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RELATIONSHIP BETWEEN STUDENTS' ABILITY TO ACHIEVE DESIGN TASKS AND CREATIVE THINKING SKILLS

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Abstract

Creative thinking provides students to solve complex problems, through searching for new learning ways in educational activities. This study aimed to reveal higher education students' creative thinking potentials with educational activities. The participant students were involved in achieving design tasks which were the course subject as closed-ended and open-ended task activities. Regarding the results, it was found a relationship significantly between students' creative thinking and open-ended task scores. The regression analysis showed that open-ended task activity encourages students' creative thinking skills positively. The present result indicated that the open-ended task design activity play a considerable role to reveal the students' creative thinking skills. By this way, this study concluded that open-ended task design activities concerning the curriculum might encourage and support students' creative thinking potentials in higher education and suggested to implement students the open-ended tasks in the education.

Keywords: Creative education, creative process, art practice, creative thinking.

INTRODUCTION

The creative thinking skill allows students to solve non-routine problems different disciplines like science, art, and culture with including economy. Munroe (2015) stated that non-routine problem is to challenge individuals cognitive development. Ramalingam, Anderson, Duckworth, Scoular and Heard (2020) clarified that creative thinking produces new ideas differently by making unconventional connections to arrive a given purpose. Based on scholars, Moselya, Wrighta, and Wrigleyb (2018) stated that creative thinking in higher education provides students in different disciplines to solve complex problems. The non-routine problem as open-ended problem requires divergent thinking. However, closed-ended problem solving as routine problem requires convergent thinking (Runco, 2014). Cropley (2001) described that *convergent thinking* motivations on a correct answer. Conversely, *divergent thinking* relates to multiple answers to an open-ended problem. Ward and Kolomyts (2010) stated that divergent thinking predicts creativity efficiently. Also, Reiter-Palmon, Fortman, and Barbot (2019) stated that a divergent thinking task accomplishment score might indicate the creative potential of individual to predict creative thinking. As Primus and Sonnenburg (2018) claimed, open-ended task designs influence individuals' creative performance. In this way, numerous scholars have agreed that divergent thinking correlates more with open-ended problems (e.g., Cropley, 2001, Plucker, Qian, & Wang, 2011, Runco, 2014). Many scholars suggested further study conducted activities such as the open-ended and closed-ended tasks to determine which process promotes creativity more (Clinton & Hokanson, 2012; Tomasi, Schuff, & Turetken, 2018). From this perspective, this study's main aim is to determine to what extent higher education students' creative thinking skills are involved in achieving the task designs. Thus, this study invented educational activities as the closed-ended and open-ended task designs concerned the visual arts education course subject in the higher education level. Therefore, the question of this study was determined such: What is the relationship between students' ability to achieve the open-ended/closed-ended task designs and their creative skills.

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The task activities as closed-ended and open-ended design tasks

According to Torrance and Myers (1970), the open-ended term in many disciplines means a great diversity of responses, by contrast, the closed-ended word usually means that it is about convergent thinking that is correct answer not include a surprise. Therefore, instructions of an open-ended task support the individual's thoughts regarding diversity. In contrast, the closed-ended task instructions would focus only on one answer or solving of the problem as a known model as what the output should be as product (Isbell & Raines, 2003). Isbell and Raines (2003) gave a checklist for the open-ended task activities as follows:

- *Ask the participants to select a task design, as they want*.

-*Provide the materials for the participants to make a design*.

- *Control the process of creation of yield regarding the structure or form,* and

- *Allow them to complete their design by using these materials.*

According to Urban (1995), an open-ended task activity can be challenge to prompt the creative potential of the participants. This challenge is an open-ended problem (e.g., Runco, 2014). Such instructions may lead to producing multiple answers with the inclusion of solving ways for the participants. For example, completing a figure or a composition unknown previously as an open-ended design problem can induce a challenge for the individual. In this way, Clinton and Hokanson (2012) claimed that these open-ended problems require creativity more than closed-ended ones. Runco and Jaeger (2012) stated that individuals do creative works under a degree of limitations. Guilford and Hoepfner (1971) also stated that divergent thinking tasks should be limited in activity output and activity time. The participants performed in both the closed-ended and open-ended task designs within the limitation of the task output and the time.

METHOD

The participants of this study were pre-school education students (N=33, 18-23 years old, M_{age}=19.58, females 86%) in their fifth semesters (as autumn 2015) pursued in the their education department. They were in different classes as intact groups. The participants were in different classes selected randomly. The students participated in current closed-ended and open-ended task designs as a part of their lesson which was the visual arts coursework. The TTCT was implemented volunteer students as based on related education department permission.

Instruments

This study used incomplete figures as a sub-battery of the Torrance Tests of Creative Thinking (TTCT) Figural Form figural form which analyzes creative thinking and subscales as fluency, originality, elaboration of the abstractness of titles (Titles), resistance to premature closure (Closure), and creative strengths (Strengths). This sub-battery requires the individual to complete given figures as a response in the simplest way within 10 minutes (Torrance, 1966). The Turkish version of the TTCT's reliability (and validity) analysis was performed by Aslan (2001) as collecting data in a wide range of samples (N = 922).

Task activities and general conditions

Current closed-ended task activity: The author handed out a sheet of paper divided by lines into 70 squares (3x3 cm^2) to each participant for producing an output (Fig. 1).

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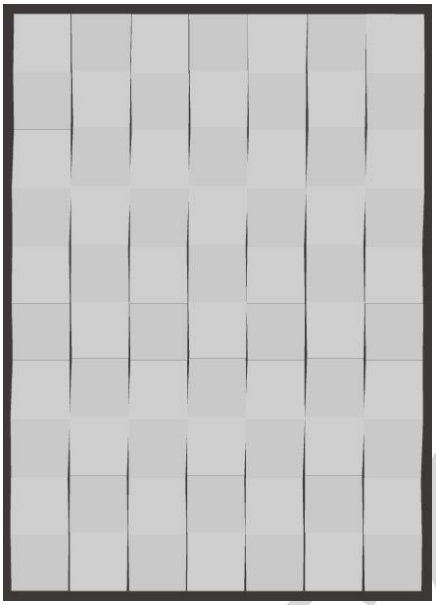

Figure 1. The initial stage of both task activities as closed-ended and open-ended tasks

The author showed a completed output model to all students at the beginning of the activity (Fig 2).

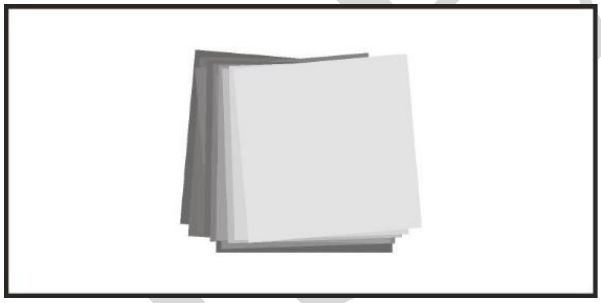

Figure 2. The distinct final stage of the closed-ended task activity

The students completed their outputs during the task, considering the model output in a limited time (40 min.). However, they were free regarding finding and using ways of producing the outcome by the delivered paper by cutting or folding and pasting without losing any part in the task process. Additionally, author gave the instructions during the closed-ended task design as follows:

- Make a design with the provided paper as a similar model as I show to you!

- You are free to find or use any method to produce it.

- You should make your design using the given paper as a whole by folding and cutting it.

- You must show me for scoring as soon as you finish your design!

The author emphasized that participants should make their outputs 2D designs by cutting and folding the given paper without losing any piece. At the end of the activity, all participants completed the same 2D artwork at different times.

Current open-ended task activity: The author handed out a sheet of the same size paper as the closed-ended activity to participants in the open-ended activity (see Fig. 1). However, the open-ended activity had different traits from the closed-ended one regarding the instructions and output. Author did not show a model output as a completed design to the participant students at the beginning of this activity. However, he asked participants to complete the task activity under the given instructions as follows:

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- Let's suppose to make a 3D design with the provided paper!
- How do you make a 3D design with the delivered paper?
- You are free to produce your work as you want in terms of both method and output.
- Shortly, make a 3D design as you imagine!
- You must show me for scoring as soon as you finish your design!

The author reminded the participants to design as they want as 3D output by the given paper (Fig. 1). The participants were free to create construction by the delivered paper by cutting or folding, and pasting without losing any part (Fig. 3).

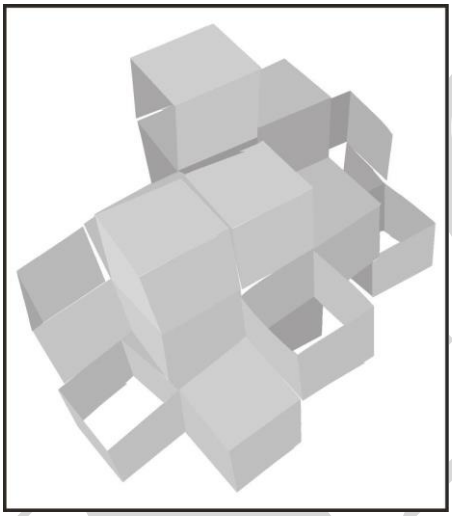

Figure 3. A sample of the open-ended task output.

Consequently, author established a flexible learning environment for the participant students in both tasks. The core qualifications of these tasks designs are presented in Table 1.

Table 1. Qualifications of closed-ended and open-ended tasks designs.

Qualifications	Closed-ended Task Design	Open-ended Task Design
Thinking style	Convergent	Divergent
Learning method Activity	Teacher-centered	Student-centered
Instruction	Conventional	Unconventional
Processes	Limited output model	Unlimited output model
Solution	Single / Similar	Multiple / Various
Output	Known model	Unknown model

Author limited both tasks within 40 minutes and did not make any intervention of the outputs, however, gave each design score by determining the completed time of the production with a stopwatch (minute with second).

General conditions of the Process: The participant students had no background in such design outputs before pursuing this visual arts lesson. In the related curriculum of the visual arts lesson, two dimensional (2D) and three dimensional (3D) designs come as lesson subjects, respectively. The author planned 2D design activity primarily dealt with a task, and then 3D design applied as the other task. The thinking styles in such activities are more crucial than activity output types (Moran, Milgram, Sawyers & Fu, 1983). Therefore, task outputs' dimensionalities as 2D or 3D have not

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Turkish International Journal of Special Education and Guidance & Counseling 2024, volume 13, issue 2

critical role in revealing the individuals' creative thinking potential (Tegano & Moran, 1989). Thus, the author planned current 2D and 3D tasks about themes and instructions as mentioned above.

The author administered the TTCT, closed-ended, and open-ended task activities for internal consistency in this study. He applied the TTCT to participant students within a day. A week later, he implemented the closed-ended task after the open-ended task consecutively to the same students in a day. There were just ten minutes between two activity tasks, as duration. The process of all activities are presented in Fig. 4.

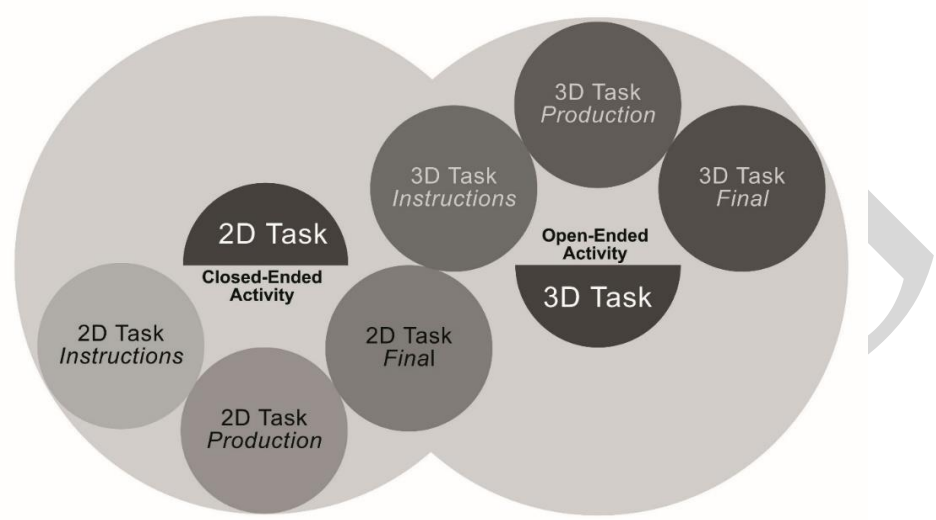

Figure 4. Closed-Ended (2D) and Open-Ended (3D) Task Processes

Snapshot scoring: Author used snapshot scoring assessment method in this study. The generation of ideas in a design task is a kind of metric uses in the assessment (Kim, Lee, Park & Jeong, 2009). The snapshot scoring in terms of subjective ratings with receiving a single holistic rating uses as a quick and straightforward approach to the assessment of the task outputs. In this method, the rater observes the response and gives a single holistic rating to the set as an output (Silvia, Martin & Nusbaum, 2009, 81). The snapshot scoring as a unidimensional view of something at a particular time is a new scoring approach mainly used in task activities. Therefore, as Forthmann et al. (2019, 4) emphasized, the unidimensionality of ratings in the snapshot scoring was a specific method. Thus, author assessed the activity output when the participant completed it during the activity. In this assessment, he agreed with the participant, as concurring mutually on whether the production was ready for the scoring according to the determined rules of the related activity to fit into the corresponding task target.

Assessment: There is a consensus among scholars about human visual perception. This perception system clarifies that the human eye recognizes anything in the space efficiently, whether it is a three-dimensional form or a two-dimensional one. The human look determines any represented 3D design under some properties, which are three sides such as *p*, *q*, *r* (Iyer, Jayanti, Lou, Kalyanaraman, & Ramani, 2005). The assessment procedure was essential for task activity outputs. Therefore, if the activity output had three sides as 3D design volumetrically without losing any part of the given paper, the author assessed it for scoring. If necessary, participants used clear tape to attach the square parts of the paper to construct their productions in the open-ended task. In the closed-ended activity, author assessed the outputs according to the 2D design properties. Accordingly, 2D work had to possess the same form as the shown model at the beginning of the activity. Each participant worked with the given paper and made this paper as a flat square through folded (or cut) it on top of another. Here, this design was ready for scoring as the 2D and 3D design forms of the outputs are presented in Fig. 5 and Fig. 6.

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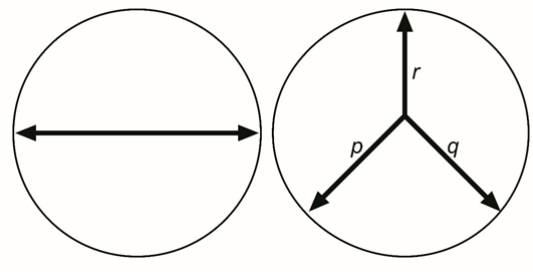

Figure 5. The drawing presentation of the 2D and 3D design respectively in the space hypothetically.

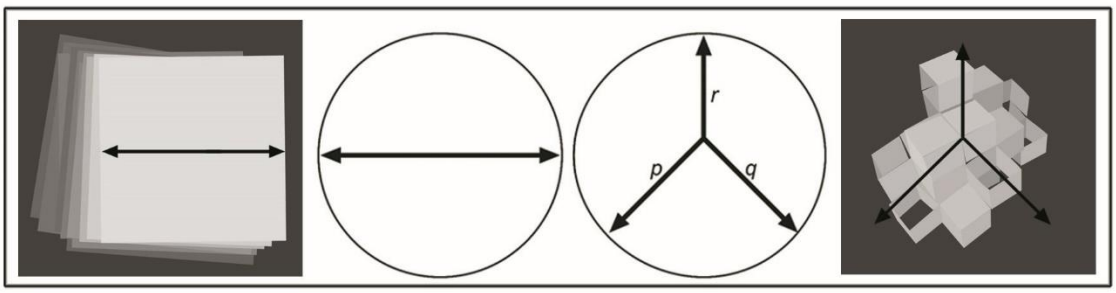

Figure 6. The exhibition of the 2D and 3D drawing presentations on the sample outputs of the closed and open-ended task activities.

In this way, the author scored closed-ended and open-ended design activity outputs as 2D and 3D design separately. When a participant believed to complete her/his design, s/he showed it to the author for the assessment. Accordingly, if the participant completed the task output following the task's instruction, each response as output was rated time-stamped by author. According to numerous scholars, the task process must be under production and activity time (Baer, 1996; Guilford & Hoepfner, 1971; Runco & Jaeger, 2012).

The account regarding assessment: If a participant student completed the output under the activity's goal, the author determined the time referred to the beginning of the task as the elapsed time. When a participant could not complete the output under the output goal, then s/he was invited to participate in the activity again. Due to each task limited by 40 minutes, the completion time was an essential indicator for the score. For the account regarding assessment, the score was the completion time (14 minutes) subtracted from the 40-minute activity time. The remaining figure (26) was the score of this output practically. According to this scoring procedure, if a participant finished the activity output in 23 minutes (40-23= 17), s/he got 17 points. Accordingly, a participant received 28 points when s/he finished the activity output in 12 minutes (40-12= 28). The author used a clock to determine the output's right completion time for the assessment. The last completed output in the activity was a bad performance. Thus, the participant as a design owner took the worst score (the lowest score).

Data Analysis

The parametric statistical techniques were used in this study as distributed normally of the data. Accordingly, the Pearson Correlation Coefficient analysis and Simple Linear Regression analysis techniques analysed the data. The *r* letter symbolizes the correlation, which can take a value of between "0" and "1" (*'Pearson' Correlation ...*, 2018). The Simple Linear Regression Analysis allows recognizing this relationship by assigning two variables as the dependent variable (predictor) and an independent variable (response) (*Lesson 1: Simple Linear Reg...*, 2018).

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RESULTS

Regarding the descriptive statistics and correlations are presented in the table 2 and Table 3 as follows:

Table 2. Descriptive statistics.

	N	Mean	Std. Devitation	Minumum	Maximum
TTCT		5.3152	1.71612	1.80	10.00
2D Closed - Ended Activity	33	18.1212	8.97830	1.00	33.00
3D Open - Ended		17.3030	9.34239	1.00	33.00

Table 3. Correlations between creative thinking and closed-ended / open-ended task activities.

		Closed - Ended Task Activity	Open - Ended Task Activity
	N	***r***	***r***
TTCT	33	.05	.36*
Fluency		.04	.20
Originality		.08	.31
Titles		-.08	.33
Elaboration		.16	.01
Closure		-.05	.20
Strengths		.03	.10

**Correlation is significant at the.05 level (p<.05)*

The Pearson Correlation Coefficient analysis determined a significant correlation between the creative thinking and open-ended task scores of students. However, there was not any significant correlation between the creative thinking and the closed-ended task ones. Additionally, there was no significant correlation between the participants' open-ended task accomplishment and creative thinking subscale scores neither (Table 3).

This statistical evidence allows to conclude that there can be a significant linear relationship between two variables (*Hypothesis Test for...*, 2018). Thus, author used a simple linear regression analysis technique to determine whether the participants' open-ended task scores predicted their creative thinking skills (Table 4).

Table 4. The simple linear regression analysis.

Variable	B	SE	*β*	*t*	Sig.
Constant	4.18	.60		6.92	.000
Open - Ended Activity	.07	.03	.36	2.13	.041*

**Correlation coefficient (r^2) is significant at the .05 level (p<.05).*

The regression analysis showed that the open-ended task scores of the participants significantly predicted their creative thinking skills (r= .36, r^2= .13, F (1, 31) = 4.54, p< .05). This result indicated that the open-ended task activity explains 13% of the creative thinking skill variance. In other words, open-ended task score may originate from creative thinking potential at the level of 13% that is, the open-ended task achievement predicts participant's creative thinking skills at 13%.

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DISCUSSION, CONCLUSION, and SUGGESTIONS

This study revealed that open-ended task design activity is a significant indicator to promote students' creative thinking potential more than the closed-ended task one with supporting the previous study findings (Tomasi et al., 2018; Baer, 1996; Rostan, 1997; Chan & Chan, 2007). Tomasi et al. (2018) stated that the participant had no ready schema in an open-ended task activity cognitively. This situation indicates that participants have to think of all possibilities in the open-ended task to complete activity output under time pressure, which leads diversity of thinking. In this way, the open-ended task activity might allow participants to try new ways to solve the design problem by avoiding referring to a ready problem-solving method. By this way, the participants had to find a new schema in the cognitive process. Such a learning environment lead them to discover new ways of thinking by stifling habitual thinking. Patil and Athavankar (2022, p.81) stated that design strategy based on tradition and habit can be a weak method to solve form generation problem creatively. Therefore, Crilly (2015) stated that creative design includes rejection of previously accepted ideas for progression. This situation provides an infinitive thinking source for open-ended activity participants to be *open to new experiences* leading to creative thinking. Doubtless, a challenge was to think out of the habitual ways of consideration for the participants in the open-ended activity. By this way, as Liu, Zhang and de Bont (2022, 334) stated, design is a kind of the result involved novel combinations. Krafft and Berk (1998) reported that the open-ended activity participants showed significant fantasy development more than the participants in the closed-ended activity ones. Suppose fantasy originates from the non-habitual ways of thinking as imaging. In that case, it may expect that the participants experience new ways within open-ended task activity through non-habitual ways of thinking. Tomasi et al. (2018) clarified that to be open new experiences can encourage creativity. Also, numerous scholars (Guiford & Hoepfner, 1971; Runco, 2014; Torrance & Myers, 1970) stated that open structures provide a learning climate for divergent thinking, which leads to creative thinking. Therefore, an open-ended design activity is a significant indicator in acting individuals' creative thinking skills.

In this study, the participants' creative thinking abilities as the *originality* and the *fluency* correlated to a lesser degree in both activities as open-ended and closed-ended tasks. As one of the possible reasons for this result, the time constraint imposed may be on the activities. Numerous scholars stated that time limitation in a creative work could be a significant factor in *originality* (Runco & Jaeger, 2012) and *fluency* (Guilford & Hoepfner, 1971). As supported by this situation, many studies reported that time pressure might enhance productivity (Tsai, Cheng, & Lo, 2018, 57). According to scholars, time pressure also positively affects innovation (Andrews & Farris, 1972) and divergent thinking task accomplishment (Forthmann, Lips, Szardenings, Scharfen & Holling, 2018). Therefore, present activity time as 40 minutes' constraint imposed as a limitation on the current activities might be too long to reveal the creative thinking subscales of the participants in the activities.

Regarding the limitations and implications, the limitation of this study might be the restriction time, which was forty minutes to complete each activity. Despite this limitation, the present research was the first study in the literature to determine students' creative thinking in open-ended and closed-ended task activities at the higher education level by connecting a course subject based on the curriculum. Thus, the implication of this study is to develop new activities in education to promote students' creative thinking skills. The other implication was the restriction time used in the open-ended task design, which could reveal participants' creative thinking subscale skills. Amabile et al. (2002) stated that too few study findings on the effect of time pressure on creativity regarding the appropriate response to an open-ended task. The time limit may be less than forty minutes to encourage students' creative thinking skills.

This study indicated that the open-ended task activity might encourage the students' creative thinking skills within a learning environment. In the open-ended task design, students would be open to new experiences by avoiding habitual thinking patterns when encountering a non-routine problem. This

situation may reveal the creative thinking potential of students leading to creative thinking. As Runco (2016) stated, implementing specific creative performance tasks is perhaps the best way to discover creative thinking potential. Because, the open-ended tasks give an opportunity the individuals compose his thought in a spontaneous way to develop the new (Runco, 2014). The other aspect of the present study is related to the restriction time used as a limitation. Amabile et al. (2002, 14) found a positive relationship between time pressure and intrinsic motivation. The current result indicated that the time constraint imposed on the activities could be an essential variable to promote the creative thinking subscales, especially *originality* and *fluency*. Therefore, the activity time should limit less than 40 minutes in the higher education level for future research. Due to the creativity plays a vital role in education, numerous scholars (Basadur, Runco, & Vega, 2000; Cropley, 2001; Murdock, 2003; Scott, Leritz, & Mumford, 2004) suggested that inventing education settings to include more variations and exercises for educational disciplines. This study indicated that integrating the course subjects into open-ended task designs promoted students' creative thinking skills meaningfully.

Ethics and Conflict of Interest

I declare and confirm that I have acted in accordance with ethical rules throughout the entire research. No potential conflict of interest was reported by the author.

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