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INTERDISCIPLINARY ART PRACTICES IN DRAWING EDUCATION

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ABSTRACT

The aim of this study is to reveal if there is any difference in students' opinions and motivation levels about drawing education and instruction before and after interdisciplinary art practices based on the relation of art and mathematics. The study was carried out with embedded design among mixed research methods. Study participants consisted of 10 first-year students taking the course "Drawing-I" for the first time as a part of their undergraduate study at Art Teaching Department in Education Faculty of a Turkish state university. "Drawing Motivation Questionnaire" as a data collection tool in the quantitative dimension of the research; In the qualitative dimension, "Semi-Structured Interview Form" and "Self-Assessment Form" were used. Quantitative data obtained from the research were analyzed using t-test and qualitative data were analyzed using content analysis. It was found that the content, activities and practices covered in the course of drawing instruction through interdisciplinary relation of art and mathematics increased students' motivation levels. On the other hand, the aspects of drawing education such as techniques, knowledge and skill development increased students' anxiety in applied courses because of aesthetic concerns and assessment anxiety. As another finding, interdisciplinary art practices improved students in associating art with various disciplines, learning the structure of drawing, model and anatomy, experiencing personal development, and increasing effectiveness in learning-teaching process. When the qualitative data of the study were compared with the data obtained from the quantitative dimension, it was determined that the students achieved positive development in subjects such as interdisciplinary interaction, model and anatomy, the structure of the design, and personal development in addition to their ability to be self-confident, self-skill and motivation in drawing applications. In light of these findings, it is recommended to plan the undergraduate drawing course applications in Art Teaching program within an interdisciplinary framework and to make sure that students participate in learning process actively by gaining outcomes from various disciplines.

Keywords: Drawing, drawing instruction, interdisciplinary art practices, motivation

INTRODUCTION

Nowadays, universities offer various art courses to students as a part of their education programs. In this way, they develop students' aesthetic awareness, boost their knowledge and humane feelings, and help students discover their own talents, gain artistic thinking competence by transforming knowledge, expand their worldview and have a humanistic understanding (Shih, 2018). "Drawing" education contributes significantly to the development of the individual's visual skills and it is among art courses offered at universities aiming to teach the target skills to students. Derived from the French word "dessin" (Türk Dil Kurumu (TDK), 2020), drawing (*desen* in Turkish) is seen as the starting point of art and art education, and it is one of the priority elements in the application, teaching, and learning of plastic arts (Küçükşen Öner & Genç, 2018). In his book "Ways of Seeing", English writer and art critic Berger (2020) states that seeing comes before speaking and that a child looks around before talking and tries to recognize his surroundings, objects, and things through observation. According to Bulut (2003), drawing education constitutes the basis of plastic arts and contributes to the emergence of artistic character by improving the visual skills of the individual. Similarly, San (2010) emphasizes the importance of drawing in art education and argues that basic art education courses are a multidimensional and complex process and the individual's thinking, comprehension, perception, and skills can be shaped by seeing, drawing, and establishing connections between objects. Therefore, drawing education and instruction should be carried out in a planned manner in order to develop the aesthetic attitude and visual skills of the individual through art education. In this scope, students should be kept active in learning through interdisciplinary art application as a combination of several undergraduate programs and lesson plans should incorporate the curricula and learning outcomes of different disciplines.

Bozkurt (2014) believes that art practices integrated into education and teaching allow the individual to connect images and objects as well as dreams and reality. Hence, it seems crucial to realize activities necessary for art education as a blend of multiple disciplines for more effective learning and teaching. In this regard, Buyurgan and Buyurgan (2012) argue that high-quality art education can be possible with a curriculum responding to the changing conditions and with bridges between different disciplines. "The interdisciplinary approach relies on different fields that make up the infrastructure of the curriculum" (Helvacı & Yılmaz, 2020). This approach also helps to remove the boundaries between the curricula of distinct disciplines while informing the disciplines about the interaction and beneficial exchange among them. Thanks to the interdisciplinary approach, students have the opportunity to increase both their knowledge and motivation (Yarımca, 2011). To back up this, the Higher Education Council of Turkey (YÖK, 2018) divided the undergraduate courses in education faculties into three main categories as Subject Matter Knowledge (SMK), Professional Knowledge of Teaching (PK), and General Knowledge (GK) during the 2018-2019 academic year as a part of restructuring works for increased quality of education. This paved the way for education based on the interdisciplinary approach. In the Teacher Education Undergraduate Programs of YÖK (2018), art courses such as "Museum Education", "Traditional Turkish Handicrafts", "Art and Aesthetics", and "History of Turkish Art" are given as common elective courses in departments of Mathematics Teaching, Science Teaching, Turkish Language

Teaching, Social Studies Teaching, and Classroom Teaching. Learning outcomes of different curricula make it possible for the instructor to prepare activities regarding a variety of disciplines. At the same time, they allow students to notice the interrelationship of distinct disciplines and expand their learning area. The Ministry of National Education (2018a; 2018b; 2018c; 2018d) underlines the importance of creative expression of emotions depending on the competence of "cultural awareness and expression" as a part of the Elementary and Secondary Education Programs. Since creative processes play a central role and require creative thinking in curricula, it is seen that creative processes are effective in developing students' problem-solving skills. Schoevers et al. (2019) emphasize that students need to combine known concepts, skills, and ideas known from mathematics and other fields in a new way to solve the problem. The relationship to be established between art and mathematics contributes to students' producing something new and meaningful by integrating different conceptual systems from both disciplines (Haylock, 1987; Plucker & Zabelina, 2009; Schoevers et al., 2020). Brezovnik (2015) points out that through the integration of art and mathematics, students' intrinsic motivation, visual imagination, and creativity develop in integration with mathematical reasoning. Departing from these thoughts, Arias-Alfonso and Franco (2021) state that efforts have been made to increase the dialogue between art and mathematics in education, and various researches have been carried out on these initiatives over the years.

Considering the curricular relation between art and mathematics, the outcomes of Visual Arts and Mathematics courses in the Elementary Education Program of the Ministry of National Education (MoNE) are interrelated as a sign of the interdisciplinary approach. These two courses at the elementary education level share themes such as "light and shadow", "ratio and proportion", and "golden ratio". Although they fall under the scope of art, these themes can be linked with mathematics and transferred into drawing education applications with an interdisciplinary approach. In addition, by using cubes and geometric objects, it is possible for students to create figure limbs, which will contribute to the development of visual and logical intelligence, through prisms in anatomy drawings. Another relationship that leads to the realization of drawing applications with the interdisciplinary approach is the transfer of portrait drawings to the two-dimensional plane in artistic, aesthetic and emotional terms by sticking to ratio-proportion and golden ratio rules. One of the commonalities of the two disciplines concerns the content of the course of "Drawing" in the undergraduate program of Art Teaching. Topics of "ratio and proportion" and "form and angle" are basically mathematical but they are also covered by the course of drawing. This shows that students can establish a connection with the discipline of mathematics in the process of drawing applications. Thus, it is important for art educators to plan the learning-teaching process from the interdisciplinary perspective, to ensure the permanence of knowledge and to structure the learning environment.

It is thought that target behaviors to be acquired through art education can be achieved faster through the interdisciplinary approach. According to Yarımca (2011), in a course planned with the interdisciplinary approach, students learn how to transfer knowledge and skills from one field to another and apply them to their lives. Deriving inspiration from this idea, the present study was carried out by developing activities which

combine art and mathematics in order to make students active in both the theoretical and practical stages through interdisciplinary art practices. These activities were integrated into the learning-teaching process by associating them with outcomes of visual arts and mathematics courses. The prospective teachers participating in the study were given a comprehensive training on teaching of topics of “cubic forms”, “ratio-proportion”, “golden ratio”, and “prism” as interacting outcomes in the curricula of mathematics and art. It was aimed to compare the students’ perspectives and motivation levels regarding drawing education and instruction before and after implementing interdisciplinary art practices drawing upon the relationship between art and mathematics.

METHOD

Research Model

This study was conducted in embedded design as a type of mixed methods research blending quantitative and qualitative research approaches. This model allows collecting quantitative data before, during and after the research by adding a qualitative stage to the quantitative stage (Creswell & Plano Clark, 2015). In the current study, the quantitative data collection method was supported by embedding the qualitative method as it was designed as an experimental study.

Study Group

The study group consists of 10 students (9 females, 1 male) enrolled in the 1st grade of Art Teaching Department under the Education Faculty of a state university. The participants were selected among students who were taking the course "Drawing-I" for the first time during the fall semester of the 2020-2021 academic year.

Data Collection Tools

Drawing Motivation Questionnaire

In the study, quantitative data were collected by means of the “Science Motivation Questionnaire” developed by Glynn et al. (2007), revised by Glynn et al. (2009), adapted to Turkish by Yıldırım and Yılmaz (2012). The instrument was used after being revised for the “Drawing” course. The questionnaire included six factors: “Intrinsic Motivation (1, 12, 16, 22)”, “Extrinsic Motivation (3, 6, 11)”, “Personal Relevance (2, 9, 14, 17, 19)”, “Self-Determination (7, 8, 20)”, “Self-Efficacy (15, 18, 21)” and “Assessment Anxiety (4, 5, 10, 13)”. In the questionnaire, the responses were listed in 5-item rating as “Never”, “Rarely”, “Sometimes”, “Usually” and “Always”. The items under the factor of "Assessment Anxiety" were reverse coded as they were negative items. After the instrument was adapted to a specific undergraduate course, that is “Drawing”, its validity was checked with “Confirmatory Factor Analysis (CFA)” by administering it to a sample of 132 people. The fit indices obtained from the CFA are shown in Table 1.

Table 1. *Fit Statistics from Confirmatory Factor Analysis*

Fit Index	Fit Measures	Motivation		Source
		Value	Level	
x^2/df	0≤x^2/df ≤2	1,927	Excellent	Kline, 2005
CFI	,90 ≤ CFI ≤ ,95	,906	Acceptable	Bentler, 1980
RMSEA	0,05≤RMSEA≤0,08	,084	Acceptable	Browne & Cudeck, 1992
SRMR	0,05≤SRMR≤0,10	,079	Acceptable	Browne & Cudeck, 1992

According to Table 1, the value of x^2/df (=1,927) below 2 indicates perfect fit, while the other values imply that the questionnaire has an acceptable fit.

Semi-Structured Interview Form

A semi-structured interview form was prepared by the researchers and used in order to expose the contribution of interdisciplinary art practices in drawing education to the artistic development of pre-service teachers and the change in pre-service teachers' perspective of the importance and necessity of interdisciplinary interaction.

Self-Assessment Form

In order to determine the effects of the activities carried out within the scope of interdisciplinary art practices in drawing instruction on the knowledge, skills, and motivation levels of prospective teachers, the "Self-Assessment Form" of Demirel and Buyurgan (2017) was used in this study.

Data Analysis

Analysis of Quantitative Data

The skewness and kurtosis coefficients were calculated to check the normality distribution of the Drawing Motivation Questionnaire scores. According to Seçer (2013), the skewness and kurtosis values in the data set in the range of ±2 represent normally distributed data. Table 2 demonstrates that the scores obtained from the data collection tool have a normal distribution.

Table 2. Conformity of the Data with Normal Distribution

Factor		N	Mean	SS	Skewness	Kurtosis
Pre-Test	Intrinsic Motivation	10	3.30	.421	-.215	.565
	Extrinsic Motivation	10	3.56	.353	-.659	-.406
	Personal Relevance	10	3.44	.539	-1.154	.496
	Self-Determination	10	3.26	.583	-1.173	1.441
	Self-Efficacy	10	3.46	.476	-.319	-1.163
	Assessment Anxiety	10	2.80	.537	-.070	.074
Post-Test	Intrinsic Motivation	10	4.65	.428	-1.042	.584
	Extrinsic Motivation	10	4.60	.344	-.272	-.896
	Personal Relevance	10	4.52	.214	-.322	-.882
	Self-Determination	10	4.53	.476	-.821	-.662
	Self-Efficacy	10	4.40	.716	-1.161	.344
	Assessment Anxiety	10	3.27	.740	-.121	-.218

As can be understood from Table 2, the scores obtained from the sub-factors of the Drawing Motivation Questionnaire showed a normal distribution. Therefore, the data were analyzed by using t-test.

Table 3. Questionnaire Score Interval

Rating	Score	Score Interval
Never	1	1.00-1.79
Rarely	2	1.80-2.59
Sometimes	3	2.60-3.39
Usually	4	3.40-4.19
Always	5	4.20-5.00

The scores from the sub-factors of the Drawing Motivation Questionnaire were interpreted within the score intervals shown in Table 3.

Analysis of Qualitative Data

The qualitative data in this research were analyzed by using content analysis. Content analysis is particularly preferred in social sciences and accepted as one of the important techniques. It is a systematic technique in which specific words in a text are summarized by category together with coding made according to certain rules (Büyüköztürk et al., 2015). In this technique, data analysis is completed in four stages: (1) coding the data, (2) eliciting themes, (3) organizing the codes and themes, (4) eliciting and interpreting findings (Yıldırım & Şimşek, 2018). Within this framework, in the first place, the students' views on the interdisciplinary art practices in drawing instruction were analyzed to identify codes. In the second stage, that is eliciting themes, the codes were collapsed into themes reflecting the main ideas. Then, the data were put into categories each of which represents a group of study themes. Third, the codes and themes were revised by defining the available data around certain phenomena. During this stage, the data were presented after being processed without adding any opinions or comments. Finally, during the interpretation of the findings, the respondents were renamed as Ö1, Ö2, Ö3… and the themes in the corresponding categories were interpreted and justified based on the responses in the interview form. In order to ensure reliability during analysis, the study data were analyzed independently by the researchers and the coefficient of concordance between the encoders was calculated. The individual encoders' pairing of relevant codes and themes was compared, and the reliability of the analyses was calculated by using Miles and Huberman's (1994) formula "reliability = (consensus/consensus + disagreement) x 100". It was seen that only two of the themes were associated with divergent categories by the encoders. The overall reliability was calculated as 94%. Miles and Huberman (1994) posit that a reliability rate of and above 70% is sufficient.

Experimental Process

Practical activities in this study served to determine the effect of interdisciplinary artistic and mathematical practices on students' drawing works. They were planned for to a total of four (4) weeks, three (3) hours a week. In preparation of the activities, the outcomes of the Elementary Visual Arts (MEB, 2018a) and

Mathematics courses (MEB, 2018b) were followed for the purpose of achieving interdisciplinary interaction. The applied activities and the target outcomes are listed in Table 4 below.

Table 4. Activities and Target Outcomes in Interdisciplinary Art Practices for Drawing Instruction

Week	Activity	Discipline	Grade	Target outcome
1	From Patterns to Light and Shadow	Visual Arts	8	**a.** (The learner) reflects different perspectives in his observational drawings.
		Mathematics	7	**b.** Examines real-life situations and judges if two quantities are proportional. • It is emphasized that the equality of two ratios is called proportion. • Directly proportional quantities are taught.
2	You Golden, Me Rule	Visual Arts	7	**a.** Makes observational drawings.
		Mathematics	7	**b.** Examines real-life situations and judges it two quantities are proportional. • It is emphasized that the equality of two ratios is called proportion. • Directly proportional quantities are taught.
3	Don't Stop, Take Action!	Visual Arts	7	**a**. Narrates any moment of his life and reflects it to his visual art work.
		Mathematics	7	**b**. Creates structures based on drawings representing their look from different directions. • Structures made of identical cubes and most common geometric objects are used. Isometric paper can be used to draw structures made of identical cubes.
4	How Would You Like It to Be?	Visual Arts	7	**a**. Recognizes the artist's style as reflected in visual art works.
		Mathematics	7	**b.** Recognizes right prisms and locates their basic elements and constructs, and draws their expansion. • Works are performed on concrete models.

Within the scope of the activity titled "From Patterns to Light and Shadow", the subject matter content and its relation with mathematics were conveyed to the students by using methods and techniques of narration, discussion, question and answer, and practice. First, a theoretical presentation was made to the students. Then, they practiced still-life painting so that they could comprehend the relation between the mathematical achievements of art-specific concepts such as composition, ratio-proportion, foreground and background harmony in objects, texture, and light and shadow. The second main activity, "You Golden, Me Rule" was implemented during Week 2. This activity was based on Leonardo da Vinci's "Vitruvian Man" and it was aimed at helping students acquire comprehensive knowledge of model (anatomy) drawing (portrait, hand, arm, leg, foot), recognize the body while conveying the visible, and learn how to draw balance and harmony in an aesthetic order with respect to ratio and proportion. During the implementation, the posture of the Vitruvian Man was imitated by one of the students in the learning environment. The Vitruvian Man was demonstrated to train students about anatomical measures and rules. The purpose was to make the students draw the live model by considering ratio and proportion. The next practical activity, "Don't Stop, Take Action!", was implemented in order to transfer a three-dimensional model to a two-dimensional plane. Before moving on to model drawing phase, the students were given cards with names of different movement actions written on them. Each student was supposed to build up a sentence by using the name of the movement action on their card so that the live model could imitate the movement action described. Once the model acted out the

movement, the students instantly made anatomical drawings in cubic form. Finally, the cubic drawings were revised for giving better shapes. The last activity on the study, “How Would You Like It to Be?”, was implemented by instructing the students to paint any person (mother, father, sibling, etc.) or a portrait in their dreams by prioritizing sense of aesthetics. Here, unlike usual portrait drawings, the students were expected to paint a real or imaginary figure with the outlook they imagine. For guidance, a debate was first held on Albert Dürer's "Portrait of His Mother" as it depicts emotions from an aesthetic and artistic perspective. The mentioned art work was discussed by referring to perspective, ratio-proportion, line values and meanings in the expression of the portrait.

FINDINGS

In the quantitative part of the research, the pre-test and post-test scores from the Drawing Motivation Questionnaire were compared to find out the difference, if any, between the students’ motivation levels regarding drawing education and instruction before and after interdisciplinary art practices. The t-test results obtained from the pre-test and post-test scores are presented in Table 5.

Table 5. T-Test Results of Prospective Teachers’ Pre-Post Test Scores

Motivation	Measure	N	$\overline{X}$	S	sd	t	p
Intrinsic motivation	Pre-test	10	3.30	.421	9	-6.194	.000*
	Post-test	10	4.65	.428			
Extrinsic motivation	Pre-test	10	3.56	.353	9	-8.188	.000*
	Post-test	10	4.60	.344			
Personal relevance	Pre-test	10	3.44	.539	9	-6.021	.000*
	Post-test	10	4.52	.214			
Self-determination	Pre-test	10	3.26	.583	9	-4.520	.001*
	Post-test	10	4.53	.476			
Self-efficacy	Pre-test	10	3.46	.476	9	-3.184	.011*
	Post-test	10	4.40	.716			
Assessment anxiety	Pre-test	10	2.80	.537	9	-1.639	.136
	Post-test	10	3.27	.740			

*p<.05

Table 5 shows that there was a significant (p<.05) variance between the pre-test and post-test mean scores under five of the sub-factors: "intrinsic motivation", "extrinsic motivation", "personal relevance", "self-determination" and "self-efficacy". The last sub-factor, "assessment anxiety", consisted of reverse coded items and yielded no significant difference between the pre-test and post-test. This implies that the students’ motivation level increased after the training on drawing education but their anxiety about the applied drawing exam was not eliminated. Evidence can be borrowed from the statistics in the table above. According to the score intervals in Table 4, the assessment anxiety ($\overline{X}$ = 2.80) and post-test ($\overline{X}$ = 3.27) means corresponded to a value meaning "sometimes", and the mean score went up in the post-test. It can be inferred that even though the level of motivation increased in applied exams, the anxiety level also increased because of assessment psychology as their knowledge was boosted by the training given. On the other hand, while the sub-factor “self-determination” corresponded to “sometimes” in the pre-test ($\overline{X}$ = 3.26), this value increased to “always” ($\overline{X}$ = 4.53) in the post-test. Except for assessment anxiety, the pre-test scores in all other sub-factors were found

to correspond to a frequency as high as "generally" and post-test scores were increased to “always”. Under another sub-factor of motivation, that is “self-determination”, there were statements such as “*I make enough effort to learn topics about drawing*”, “*I use ways that help me to learn drawing well*”, and “*I prepare well for drawing exams and workshop practices*”. In this sub-factor, the students' motivation levels showed a higher increase than other sub-factors which concern motivation levels such as success, content, and learning. Hence, it can be suggested that the content, activities, and practices of interdisciplinary art practices teaching art-mathematics relation in drawing instruction have a positive effect on the motivation levels of the students. Yet technique, knowledge, and skill development inevitably increased aesthetic concerns and hence students reported assessment anxiety in applied courses, which caused increased anxiety due to the psychology of assessment.

Table 6. Students’ Views on Interdisciplinary Interaction for Drawing Instruction

Category	Theme	Respondent
Interdisciplinary Interaction	Associating art with other school subjects (science, mathematics)	Ö1, Ö2, Ö3, Ö4, Ö5, Ö6, Ö7, Ö8, Ö9
	Establishing relationship between outcomes (of distinct fields)	Ö1, Ö4, Ö8
	Interaction between distinct art fields (sculpture)	Ö1, Ö2
	Relation of art and medicine (aesthetics)	Ö1
Structure of Drawing	Principles and elements of visual design	Ö1, Ö2, Ö3, Ö4, Ö5, Ö6, Ö7, Ö8, Ö9, Ö10
	Drawing techniques	Ö1, Ö2, Ö3, Ö4, Ö5, Ö6, Ö7, Ö8, Ö9, Ö10
	Perspective	Ö1, Ö3, Ö4, Ö6, Ö7, Ö9, Ö10
	Ability to transfer to two-dimensional plane	Ö1, Ö3, Ö5, Ö7, Ö9, Ö10
	Development of drawing	Ö1, Ö2, Ö3, Ö4, Ö5, Ö7
	Design and three-dimensionality	Ö3
Model and Anatomy	Rapid drawing	Ö1, Ö2, Ö3, Ö4, Ö6, Ö7, Ö8, Ö9, Ö10
	Learning to see	Ö1, Ö2, Ö5, Ö6, Ö7, Ö8, Ö9
	Visual perception	Ö1, Ö3, Ö6, Ö8 Ö2, Ö7, Ö9
	Observing the model in different postures	Ö1, Ö2, Ö4, Ö6, Ö7, Ö8
	Aesthetic integrity	Ö2, Ö3, Ö4, Ö5, Ö6, Ö7
	Noticing details	Ö1, Ö2, Ö4, Ö8, Ö9
	Aesthetic expression	Ö1, Ö3, Ö6, Ö8
	Learning to look	Ö5, Ö7, Ö9
	Ideal reality	Ö1, Ö6, Ö8
Personal development	Developing one’s point of view	Ö2, Ö3, Ö5, Ö6, Ö7, Ö8
	Expression of emotions	Ö1, Ö3, Ö7
	Development of hand skill	Ö1, Ö3
	Authenticity	Ö3, Ö8
	Being open to development	Ö6, Ö7
	Artistic creation	Ö2
	Stylistic development	Ö3
	Evolution of dream world	Ö3
Learning-Teaching Process	Artistic development	Ö1, Ö3, Ö4, Ö5, Ö6, Ö7, Ö8, Ö9
	Start of artistic effort	Ö4, Ö6, Ö9, Ö10
	Art criticism	Ö4, Ö5, Ö6
	Effective learning	Ö2
	Activity-based instruction	Ö1
	Relating art to everyday life	Ö4
	Facilitating learning in other lessons	Ö9
	Making other lessons interesting	Ö9

As seen in Table 6, the analysis of the prospective art teachers' views about the interdisciplinary interaction in drawing instruction yielded five (5) distinct categories as "interdisciplinary interaction", "structure of drawing", "model and anatomy", "personal development", and "learning-teaching process".

To start with, under the category "interdisciplinary interaction", the respondents associated interdisciplinary art practices in drawing instruction with other school subjects like science and mathematics (9), establishing relationship between outcomes of distinct fields (3), interaction between distinct art fields (sculpture) (2), and relation of art and medicine (aesthetics). When the related themes were examined, it was noticed that the interdisciplinary art practices in drawing education could improve the participants' consciousness and awareness about associating drawing education with different disciplines. As regards to benefits of the interdisciplinary approach, it was found that the prospective teachers associated drawing education with disciplines such as mathematics and science as a result of the instruction and particularly the practical activities performed (f=9). In support of this finding, the view of the respondent named Ö1 was as follows: *"… We can adapt the art activities in the Drawing class to other disciplines. …to exemplify, the doctor of aesthetics should benefit from courses such as drawing and basic design.*" The respondent placed emphasis on the probable relation between disiplines of art and medicine. Another respondent, Ö6, also said, "*…I believe it can be very effective in teaching the human body in science classes.*" Morover, Ö8 said, "*…I learned how to translate an existing mathematics topic into drawing*". This suggests that the participants' level of consciousness and awareness towards interdisciplinary art practices increased thanks to the practical instruction here. Furthermore, Ö4 expressed their view as, "*With the interdisciplinary approach, I learned to take measurements on the model by applying ratio and proportion, and I learned the proportions of the body parts to each other and I learned that the length between two arms is equal to our height when we open the arms to the sides*." It is understood that this respondent learned the concepts of "proportion" and "ratio-proportion" during the interdisciplinary art-mathematics practices and it had an effect on composition and arrangement regarding the structure of drawing. This effect manifested itself on the respondent's artistic works. Secondly, regarding the theme "establishing relationship between outcomes (of distinct fields)", it was found out that the prospective teachers paid attention to the overlapping outcomes of art and mathematics subjects in drawing applications and they could benefit from the drawing practices for reflecting the emotional aspect (f=3). In this regard, the participant named Ö8 stated the following: "*Thanks to the facial shape, reflecting the emotions, the proportions of the face, the way of drawing, and mathematical achievements in portrait drawing, I improved myself by ensuring ratio and proportion in a portrait and depicting the intended emotions in the face in a portrait*." It can be inferred from the quotation above that covering certain concepts like ratio and proportion and emotional transference in portrait drawing led to improved cognitive, affective, and artistic skills in the scope of drawing practices. Likewise, Ö4 said, "*Interpreting the artist's style reflected in the work of art in the visual art piece. As a maths outcome, we got to recognize right prisms. These right prisms guide works with concrete models. We interpreted the Portrait of His Mother by Albert Dürer."* As a result of interactions between art and mathematics outcomes, the intersection of outcomes from distinct disciplines were beneficial in drawing

practices in terms of adding emotions and interpretation and stylistic development through the concepts “painting and interpretation”, “painting and mathematics”, and “artistic development”.

Secondly, the participants’ views regarding “Structure of Drawing” was related to the following themes: principles and elements of visual design (10), drawing techniques (10), perspective (7), ability to transfer to two-dimensional plane (6), development of drawing (6), and design and three-dimensionality (1). When the related themes were examined, it was seen that the interdisciplinary art and mathematics activities proved beneficial for the prospective teachers in particular connection with artistic skills and competence in drawing education. As a result of the practical activities performed for interdisciplinary drawing education, the prospective teachers agreed that they could improve themselves in visual design principles and elements (f=10) and drawing techniques (f=10), which constitute the basis of artistic process. For instance, Ö7 said, “*We learned about light and shadow, form harmony, horizon line and giving shapes from cubic prisms*.” It was stressed that the interdisciplinary approach had a favourable effect on the artistic process in terms of conveying what is visible and developing the design process by highlighting the concepts such as "light-shadow", "shape", and "form" in design. In a similar vein, Ö9 said, *“…I learned to use ratio and proportion better. With perspective, I learned how things and objects look from afar and how I must draw them. This, in return, contributed to how I should look at the outlook of objects in my drawings and how I should draw. It helped me distinguish between light and shadow colors.”* Like the previous respondent, Ö9 meant that they were able to gain experience and skills concerning design principles and elements that are important in drawings by emphasizing the importance of "ratio-proportion", "light-shadow", and "color". Under another theme, “drawing techniques”, all of the participant prospective teachers stated that the original topics of mathematics and art (ratio-proportion, prisms, cube drawing) were employed in the drawings through the interdisciplinary practical activities, enhancing their development of drawing and techniques. It was also found out that the activities based on mathematics and art outcomes brought significant improvements to the participants in terms of line value and technical development as the fundamentals of drawing. In the same direction, Ö1 said, *“I learned to obtain smoother, more beautiful, more proportional lines by placing the contours of our models into a cube. And that helped me a lot. I learned that I can extract any model product drawing from the cube*.” Underlining the concepts of “cubic drawing” and “proportional drawing”, the respondent explained that their artistic cognition improved in the context of art and mathematics relation. Under the next theme, “perspective”, it was found out that the majority of the participants improved their perspective perceptions in model drawings and they acquired technical skills for drawing in a given angle thanks to the activities planned with the interdisciplinary approach. Similarly, Ö6 expressed views by saying *“We learned that interdisciplinary knowledge is important in art and that we will need to use numerical information at times. We learned how to locate the horizon line, learned about positions of objects relative to each other and many dimensions of them, and learned how to interpret them based on perspective.”* It can be inferred that departing from the necessity to use interdisciplinary art and numerical information, the respondent thinks that relevant concepts such as “art and mathematics" relation and “perspective” by referring to their effective role in drawings.

Thirdly, under the category "Model and Anatomy" concerning the benefits of the interdisciplinary approach, the participants' views were found to touch 9 different themes: rapid drawing (9), learning to see (7), visual perception (7), observing the model in different postures (6), aesthetic integrity (6), noticing details (5), aesthetic expression (4), learning to look (3), and ideal reality (3). The themes showed that thanks to the interdisciplinary art practices, the participants were able to become more competent in drawing rapidly or instantly and in noticing details on models or different compositions by learning to see. It was found out that the participants' shared opinions about rapid drawing (f=9), learning to see (f=7), and observing the model in different postures (f=7) clearly revealed the competencies promoted by the instruction performed with the interdisciplinary approach. In relation with the first theme in this category, "rapid drawing", the respondents were found to think that they were able to make better rapid drawings and this made them more skilled at drawing (f=9) thanks to the interdisciplinary teaching of art and mathematics. As an example, Ö5 said, *"We learned to make cubic drawings, to locate the outlines of objects that frequently change their posture and to draw a sketch*." In other words, artistic development was gained for drawing sketches by creating the outline of cubic drawings and objects in rapid drawing as a favourable result of the connection between art and mathematics. In parallel, Ö8 reported their experience by saying, *"We learned to produce more proportional drawings through prism and cubic drawing. We learned how to draw figures comfortably and more proportionally with rapid model drawing. Different postures contributed a lot to being able to depict the movements."* It was found that the interdisciplinary applied activities benefited the participants particularly in obtaining proportional drawings from prisms and cubic drawings, drawing models rapidly and comfortably, and drawing extraordinary postures and movements with better proportion. The next theme, "learning to see", revealed that most of the respondents appreciated the interdisciplinary instructional activities for the learning outcomes such as transferring the model properties to the two-dimensional plane and promoting drawing skills (f=7). As an example, Ö10 described the positive outcome by saying, *"It helped to capture and draw the instant movements*." It can be inferred that the interdisciplinary activities improved the beneficiaries' seeing skills by means of capturing the details in (model) drawing and the ability of capturing the instant movements enhanced hand-eye coordination. In relation with another theme, "aesthetic integrity," it was found out that the participants stated that the interdisciplinary practical activities fostered their aesthetic skills and points of view (f=6). In this respect, Ö5 said the following: "*We learned the subtleties of portrait drawing, how to take measurements, and techniques for maintaining the balance between the eyes, nose, ears, lips and eyebrows. We excelled this knowledge by examining how an artist painted his mother."* The respondent was seen to stress the importance of the art and mathematics outcomes such as examining objects and maintaining the balance between the existing elements in a composition by referring to the drawing-related concepts of "measurement" and "part-whole relation".

Fourthly, the category "Personal Development" aspect of the prospective teachers yielded the themes of developing one's point of view (6), expression of emotions (3), development of hand skill (2), authenticity (2), being open to development (2), artistic creation (1), stylistic development (1), and evolution of dream world

(1). It was seen that the interdisciplinary instructional activities chiefly improved the prospective teachers' affective and expressive skills. As the first affiliated theme, the majority of pre-service teachers were found to refer to developing one's point of view. There was a consensus among the respondents (f=6) that they developed their points of view as a result of the interdisciplinary instructional activities. In this regard, Ö5 said, *"It allowed me to learn how to address the drawing from the point of view of the sitting human being and learn the shape in the point of view*." They pointed out that the drawing education based on the interdisciplinary relations developed their artistic point of view. In the same sence, Ö2 said, *"…Because it allows us to see objects better and to improve our point of view. It allows lines to switch from a rigid use to a smoother use so we end up with the outcome of being able to design the shapes as we want."* The respondent described the contribution of the interdisciplinary drawing education to their artistic expressions through seeing objects better and gaining design skills thanks to the instruction using the relationship between art and mathematics. As the second theme, "expression of emotions", was examined, it was seen that the respondents mentioned favourable effects of the interdisciplinary activities on "expression" (f=3). Concerning the drawing education carried out in this study, the respondent named Ö7 noted the following: *"We learned that the actual image can take up a different dimension in (art) works by reflecting the past experiences and current feelings on the drawings, and we learned the rules of golden ratio of the face."* As can be inferred from the direct quotation, emphasis was placed on some key concepts like "golden ratio", "painting and emotion" and "development of drawing". In this respect, it was seen that drawing education based on the interdisciplinary approach affected the artistic and emotional expression of the participant teacher candidates in a positive way.

As the last category, detailed analysis of "Learning-Teaching Process" showed that the respondents shared their views on the contributions of the interdisciplinary practices in connection with a number of themes: artistic development (8), start of artistic effort (4), art criticism (3), effective learning (1), activity-based instruction (1), relating art to everyday life (1), facilitating learning in other lessons (1), and making other lessons interesting (1). More specifically, the theme of artistic development demonstrated that the majority of the participants believe that the interdisciplinary drawing education contributed to their artistic development (f=8). For example, the respondent called Ö3 said, *"We learned cubic drawings. We learned the instant drawings quickly. We learned to draw the angles of movements on the model in cubic form. We went over dark, medium and light tones."* It was found out that the role played by the interdisciplinary art activities in artistic practices such as "cubic drawings", "instant drawings", and "shading". Similarly, Ö4 noted the following: *"I was able to see more clearly the points that I could not otherwise see in perspective and I corrected my mistakes and was able to fit the objects better."* It was understood that the use of perspective led to an improvement in techniques and lines for drawings thanks to the interdisciplinary instruction. Next, the theme "start of artistic effort" revealed that the training allowed the beneficiaries to solve the problems during the drawing process as well as developing self-confidence in the artistic process (f=4). Likewise, Ö9 expressed their views by saying, *"While I used to worry about how to put this on paper at the beginning of the term, now I can at least attempt*

to create a draft." It can be seen that the participant referred to the performed drawing education process as a means of advancement of their artistic development.

CONCLUSION and DISCUSSION

In this research, an instructional training was planned and run by paying regard to the relationship between art and mathematics in an interdisciplinary context. The aim of the training was two-folds: to identify students' viewpoints of drawing education and instruction through interdisciplinary art practices and to tell if there was a significant difference between the participants' motivation levels before and after the training. To this end, collected qualitative data were analyzed and it was concluded that the students' scores were significantly higher in five out of six sub-factors of the Drawing Motivation Questionnaire ($p<.05$) during the post-test. These sub-factors were "intrinsic motivation", "extrinsic motivation", "personal relevance", "self-determination" and "self-efficacy". The remaining sub-scale, "assessment anxiety", exhibited no significant difference between the pre and post-test. Unlike the others, this dimension of the questionnaire consisted of reversely coded items due to the negative wording of the statements. The drawing education and the instruction was carried out in an integrated manner combining the common outcomes of the disciplines of art and mathematics with an eye to improve students' techniques and skills. It is obvious that the interdisciplinary art practices (art and mathematics) in drawing instruction successfully affected the motivation of students in their learning processes and thus the students felt competent in cognitive and affective aspects during the implementation. However, no significant difference was measured in assessment anxiety, and the individuals' anxiety about applied drawing exams did not come to an end. Seval and Cavide (2018) implemented an active learning process by integrating Turkish, science, mathematics and social studies courses into art lessons and found out that the students' self-confidence increased in the learning process and a more fun learning environment was enjoyed. Considering the importance of the interdisciplinary approach in education, Özçelik and Semerci (2016) concluded in their study that interdisciplinary activities increased the participant students' problem solving skills and academic achievements. Also, Nalbur (2021) conducted a study to improve students' self-confidence skills through interdisciplinary art education. She found that students could have higher self-confidence thanks to the interdisciplinary art education. Schoevers et al. (2020) used the MACE program (Mathematics, Arts, and Creativity in Education) to examine its effects on students' geometry and visual arts skills in an interdisciplinary context. It was found that the geometric perception skills of the students who took the course with the MACE program experienced considerable improvement in geometic perception skills in a visual art work compared to the control group. In summary, it can be contended that the existing literature support the present study in that the interdisciplinary instruction process increased the students' self-confidence, improved their cognitive and affective status, and helped them to generate practical solutions in applied settings. Therefore, it seems necessary to carry out an instruction process based on the interdisciplinary approach in order to support interdisciplinary drawing practices with the overlapping outcomes of art and mathematics, to increase prospective teachers' self-confidence and intrinsic and extrinsic motivation for the learning process, and to make sure they have mastery of both theory and practice.

Apart from the quantitative dimension, the analysis of the qualitative study data demonstrated that the interdisciplinary drawing practices were influential for visual arts teacher candidates' acquiring certain skills such as associating art with other courses, improving in techniques and methods at applied stages, fostering their visual skills, and using elements and principles of art in creating an art work. It can thus be argued that the instructional activities in the interdisciplinary art syllabus benefitted the students in terms of motivation in learning and teaching process, active participation, improvement in cognitive and affective personal skills, and internalization of the interdisciplinary teaching process. Comparison of the results of the qualitative and quantitative data shows that the participants in this study progressed in interdisciplinary interaction in drawing practices, model and anatomy, structure of drawing, and personal development besides other assets including self-confidence in drawing practices, self-skills, and motivation as a result of the interdisciplinary art practices. These findings are backed up by Şimşek (2018), who noted that students learn to establish relationships between disciplines by gaining different perspectives on existing topics thanks to interdisciplinary teaching methods and activities and that the topics and learning process can become more fun and interesting for students if independent courses are associated with each other through an interdisciplinary lense.

As another main finding, the students' impression of the interdisciplinary art practices in drawing education was analyzed in association with the structure of drawing. It was found that the students developed a set of skills including using visual design principles and elements in drawing practices, developing drawing techniques, and the ability to perceive perspective, transfer the visible to the two-dimensional plane and experiencing development of drawing. This shows that the students could gain consciousness of artistic skills thanks to the interdisciplinary learning process. Similarly, Özdemir et al., (2015) carried out a study to expose the effectiveness of practices based on an interdisciplinary approach by using painting and music in the teaching of basic art elements. They concluded that interdisciplinary experimental methods, rather than traditional learning methods, had a significant effect on the learning process of students. In the same way, Özay Köse (2016), in her research on challenges encountered in interdisciplinary teaching process and the role of the interdisciplinary teaching process in overcoming them, observed an increase in the students' academic achievement levels, motivation in the teaching process, and attitudes towards the lesson. The present study seems to be in compliance with the previous research regarding the desireable results of activities inspired by the interdisciplinary approach in favor or learners since the students' progress in the drawing process emerges as the product of the motivation and attitude derived from the activities based on the interdisciplinary approach. In the current research, another view on interdisciplinary art practices was found to be associated with the category of model and anatomy. It was observed that the interdisciplinary activities had a positive effect on the students' artistic skills, particularly on rapid drawings, learning to see, visual perception, observing the model in different postures, aesthetic integrity, noticing details, and aesthetic expression. In this regard, Kayahan and Çevik (2020), in their study discussing Ceramic and Print Painting courses in an interdisciplinary context, intended to examine the students' artistic improvement and creativity levels. They concluded that the students became successful in selected outcomes of distinct fields such as the ability to use different materials

together, produce authentic creative products, and introduce a new individual perspective thanks to the interdisciplinary approach process. Another study was conducted by Pazarlıoğlu Bingöl (2015) on students in fine arts faculty to understand the role of literature in Drawing course. Again, the interdisciplinary approach was adopted, and it was found that the students could find the opportunity to freely express their ideas, deliver creative solutions in the face of problems, achieve authentic designs, and use various techniques in the drawing process. On the ground of the foregoing, the present findings seem to be in congruence with the past research owing to the interdisciplinary instructional activities' contribution to the students' artistic faculties and development of an aesthetic view point.

Another noteworthy finding is about the students' personal development in Drawing course as a result of the interdisciplinary art practices. To be more specific, the teaching activities used in this study expanded the students' points of view, gave them the chance for emotional expression, and improved their hand skill and authenticity. Kavuran (2005), in his study aiming to identify the problems encountered in the implementation of Drawing course offered in education faculties, concluded that there are deficiencies regarding weekly lesson hours, the content of the course, and implementation of the course content. These deficiencies were reported to gradually result in an unfavorable, passive art education based on rotten learning. By looking at these research findings, it can be claimed that interdisciplinary practices need to be sustained to make sure that students can assume an active participatory role in Drawing course and experience personal growth. As suggested by the qualitative data analysis of the participants' views, another strength of the interdisciplinary art practices was related with the category of learning-teaching process. As far as the themes falling under this category suggest, the interdisciplinary activities in this study taught students many skills such as artistic development, start of artistic effort, art criticism, effective learning, activity-based instruction, relating art with everyday life, facilitating learning with other lessons, and making other lessons interestin. According to Jones (2009), the interdisciplinary approach has become an important technique in the modern curriculum as it synthesizes several disciplines, enriches the overall education experiences of the teacher and the student, and holds a crucial status for students' life-long learning. For this reason, in order to ensure the holistic development of art education students, it seems that the teaching curricula and in-class activities need to be associated with different disciplines, and permanence of knowledge needs to be ensured in theory and practice through overlapping outcomes.

RECOMMENDATIONS

- It is deemed necessary to adopt the interdisciplinary approach in order to increase the contribution of Drawing course applications in Art Teaching department to the artistic development of the students, to ensure the permanence of the theoretical knowledge, to develop the students' problem solving skills and practical intelligence, and to discover their individual talents in the drawing process. By building a bridge between Drawing course and the target outcomes of other disciplines, especially through interdisciplinary art practices, it is thought that students' active participation in the learning

process can be achieved, their self-confidence in drawing can be increased, and diverse methods and techniques can be used in the lessons.

- Also, interdisciplinary activities should be diversified in order to teach students the content and objectives of "Drawing-I" course in Art Teaching Undergraduate Program. At this point, new interdisciplinary activities should be proposed to integrate the outcomes of art and other disciplines outside mathematics.
- For the success of outcome-based activities aided by cognitive skills, students should be given the opportunity to prepare activities based on the interdisciplinary approach and thus to ensure the permanence of knowledge. To achieve this goal, art practices based on the interdisciplinary approach should be actively used in order to train pre-service teachers who can analyze, think and produce creative ideas in practice, not only in theory.
- It is thought that instructional activities are vital in reaching the goal of drawing education, which is accepted as the basis of visual arts. Hence, lesson plans should be prepared for real use through an interdisciplinary point of view. Bearing this in mind, academicians should take into account the interdisciplinary approach so that learner motivation can be maintained in teacher training institutions along with elevating skills of self-confidence, self-efficacy, personal development and artistic development to upper levels.
- Artistic expressions should be used by academicians as a part of in-class activities to increase student motivation and self-confidence. This attempt seems important for minimizing assessment anxiety.

ETHICAL TEXT

In this article, the journal writing rules, publication principles, research and publication ethics, and journal ethical rules were followed. The responsibility belongs to the authors for any violations that may arise regarding the article. Ethical approval was granted by Recep Tayyip Erdogan University/Social and Human Sciences Ethics Board with the decision dated 16.11.2021 and numbered session and issue number 2021-242."

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