & Madsen, 2010) by using only discussions or the teachers' indirect guidance (Chang et al., 2015) may be difficult. More studies are needed to detect the effects of the PBL approach on visual arts learners' critical thinking (disposition) skills. Savery (2006) emphasized that the use of the PBL approach in education is crucial for present and future generations of students to enhance their ability to think critically.

Limitations and Implications

When a study uses a one-group pretest-posttest design, changes may occur between pre- and posttests because the experimental treatment may include certain biases (Y520, 2000). In terms of threats to internal validity, it is possible that one limitation of this study occurs because of threats regarding history, maturation, testing, and the attitudes of the subjects. Therefore, the *p* value for the significance level of the ANOVA was reduced to .01 to reduce the possibility of type 1 errors. Although the data of this study were analyzed with specific statistical techniques to control the false discoveries regarding the results, the present PBL treatment effect cannot be generalized until it is confirmed by another study in visual arts education owing to the one-group pretest-posttest research design limitations. Despite this limitation, this study was the first to implement the PBL approach by adopting a curriculum in visual arts higher education. This experimental study began with 19 (*N*) subjects, but only 17 completed the PBL treatment. Therefore, another limitation may be that the sample only included 17 subjects. One implication of this study is that open structures represent nonroutine problem-solving processes that are used in the PBL approach. The use of open structures in learning may enhance independent thinking, which supports visual arts students' creative thinking.

Implications for Implementing PBL

This implications of this study regarding the implementation of PBL in visual arts are as follows: The teacher may motivate students to analyze the problem through open-ended questions and by extending uncertainty during the problem-solving process. When students encounter difficulties in group study, the teacher can become involved, as though the teacher were an actual group member, without dictating the course of events. In addition, the teacher may tolerate minimal conflicts among the students and become a mediator without unduly disrupting the process. Doing so would allow the students to think creatively in a flexible learning environment. Another implication of this study is that the teacher can develop a flow plan by distributing instructions to the students. These instructions may include the primary tasks, open-ended questions, and students' possible responses that are related to the PBL meeting. For example, in terms of what to do, this plan would help the teacher conduct the meetings in a thorough manner. Another implication of this study is that the PBL process must be conducted carefully by both the teacher and students and include observation forms to determine the students' awareness of the process and how group study contributes to the process.

Implications for Future Studies

This study used the PBL approach as a treatment in visual arts education for only one semester. The measures were repeated during the research period, showing that implementing the PBL treatment for only one semester is not sufficient for maintaining the benefits of the treatment. Therefore, future studies should conduct a PBL treatment for a minimum of two semesters so that the benefits of the treatment are maintained. In addition, this study indicated that during the PBL treatment in visual arts learning, certain subscales of creative thinking were enhanced, whereas other subscales were not. Future studies may use different training techniques during the PBL treatment in visual arts education to improve the subscales of creative thinking. For example, open-ended activities as related to a primary task, or the hierarchical method can be conducted after brainstorming; these techniques may enhance the uncertainty and elaboration of the treatment if used with the traditional techniques of PBL.

Conclusion

Creative thinking and critical thinking are very important skills that visual arts students use in the production of artwork. In addition, these skills are the most important for all learners more than ever before. Current educational programs in schools are generally focused on certain information or routine problem solving, which focuses only on one solution or correct answer. Unfortunately, this type of education guides students to accept information without inquiring and discovering new methods for problem solving. This type of education does not involve students' probing, critique, or creativity. However, using an open structure in visual arts education in the form of nonroutine problem solving with

PBL can support the development of creative thinking skills through probing and critique while maintaining uncertainty. Nonroutine problems are generally not solved by using one unique solution or a solution that was previously known. Furthermore, numerous future studies are needed to analyze critical thinking (disposition) skills to determine the effects of the PBL approach on visual arts learners.

This study implemented the PBL approach in visual arts education in Turkey and revealed that students' creative thinking skills were significantly enhanced. Therefore, it is firmly recommended that future studies use the PBL approach in various education disciplines to offer students the opportunity to enhance their thinking skills.

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