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Exploring the Potential of Art Workshop: An Attempt to Foster People's Creativity in an Online Environment

Daichi Shimizu, **Ibuki Yomogida**, **Wang Shijun**, and **Takeshi Okada**

Graduate School of Education, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-8654, Japan

ABSTRACT

Recently, the importance of creativity in society has been clearly recognized. Furthermore, educational practices through art, such as the STEAM paradigm, are being implemented gradually. However, the framework of how creativity should be fostered through art has not been sufficiently discussed. Based on studies of artists' creative expertise, this study proposed a framework for fostering creativity through art. In addition, we conducted a year-long art program based on this framework in an online environment and investigated its effects. As a framework, we proposed the importance of long-term support for the dynamic development of participants' creativity. We mainly focused on the following four components: active interaction with objects and the environment through bodily action, active interaction with others and their works (inspiration), exploration in creative processes (exploration), and promotion of intrinsic motivation and decrease in creativity anxiety (motivation). After a total of eight workshops over a year, we observed improvements in the participants' creativity anxiety, divergent thinking skills, images of art and creation, and openness to others. We discussed the effectiveness of the proposed framework and the advantages and limitations of using an online environment.

KEYWORDS:

creativity; creativity facilitation; STEAM; online environment; educational effect

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Corresponding author at:

Daichi Shimizu
E-MAIL: tothefuture0415@yahoo.co.jp

INTRODUCTION

Recently, the importance of creativity—the ability to generate something with new values and qualities—has been clearly recognized. In addition, fostering creativity has become an urgent need for society and education. This study thus proposed a framework for an online art workshop program to foster creativity. We also reported detailed contents and effects of the program implemented over a year.

The importance of fostering creativity has been strongly advocated worldwide. For example, the framework for Education 2030 of Organisation for Economic Co-operation and Development (OECD) suggests the importance of fostering creativity through education to develop our society (OECD, 2018). A similar suggestion was mentioned in a declaration by the White House (2013). Furthermore, sociologists and economists cited quantitative data and argued the importance of having a large Creative Class (people involved in jobs producing new values) for the future development of societies and cities (Florida, 2002; Florida & Florida, 2005; McGranahan & Wojan, 2007; Wojan, Lambert, & McGranahan, 2007). Among various domains, art is considered one of the most representative domains of creativity (e.g., Getzels & Csikszentmihayli, 1976; Okada, Yokochi, Ishibashi, & Ueda, 2009), and its importance in fostering creativity in other domains such as science has been pointed out (e.g., Root-Bernstein et al., 2008).

Based on these claims, this study aims to develop a framework for art programs to foster creativity. To do so, the STEAM education paradigm seems to serve as a useful framework. The STEAM paradigm, an extension of the STEM paradigm, began to gain attention in the 2010s. STEM refers to science, technology, engineering, and mathematics, and by incorporating art and design, it became STEAM. The STEAM paradigm proposes that the competencies related to these areas are essential for the future development of society (Allina, 2018; Perignat & Katz-Buonincon, 2018). Further, it suggests the importance of fostering such competencies by relating, integrating, and blending relevant courses. The STEAM paradigm has been actively included in education in the United States since the 2010s, and its long-term educational effects have been examined. For instance, in a course collaborating with a glass-making artist (Gates, 2017), students tried to understand the properties of volcanoes and lava through glasswork creation. Through visual and tactile experience, they could deeply understand the properties of molten glass with properties similar to those of lava. Another example is a course with expert dancers (Graham & Brouillette, 2016). In this class, students saw themselves as planets or cities and performed spinning movements. They could understand the movement of the planets and the resulting changes of day and night using their bodies. These studies suggested that the STEAM program promotes learning in STEM courses and other important subjects and facilitates student intrinsic motivation (e.g., Gates, 2017; Graham & Brouillette, 2016; Inoa, Welsek, & Tabone, 2014; Perignat et al., 2019).

While these practices have shown significant outcomes, several studies argued that most STEAM practices mainly focus on how they can improve STEM courses and subjects rather than revealing effects on creativity itself (Perignat et al., 2019). The advantages over simple STEM courses

have been broadly used to explain the value of adding the arts to the STEM paradigm (Allina, 2018; Perignat et al., 2019). While these influences on STEM courses are important, the framework of art education focusing on fostering creativity has considerable social importance. Therefore, this study aims to develop a framework for an art program that focuses on fostering creativity through the program's design, implementation, and evaluation. We especially focus on development engineers who participate in technology development in a company in this study. However, we think that our framework is applicable not only to such people in the creative class but also to ordinary citizens.

Among the various aspects of creativity, we focus on supporting the process of developing creative concepts and visions connected firmly to the participants' own lives and values. Studies investigating the development of the creative expertise of dancers suggest that they exploratorily generate various types of expressions that expand existing repertoires of expression in the domain (Shimizu & Okada, 2018). Moreover, they develop their own interpretations of expression through this exploratory process (Shimizu & Okada, 2020). Further, through long-term engagement in these kinds of exploratory processes, the contemporary artists generated their artistic concepts and creative visions connected strongly to their values and lives. This is a kind of "Process Modification" in which these artists modify their usual art-making process to attempt something new (Okada, Yokochi, Ishibashi, & Ueda, 2009; Yokochi & Okada, 2020). Previous studies to facilitate the creativity have not sufficiently examined these concepts and creative visions. However, these are considered extremely important in developing people who can create and propose new and unique values for society. Thus, it is necessary to develop a framework for fostering creativity over the long term, aiming at concept and vision generation related to the participants' values and lives.

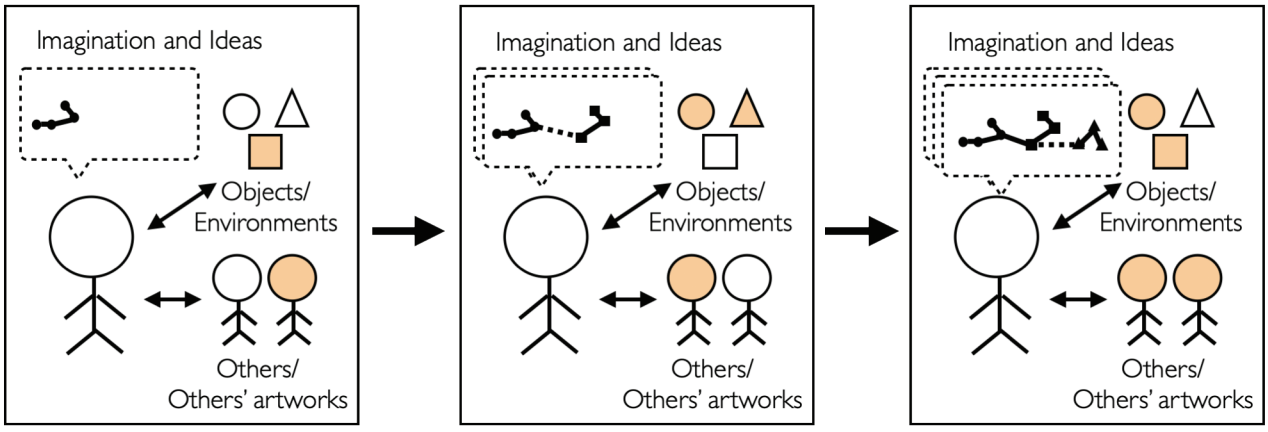

Figure 1. **Outline of the creativity dynamics approach framework. By repeating this dynamical developmental process, people gradually expand the imagination and develop their concepts and visions**

As the abovementioned studies on creative expertise suggested, creativity dynamically changes and develops through long-term efforts and interactions with the environment and other people. The systems model also suggested that creativity is achieved through the interaction among domains (contents and culture that the genre activities have accumulated for a long time), fields

(places where people in the genre conduct their activities), and individuals (an individual who conducts the creative activities in the genre) (Csikszentmihayli, 1988, 2014). It proposed that the field and domain provide individuals information from the past and potentials for novel variations in the genre, and the individual also generates novel variations and provides them back to the field and domain. This study proposed that creativity is achieved and developed through such active interaction among these activities. In addition, the 5A approach recently advocated that creativity is achieved through the five factors (Glaveanu, 2013): actors (people who conduct the creative activity); audiences (other people who engage with actors' process and product, and people who conduct creative activity); artifacts (object and others' product in the environment); actions (actions of actors and audiences that try to generate and develop their products); and affordance (features of artifacts that facilitate actors and audiences to conduct some specific actions). The 5A approach suggested that creativity is developed through the active interactions among these five factors. In accordance with the 5A approach, Botella, Glaveanu, Zenasni, Strome, Myszkowski, Wolff, and Lubart (2013) uncovered that artists' creative process involves the interaction between cognitive, emotional, conative, and environmental factors. Gruber (1989) also focused on the development of expertise using a phenomenological approach and claimed that Darwin developed his work through the networks of enterprises.

Based on these studies, we propose the creativity dynamics approach, which focuses on the dynamic aspects of creativity that change and develop depending on life experiences and interactions with the various variables mentioned above. This approach aims to offer design principles for educational practices to facilitate such aspects of creativity. *Figure 1* shows the process of the active development of creativity through long-term exploration and generation of creative ideas. We think that this dynamic process of creativity over a long period will eventually lead to the generation of participants' creative visions. As the creativity dynamics approach is still under construction, and the details of the mechanism need to be developed, this paper describes only its snapshot process, as *Figure 1* shows supporting evidence that we have worked on its components.

This study focuses on the following four components listed in *Table 1* to facilitate the dynamic process described above. Although detailed explanations of these components will be left for the studies of each component, recent creativity studies have suggested the importance of these four components in creativity. Regarding the first component, previous studies suggest that perceptual experiences with bodily action have a strong influence on imagination (Shimizu & Okada, 2019, 2021). The experiments with novice's creation task showed that diverse perceptual experiences led to various imaginings and ideas of the same object (Shimizu & Okada, 2021). It is well known that imagination is strongly rooted in the knowledge and memory of individuals (Ward, 1994, 2004; Ward & Sifonis, 1997), preventing the generation of new ideas. However, having diverse perceptual and active experiences can facilitate creative imagination (Shimizu & Okada, 2021). Furthermore, it has been pointed out that visual artists used similar processes to expand their imagination in their art creations (e.g., Takagi, Yokochi, & Okada, 2013; Yokochi & Okada, 2005). Regarding the second

component, some studies pointed out that appreciating others' artwork and comparing their perspectives with one's own facilitate creation (Ishiguro & Okada, 2020; Okada & Ishibashi, 2017). For example, a study of novices' art creation showed that by incorporating others' perspectives by copying others' artwork, people can change their own perspective of creation and generate novel works (Okada & Ishibashi, 2017). As for the third component, studies on the development of creative expertise suggest that the long-term exploratory process plays a critical role in the creative expertise development (Okada, Yokochi, Ishibashi, & Ueda, 2009; Shimizu & Okada, 2018; 2020; Yokochi & Okada, 2020). We have previously mentioned the details of this component.

Based on these discussions, we consider that the participants expand their imagination and dynamically develop their creativity by implementing these three components. However, we also need to consider the fourth component. Previous studies have suggested that most people are anxious about engaging in creative activities with unclear answers (e.g., Agata & Okada, 2010; Daker, Cortes, Lyons, & Green, 2020) and that intrinsic motivation of the individual is essential in continuing to engage in creative activities and generate novel products (e.g., Amabile, 1988, 1996). Reducing creativity anxiety and increasing intrinsic motivation will serve as a foundation for facilitating long-term creative activities. Without a secure feeling about one's own creative self and high motivation toward creative activities, such activities would not occur. Therefore, our art program focused on this fourth component. The design principles derived from the proposed framework and components provide a basis for developing specific art programs to foster creativity.

These frameworks and components focusing on supporting the concept and vision generation for a long period are also expected to work effectively in fostering creativity in business settings. Past creativity studies in business settings have mainly focused on members' characteristics, members' combinations, leaders' characteristics, workplace atmosphere, and workplace resources (e.g., Beghetto, 2019; Scott et al., 2004). Furthermore, most programs for fostering creativity have focused on divergent thinking (e.g., Scott et al., 2004). These programs implemented the contents to foster divergent thinking skills and confirmed their effectiveness using quantitative data (e.g., Scott et al., 2004). However, these studies have not paid sufficient attention to the generation of concepts and visions, nor have they sufficiently investigated their changes. Developing new and broad concepts and visions that contribute to the SDGs (sustainable development goals) of society has been considered an essential activity in the business (United Nations, 2015). To do so, people in business need to generate innovative ideas that change their perspectives and create new concepts and visions.

Using the components of the creativity dynamics approach as design principles for creativity facilitation, this study developed and conducted an art program lasting about a year for specific company members who were involved in planning and developing new products. Primarily, we focused on the above four essential components for the active development of creativity. The expected effects of each component are listed in *Table 1*.

***Table 1*. Four important components for facilitating the dynamical development prosess of creativity**

No	Component	Expected effects
1	Active interaction with diverse objects and environments through the bodily action. An imagination expansion through these interactions (i.e., Perception and Action-based imagination: PAI)	Increase in the divergent thinking scores
2	Active interaction with others and others' works. An imagination expansion through these interactions	Increase in openness to others' opinions and increase in the divergent thinking scores
3	Exploration in creative process. An imagination expansion through changing one's own creative patterns	Increase in openness to others' opinions and increase in the divergent scores
4	A promotion of intrinsic motivation and reduction of creativity anxiety	Increase in intrinsic motivation and reduction of creativity anxiety

Owing to the COVID-19 pandemic, we conducted this art program in an online environment using Zoom (Zoom Video Communications Inc.). To ensure the effectiveness of implementing the above four components in an online environment, we utilized the functions of the online discussion system. In particular, we used technologies that are simple and accessible to numerous people. For instance, we used the functions of screen sharing and a breakout room for the second component. Based on the pilot study, we considered that the screen-sharing function would facilitate participants to actively share their work with each other and with all participants. The breakout room function was also considered to facilitate each group to focus intensely on their group work and generate their unique opinions and expressions. Further, as some participants mentioned that they could concentrate on their creation without feeling embarrassed because the online environment weakened the attention of others to them in the pilot study, the non-face-to-face environment of the online platform also brought advantages to this program. We applied these environmental features to implement the first and third components. Thus, this study also attempts to uncover the role of the online environment in fostering participants' creativity.

OUTLINE OF AN ONLINE ART PROGRAM

Based on the above four components, this study conducted a year-long art program to foster the creativity of specific company members. Although there were some fluctuations in the number of participants in each workshop, nine members participated in the entire program throughout the year. All participants were adults working for the same company and were included in the technology development department.

Figure 2 shows the outline of the program and workshop. Specifically, eight art workshops were conducted in total, including art appreciation, art creation, music creation, and story creation. Each workshop was conducted with a strong emphasis on three or four of the proposed components. For example, in the music creation workshop on June 23, participants tried to find interesting

sounds from their daily surroundings by touching and moving various objects (the first and third components were emphasized). They created a piece of music by integrating the object sounds of other participants (the second component was emphasized). Further, they developed the music works again based on the instructor's comments on the works that they created (the second and third components were emphasized). Thus, by working with various artists, we structured each workshop emphasizing some of the components, as shown in *Figure 2*.

Date	Title	WS designer	1. PAI	2. Inspiration	3. Exploration	4. Motivation
4/1–30	Pre Measurement					
5/12	Appreciation and Coversation	Yu Sato	○	○		○
6/8	Reconsideration of Viewing	Minami Koto	○	○		○
6/16	Vision-Making	Kunitake Saso		○	○	○
6/23	Co-creation of Music	Michael Spencer	○		○	○
9/3	Creativity and Story 1	Steven Fischer	○		○	○
9/17	Appreciation, Creation, and Conversation	Yu Sato	○	○		○
11/17	Five Senses and Images	Takeshi Shinohara	○		○	○
12/18	Creativity and Story 2	Steven Fischer	○		○	○
12/1–31	Post Measurement					

***Figure 2*. Outline of the entire art program and workshops**

The major goal of this program was to facilitate the development of the creative expertise of the participants. Therefore, we measured and compared several measurement scores before and after each workshop and the entire program (*Figure 2*) to examine the effect of participating in this art program on creativity. We conducted the measurements in April 2020 before and December 2020 after the program to confirm the effects of the entire program. In the third section, the art appreciation workshops are reported as two representative examples that strongly reflect the four components; in the fourth section, we report the outcome of the entire program.

THE ART APPRECIATION WORKSHOPS AND THEIR EFFECTS

Outline of the art appreciation workshops

We held the art appreciation workshops twice, once focusing on appreciation and conversation and once focusing on creation in addition to appreciation and conversation. The first workshop was held on May 12, 2020, with 11 participants, and the second workshop was held on September 17, 2020, with eight participants. *Figures 3* and *4* show the details of these two workshops.

The first workshop (The workshop of art appreciation and conversation)

Time (min.)	Contents	Details of Contents
15	①Warm-up	Expressing some themes such as rain with the bodies
10	②Preparation for appreciation	Receiving a brief lecture on how to approach artworks
15 (5*3)	③Appreciation	Seeing three artworks for five minutes each
5	④Making questions	Developing the participants' own questions about the artworks
40 (20*2)	⑤Conversation in pairs	Making pairs and asking about the impressions and questions. The speakers share their impressions and questions, and the listener tries to develop them
10	⑥Reading the author's statement	Reading the author's statement by referring to their own and others' impressions and questions.
15	⑦Making a short sentence of impression	Making a short sentence that combines three simple words to express the impressions and questions that have arisen so far





Figure 3. **Contents of the first art appreciation workshop. The pictures show the representative situation of each content**

In the first workshop, we focused on art appreciation and conversations. *Figure 3* shows the workshop content. (1) As a warm-up, participants expressed a specific phenomenon, such as rain, using their bodies. In particular, they focused on other participants' expressions and tried to mimic them. Through this work, we tried to make them realize that it is interesting to incorporate others' perspectives. (2) Next, the participants received a brief lecture on how to approach the artwork. In particular, the lecturer emphasizes that the points one cannot understand are important because they give an opportunity to deepen one's thoughts. (3) The participants worked on the appreciation of the artwork presented by the instructor. They viewed three artworks for five minutes each, which was relatively long compared to typical appreciation. (4) Subsequently, they developed their own questions about these artworks based on their impressions of the third phase. (5) Participants shared their impressions and questions in pairs. In each pair, the participants were divided into speakers and listeners. While the speakers shared their impressions and questions, the listeners asked questions to deepen their impressions and questions for 20 minutes. Later, they alternated their roles in the middle of the phase. (6) Subsequently, the participants read the author's statement about the three artworks as a reference for their own and others' impressions and questions. (7) Finally, the participants generated three words to express their impressions and questions. They connected these words together and made short sentences to express their questions. Overall, from the video recordings and the participants' comments on the workshop, they seemed to deepen their impressions and questions about the artwork through conversations with others and actively expanded their imagination. Listening to other people's impressions and questions that differed

from their own especially seemed to expand their imagination about the original artworks. Most participants wrote positive comments about the first workshop, saying that they had made some discoveries through these experiences.

Time (min.)	Contents	Details of Contents
5	①Warm-up	Drawing unintentional lines based on the lecturer's sign
2	②Appreciation	Seeing artworks for several minutes
15 (5*3)	③Making sketches	Making sketches of some parts of artworks where they are interested in without seeing their lines
16 (8*2)	④Conversation in pairs	Making pairs and asking about the sketches
15	⑤Expanding imagination and making sketches	Imagining the background of artworks and making sketches
20	⑥Editing sketches and making a story	Placing the sketches in the order and making some stories
30	⑦Appreciation of each story	Showing sketches to each other and guessing the stories of other participants

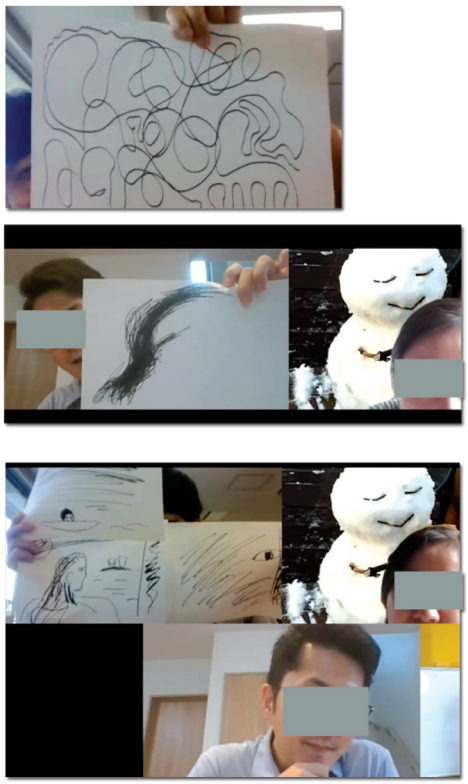

***Figure 4*. Contents of the second art appreciation workshop. The pictures show the representative situation of each content**

The second workshop (The workshop of art appreciation, creation, and conversation)

In the second workshop, we focused more on creation, in addition to appreciation and conversation. *Figure 4* shows the workshop content. (1) As a warm-up, participants drew random lines and changed the way of drawing in response to the instructor's cues. Specifically, participants could draw lines across lines if the instructor said "okay, okay," and they would not be allowed to draw crossing lines when the instructor said "stop, stop." The participants generated unintended lines by their body movements using these cues. (2) Next, participants appreciated artwork (Edvard Munch, *The Sick Child II*). They viewed the presented work for a relatively long time (2 min) compared to the typical appreciation. (3) Subsequently, they picked up three parts of the artwork they found impressive and sketched these parts without looking at their hands. (4) The participants talked about their sketches in pairs. In this conversation, the participants who drew the sketches could not explain, and the other participants who viewed the sketch actively asked questions. Thus, they shared different viewpoints of the original artwork and sketches exploratively. (5) The participants worked on drawing three sketches of the backgrounds of the original artwork that were not drawn. The aim here was to expand the imagination related to the original artwork while reflecting the shared viewpoints in the fourth phase. (6) Afterward, they arranged these sketches in any order

they wanted and created a story based on these arrangements and the original artwork. (7) Finally, participants were assigned to several groups, and they shared their sequences of sketches within the group. Similar to the conversation held in the fourth step, the story creators could not give any explanation but only listened to the imagined story and discussion generated by the other three group members based on the story creator's arrangement of the sketches. Overall, from the video recordings and the participants' workshop comments, the participants seemed to actively expand their imagination through their bodily movements and conversations with others. In particular, listening to other people's viewpoints, which they had not expected, seemed to expand their imagination about the original artwork. Most participants wrote positive comments about the second workshop, saying that they had made some discoveries through these experiences.

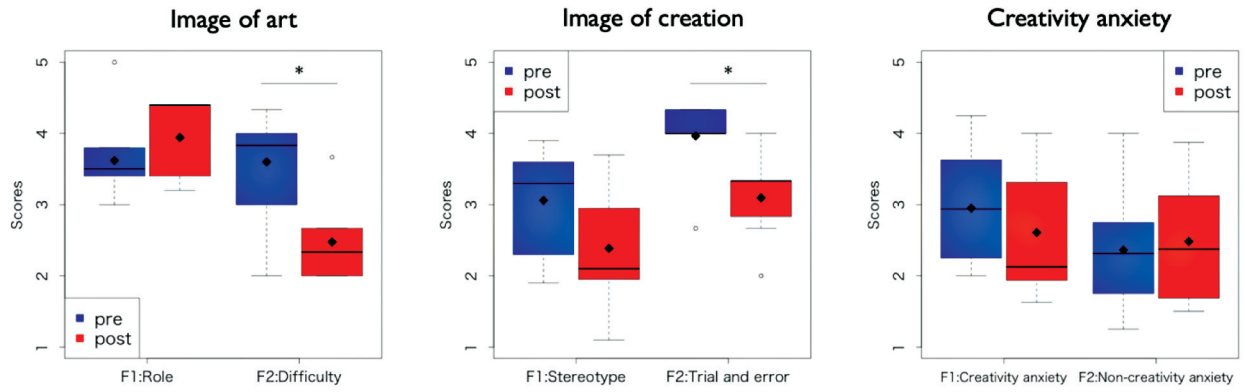

***Figure 5*. Results of the first workshop. Diamonds in the figure indicate the mean. We describe the result of the significance test of creativity anxiety only in the text because we conducted a linear mixed model analysis by integrating the data of the first and the second workshops. *: $p < .05$**

Effects of art appreciation workshops

Regarding the effects of each workshop, we mainly report the changes in the scores of psychological measurements and cognitive tasks measured before and after each workshop. As the Creativity Anxiety Scale was measured in both workshops, we integrated the data from both workshops and described the results after each workshop's report.

The results of the first workshop (The workshop of art appreciation and conversation)

In the first workshop, three psychological scales were used: creativity anxiety (Daker et al., 2020), image of art (Agata & Okada, 2010), and image of creation (Agata & Okada, 2010). We will explain the Creativity Anxiety Scale later. The image of art is a scale used to measure the degree of agreement with art value and the degree of the impression that art is difficult. It consists of two factors—"the role of art" and "recognition of the difficulty of art." The image of creation is a scale that measures the impression of creative activities. It consists of two factors—the "stereotype of creation" and "impression of trial and error regarding creation."

Figure 5 and *Table 2* shows the results of these measurements. From this figure, we can observe that "recognition of the difficulty of art," "stereotype of creation," and "impression of trial and error regarding creation" decreased after the workshop. We conducted a linear mixed model to investigate these changes in participants. The model included the timing of the measurement as an explanatory variable, each measurement score as an objective variable, and the participants as a random effect. We then tested the effects (coefficients) of the explanatory variable. The results showed that the timing of the measurement (before and after the workshop) had significant effects for the following measures: "recognition of the difficulty of art" (coefficient: -1.29, t (15) = 3.33, p = .005, f = .69) and "impression of trial and error regarding creation" (coefficient: -1.39, t (15) = 4.70, p = .004, f = .75). For "stereotypes of creation," the results showed a middle effect size, while there was no significant effect (coefficient: -0.80, t (15) = 1.72, p = .11, f = .19). These results indicated that the participants in the first workshop changed their image of art and creation and that the impression of a difficulty in art and stereotypical images of creation had decreased.

***Table 2*. Outline of the results of Linear Mixed Modeling for each mesurement scores**

Workshop/ Program	Questionnaire/Task	Measurement	Model	*t*	*df*	*p*
First art appreciation workshop	Image of art	Role of art	$Y_t = -0.24 + 0.57 * a_t$	1.18	15	.26
		Difficulty of art	$Y_t = 0.53 - 1.29 * a_t$	3.33	15	.005
	Image of creation	Stereotype	$Y_t = 0.33 - 0.80 * a_t$	1.72	15	.11
		Trial and error	$Y_{it} = 0.52 - 1.39 * a_{it} + c_i$, $c_i \sim (0, 0.33)$	4.7	5.37	.004
Second art appreciation workshop	Divergent thinking	Divergent thinking	$Y_{it} = -0.34 + 0.88 * a_{it} + c_i$, $c_i \sim (0, 0.51)$	2.12	3.81	.10
Both art appreciation workshop	Creativity Anxiety	Creativity Anxiety	$Y_{it} = 0.22 - 0.37 * a_{it} + c_i$, $c_i \sim (0, 0.82)$	2.65	9.85	.025
		Non-creativity Anxiety	$Y_{it} = 0.08 + 0.07 * a_{it} + c_i$, $c_i \sim (0, 0.93)$	0.49	9.57	.63
Entire art program	Creativity Anxiety	Creativity Anxiety	$Y_{it} = 0.28 - 0.56 * a_{it} + c_i$, $c_i \sim (0, 0.73)$	2.56	9	.03
		Non-creativity Anxiety	$Y_{it} = -0.16 + 0.32 * a_{it} + c_i$, $c_i \sim (0, 0.97)$	2.9	9	.02
	Divergent thinking	Divergent thinking	$Y_{itk} = -0.89 + 0.74 * a_{it} - 0.56 * b_{ik} + c_i$, $c_i \sim (0, 0.19)$	2.76	25	.01

Y: each measurement score, a: timing of the measurement (pre, post), t: dummy code of timing of the measurement, b: task number of divergent thinking task, k: dummy code of task number of divergent thinking task, c: participant ID, i: code of participant ID. We normalized each measurement score and conducted these analysis.

The second workshop (The workshop of art appreciation, creation, and conversation)

In the second workshop, two psychological scales and one cognitive skill measure were used: creativity anxiety (Daker et al., 2020), openness to others, and divergent thinking skill (*Figure 6*). We will explain creativity anxiety later, as in the first workshop. Divergent thinking, originally proposed by Guilford (1950), refers to the skill of generating various ideas as a representative aspect of creative cognitive processes. Since its proposal, various tasks such as TTCT have been generated and have become widespread in measuring this skill (e.g., Torrance, 1960, 1962; Torrance & Hall, 1980).

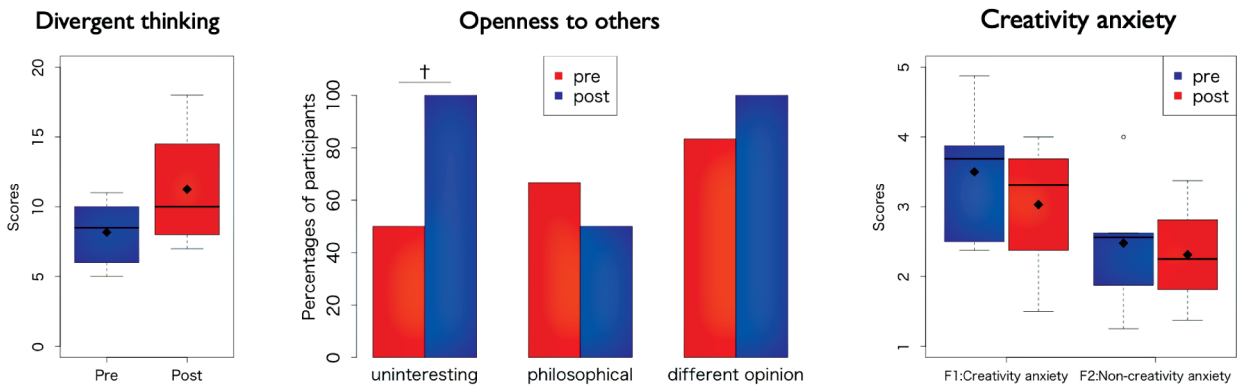

***Figure 6*. Results of the second workshop. Diamonds in the figure indicate the mean. We describe the result of the significance test of creativity anxiety only in the text because we conducted a linear mixed model analysis by integrating the data of the first and the second workshops. †: $p < .10$**

This study used the Unusual Uses Test (e.g., Torrance, 1962), which asks the participants to list as many ways to use their daily objects as possible. The variations in answers, such as numbers or categories (the number of non-overlapping contents), are counted as an indicator of the skill. In this workshop measurement, we used a newspaper as an object and evaluated the skill by counting the categories. Openness to others is a group of items that measure the degree to which participants are willing to engage in discussions with others and adopt different opinions. We developed this item group based on openness to experience in the Big Five scales, which is strongly linked to creativity (Amabile, 1988). As mentioned in the introduction, it is important to draw inspiration from others and their artworks to actively develop creativity. This item group was set to measure changes in the degree of this tendency. Participants were asked to answer yes or no to the question, "Do you want to have conversations with others about the following topics?" Three topics were included: topics you are not interested in, philosophical topics, and topics for which you have different opinions. By counting the number of people who answered yes to these questions, we can investigate changes in the tendency to talk and discuss some unclear topics with others.

Figure 6 and *Table 2* shows the results. We can observe that the divergent thinking scores and the number of people who wanted to talk with others about "uninteresting topics" and "topics with different opinions" increased after the workshop. We conducted a linear mixed model to investigate the effects of the measurement timing. For the divergent thinking scores, the results showed a large

effect size, while there was no significant effect of the measurement timing (coefficient: 0.88, $t(3.81) = 2.12, p = .10, f = .08$). The chi-square test results also showed a marginally significant difference and large effect size for "uninteresting topics" and "topics with different opinions" before and after the workshop (χ^2 (1) = 2.86, $p = .09$, $h = 1.57$, and χ^2 (1) = 0.74, $p = .39$, $h = 0.84$, respectively). These results suggest that the participants in the second workshop somewhat improved their divergent thinking skills and increased their openness to others, such as the attitudes to talk with others about topics with different opinions.

Finally, we described the results of creativity anxiety. Creativity anxiety is a scale used to measure the degree of anxiety about conducting creative activities proposed by Daker et al. (2020). It consists of two factors: anxiety about conducting creative activities as the main factor and anxiety about conducting non-creative activities as the controlling factor (general degree of anxiety). Figures 5 and 6 present the results, showing that "anxiety about conducting creative activities" decreased after both workshops, while "anxiety about conducting non-creative activities" did not decrease. The analysis using a linear mixed model showed that there was a significant effect of the measurement timing in "anxiety about conducting creative activities" (coefficient: -0.37, t (9.85) = -2.65, $p = .025$, $f = 0.037$). This result suggests that the participants in the art appreciation workshop decreased their anxiety caused by engaging in creative activities. However, caveats need to be addressed. At the beginning of the first workshop, creativity anxiety indicated 3.0, which decreased to about 2.6 at the end. However, at the beginning of the second workshop, it showed a value of 3.5. We cannot identify the reason for this increase in creativity anxiety at the second workshop's beginning from our results. However, it is possible to speculate on some of them. For example, the effects on creativity-anxiety reduction may not have lasted for a long time and faded away. Also, people who participated in each workshop have been slightly different due to several outside participants or people who could not attend each workshop because of their works.

THE ENTIRE ART PROGRAM OVER A YEAR AND ITS EFFECTS

Effects of the entire program over a year

First, we report participants' reactions to the entire program. Throughout this one-year art program, they seemed to actively participate in the program. Nine participants took part in almost all workshops. Some of them tried out their techniques and experiences during the workshops in their actual work immediately afterward. When asked if they found the program interesting in the post questionnaires, 7 out of 9 participants answered, "very interesting," and 2 participants answered, "somewhat interesting." In addition, when asked if they learned something, 7 out of 9 participants answered, "I learned many things," and 2 out of 9 answered, "I learned to some extent."

A psychological scale and a measure of cognitive skill were used before and after the entire program (i.e., creativity anxiety and divergent thinking skills test). We used a brick and socks

as the task objects for the divergent thinking task, which were not used in the art appreciation workshop.

Figure 7 and *Table 2* shows the results. We can observe that the "anxiety about conducting creative activities" decreased, and divergent thinking scores increased after the entire program. An analysis using a linear mixed model showed that there was a significant effect of the measurement timing for "anxiety about conducting creative activities" (coefficient: -0.56, t (9) = -2.56, p = .03, f = 0.086). For the divergent thinking scores, the analysis using the model also showed a significant coefficient of measurement timing (coefficient: 0.74, t (25.00) = 2.76, p = .01, f = .17). The interaction between the timing of the measurement and the type of task objects did not reach significance, suggesting that the timing of measurement (before or after the program) had a common effect on both tasks. These results indicate that the participants' anxiety about engaging in creative activities decreased, and their ability to generate ideas in a divergent manner improved through their participation in this one-year program.

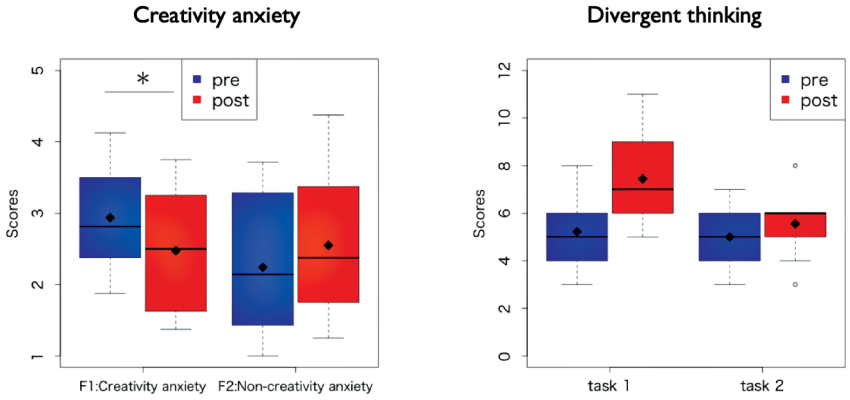

Figure 7. **Results of the entire art program. Diamonds in the figure indicate the mean. We describe the result of the significance test of divergent thinking scores only in the text because we conducted a linear mixed model analysis by integrating the both data of the task 1 and task 2. *: $p < .05$**

DISCUSSION

This study proposed a framework for an art program for creativity facilitation and conducted a year-long program reflecting the proposed framework for engineers of a company. We also investigated its effects using several psychological measures and cognitive tasks. As for the framework, we pointed out the importance of the art program to support the dynamic development of participants' creativity based on studies investigating the development of the creative expertise of artists. In addition, we suggest four important components of these developmental processes: (1) interaction with diverse objects and environments and the expansion of imagination through this interaction; (2) inspiration from others' artworks; (3) exploration of creative processes; and (4) increase in intrinsic

motivation and decrease in creativity anxiety. Subsequently, we constructed an art program that reflected these four components.

We confirmed the following effects. First, through the art appreciation workshop, participants changed their image of art and creation. They decreased their impressions of the difficulty of these activities. In addition, they decreased their anxiety about doing something creative. They also increased openness to others, as they actively tried to talk with others who had different opinions and broadened their perspectives. Further, the divergent thinking score, which is the ability to think of various aspects of a specific object, increased. Second, through the entire art program over a year, participants decreased their anxiety about engaging in creative activities. Moreover, the divergent thinking scores increased, indicating that they came to see a particular object from broader perspectives. Furthermore, the participants mentioned that they started to engage in art activities in their daily lives, such as drawing paintings and going to museums and exploring their connection to their work. These results indicate that the proposed framework of the art program was effective as a trigger for participants to develop their creativity dynamically. The participants decreased their anxiety and resistance to engaging in creative activities and started to participate in such activities. They were willing to interact with others with various opinions and exchange their perspectives. In addition, they expanded their perspectives to see some objects.

The above framework of art workshops for fostering creativity may provide valuable suggestions for the STEAM paradigm and creativity facilitation in business settings. As mentioned in the introduction, STEAM practices that focus on fostering creativity are limited. In particular, a systematic and scientific framework for its content has not been sufficiently proposed and investigated (e.g., Allina, 2018; Perignat et al., 2019). Additionally, creativity facilitation in business settings has mainly focused on divergent thinking skills (c.f., Scott et al., 2004). Most programs and studies have not paid sufficient attention to broad and comprehensive ways to facilitate creativity and support the concept and vision generation. This study proposed the importance of the creativity dynamics approach with the ultimate goal of generating concepts and visions from a long-term perspective based on the theory of creative expertise (e.g., Okada et al., 2009; Shimizu & Okada, 2018; Yokochi & Okada, 2020). This approach also referred to the systems model (Csikszentmihayli, 1988, 2014) and the 5A approach (Glaveanu, 2013) that strongly proposed the importance of interaction among people and the environment. We included the aspect of imagination development through interaction with objects and other people as important components. By participating in the workshops reflecting the above components, the participants expanded their perspectives to understand objects in their surroundings. This framework may provide perspectives on what components should be emphasized in art programs in the above educational and business settings.

The program of this study also indicates the effectiveness of art workshops in an online environment using commercially available technology—Zoom. We conducted almost all workshops online. We observed several difficulties in conducting the workshops: the difficulty of giving individual instructions to each participant and sharing the same object and its sensation. However, the participants were actively engaged in creating their work and interacting with others

in most workshops. For example, they mentioned that screen sharing made it easier to share their work with other participants and that projecting multiple people's work on a single screen simultaneously brought them new insights. They also described that they easily concentrated on group work in the breakout room because each group was completely separated from the other groups. In addition, it seemed easier for them to develop a unique focus and perspective for each group. It was also mentioned that the non-face-to-face environment allowed the participants to concentrate deeply on their creation. We believe that we could use the technology to actively facilitate participants' involvement in the four components. When using technology in art workshops, it would be desirable to emphasize the important components of the workshop. We considered that this program provided a concrete example of this technology usage. In the future, it will also be important to develop and implement a system that further facilitates the involvement of the above components. The following are the possible candidates: a system that accumulates each person's creative process and works, extracts, and shares interesting parts of them; a system that shares the process of breakout rooms and allows different group members to review them; and a system using a VR environment that enables contact with the same object and its perceptual feedback. By incorporating these systems, the proposed four components will work more effectively, and participants can develop their creativity more actively.

Finally, we discuss some limitations and prospects. First, further elaboration and organization are necessary for the proposed framework and components. This study confirmed that the proposed framework and its components affect people's creativity. However, we could not investigate whether the proposed four components are sufficient to dynamically develop the creativity of participants or whether any other components are necessary. Future studies are required to investigate the effects of each component individually and in combination. In this case, the linear mixed model analysis used in this study is an effective way to extract the individual and combined effects. It is also necessary to organize and structure how to implement the above four components in an actual program. Currently, we asked artists and workshop designers with many experiences of the art workshop and relied on their rich knowledge and experiences. However, it is crucial to systematize the implementation wisdom of each expert so that other experts can be stimulated and can further develop their workshops. This wisdom offers fruitful suggestions for educational practices such as STEAM. Finally, a more systematic method to conduct and measure program effects is needed. This study examined the longitudinal changes of creativity for a limited number of engineers who belong to the creative class (Florida, 2002, 2005). A further systematic investigation conducting these studies at a larger scale is needed to uncover whether the effects obtained in this study can be broadly applied to other workers and students. We also need to compare the effects on the participants of our program with those of a controlled group to demonstrate our program's influences clearly. In addition, this paper could not quantitatively measure, for example, whether the participants could develop their deep concepts and visions or whether they became actively engaged in creative activities in their daily lives. Also, we could not measure the changes of the intrinsic motivation in the participants, an important component of our

proposed framework. Owing to practical reasons for conducting various workshops online, such as time limitations and the procedures of workshops, slightly different psychological indicators were applied for each workshop. Therefore, we could not clearly explain the relationship between the effects of individual workshops and those of the entire program. Further, future studies are necessary to investigate the process of each workshop from both qualitative and quantitative perspectives. The study focusing on the complicated interactions among the participants in the art appreciation workshop is an example. This approach is important for identifying the specific change and process that occurred in each workshop in detail. Also, it could provide rich insights to understand and interpret the overall effects observed across the entire program. In future studies, it will be necessary to systematize the measurement and analysis methods.

Author Contributions

All authors contributed to the study and program design. D.S., I.Y., and S.W. performed the workshop, conducted measurements, and analyzed them. D.S. and T.O. drafted the manuscript and I. Y. and S.W. provided critical revisions. All authors approved the final version of the manuscript for submission.

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Reference

Agata, T., & Okada, T. (2010). How Do Perceptions of Artistic Creation Affect Motivation for Artistic Expression and Art Appreciation? *The Japanese Journal of Educational Psychology*, *58*(4), 438–451. https://doi.org/10.5926/jjep.58.438

Allina, B. (2018). The development of STEAM educational policy to promote student creativity and social empowerment. *Arts Education Policy Review*, *119*(2), 77–87. https://doi.org/10.1080/10632913.2017.1296392

Amabile, T.M. (1988). A model of creativity and innovation in organizations. *Research in organizational behavior*, *10*(1), 123–167.

Amabile, T.M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of management journal*, *39*(5), 1154–1184. https://doi.org/10.5465/256995

Beghetto, R.A. (2019). Structured uncertainty: How creativity thrives under constraints and uncertainty. In *Creativity Under Duress in Education?* (pp. 27–40). Springer, Cham.

Botella, M., Glaveanu, V., Zenasni, F., Storme, M., Myszkowski, N., Wolff, M., & Lubart, T. (2013). How artists create: Creative process and multivariate factors. *Learning and Individual Differences*, *26*, 161–170. https:// https://doi.org/10.1016/j.lindif.2013.02.008

Csikszentmihalyi, M. (1988). Motivation and creativity: Toward a synthesis of structural and energistic approaches to cognition. *New Ideas in psychology*, *6*(2), 159–176. https://doi.org/10.1016/0732-118X(88)90001-3

Csikszentmihalyi, M. (2014). Society, culture, and person: A systems view of creativity. In *The systems model of creativity* (pp. 47–61). Springer, Dordrecht.

Daker, R.J., Cortes, R.A., Lyons, I.M., & Green, A.E. (2020). Creativity anxiety: Evidence for anxiety that is specific to creative thinking, from STEM to the arts. *Journal of Experimental Psychology: General*, *149*(1), 42. https://doi.org/10.1037/xge0000630

Florida, R. (2002). *The rise of the creative class*. New York: Basic books.

Florida, R.L., & Florida, R. (2005). *Cities and the creative class*. New York: Routledge.

Gates, A.E. (2017). Benefits of a STEAM collaboration in Newark, New Jersey: Volcano simulation through a glass-making experience. *Journal of Geoscience Education*, *65*(1), 4–11. https://doi.org/10.5408/16-188.1

Getzels, J.W., & Csikszentmihalyi, M. (1976). *The Creative Vision: Longitudinal Study of Problem Finding in Art*. New Jersey: John Wiley & Sons Inc.

Glăveanu, V.P. (2013). Rewriting the language of creativity: The Five A's framework. *Review of General Psychology*, *17*(1), 69–81. https://doi.org/10.1037/a0029528

Graham, N.J., & Brouillette, L. (2016). Using Arts Integration to Make Science Learning Memorable in the Upper Elementary Grades: A Quasi-Experimental Study. *Journal for Learning through the Arts*, *12*(1).

Gruber, T.R. (1989). Automated knowledge acquisition for strategic knowledge. In *Knowledge Acquisition: Selected Research and Commentary* (pp. 47–90). Boston, MA: Springer.

Guilford, J.P. (1950). Creativity. *American psychologist*, *5*(9). https://doi.org/10.1037/h0063487

Inoa, R., Weltsek, G., & Tabone, C. (2014). A Study on the Relationship between Theater Arts and Student Literacy and Mathematics Achievement. *Journal for Learning through the Arts*, *10*(1), n1. https://doi.org/10.21977/D910123495

Ishiguro, C., & Okada, T. (2020). How Does Art Viewing Inspires Creativity?. *The Journal of Creative Behavior*. https://doi.org/10.1002/jocb.469

McGranahan, D., & Wojan, T. (2007). Recasting the creative class to examine growth processes in rural and urban counties. *Regional studies*, *41*(2), 197–216. https://doi.org/10.1080/00343400600928285

Organisation for Economic Cooperation and Development (OECD). (2018). The future of education and skills: Education 2030. OECD Education Working Papers.

Okada, T., Yokochi, S., Ishibashi, K., & Ueda, K. (2009). Analogical modification in the creation of contemporary art. *Cognitive Systems Research*, *10*(3), 189–203. https://doi.org/10.1016/j.cogsys.2008.09.007

Okada, T., & Ishibashi, K. (2017). Imitation, inspiration, and creation: Cognitive process of creative drawing by copying others' artworks. *Cognitive science*, *41*(7), 1804–1837. https://doi.org/10.1111/cogs.12442

Perignat, E., & Katz-Buonincontro, J. (2019). STEAM in practice and research: An integrative literature review. *Thinking Skills and Creativity*, *31*, 31–43. https://doi.org/10.1016/j.tsc.2018.10.002

Root-Bernstein, R., Allen, L., Beach, L., Bhadula, R., Fast, J., Hosey, C., ... & Weinlander, S. (2008). Arts foster scientific success: Avocations of nobel, national academy, royal society, and sigma xi members. *Journal of Psychology of Science and Technology*, *1*(2), 51–63. https://doi.org/10.1891/1939-7054.1.2.51

Scott, G., Leritz, L.E., & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity research journal*, *16*(4), 361–388. https://doi.org/10.1080/10400410409534549

Shimizu, D., & Okada, T. (2018). How do creative experts practice new skills? Exploratory practice in breakdancers. *Cognitive science*, *42*(7), 2364–2396. https://doi.org/10.1111/cogs.12668

Shimizu, D., Hirashima, M., & Okada, T. (2019). Interaction between Idea-generation and Idea-externalization Processes in Artistic Creation: Study of an Expert Breakdancer. *Proceedings of the of the 41st annual conference of the Cognitive Science Society*, 1041–1047.

Shimizu, D., & Okada, T. (2020). Relaxation and Reorganization of "Internal Constraints" in Artistic Creation: Studies Focusing on the Embodiment of Ideas and Interaction with Others in Breakdance. In K. Knutson, T. Okada, & K. Crowley (Eds.), *Multidisciplinary Approaches to Art Learning and Creativity* (pp. 47-63). New York: Routledge.

Shimizu, D., & Okada, T. (2021). Interaction between the action and cognition in creativity: perception and action-based imagination framework. *Proceedings of the of the 43st annual conference of the Cognitive Science Society*.

Scott, G., Leritz, L.E., & Mumford, M.D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity research journal*, *16*(4), 361–388. https://doi.org/10.1080/10400410409534549

Takagi, K., Okada, T., & Yokochi, S. (2013). Formation of an art concept: How is visual information from photography utilized by the artist in concept formation?. *Cognitive Studies: Bulletin of the Japanese Cognitive Science Society*, *20*(1), 59–78. https://doi.org/10.11225/jcss.20.59

Torrance, E.P. (1960). Explorations in creative thinking. *Education*, *81*, 216–220.

Torrance, E.P. (1962). Cultural discontinuities and the development of originality of thinking. *Exceptional Children*, *29*(1), 2–13. https://doi.org/10.1177/001440296202900102

Torrance, E.P., & Hall, L.K. (1980). Assessing the Further Reaches of Creative Potential. *Journal of Creative Behavior*, *14*(1), 1–19. https://doi.org/10.1002/j.2162-6057.1980.tb00220.x

Ward, T.B. (1994). Structured imagination: The role of category structure in exemplar generation. *Cognitive psychology*, *27*(1), 1–40. https://doi.org/10.1006/cogp.1994.1010

Ward, B.W. (2004). Faith, Romance, and Imagination: Newman the Storyteller. In *Victorian Religious Discourse* (pp. 175–187). New York: Palgrave Macmillan.

Ward, T.B., & Sifonis, C.M. (1997). Tosh demands and generative thinking: What changes and what remains the same?. *The Journal of Creative Behavior*, *31*(4), 245–259. https://doi.org/10.1002/j.2162-6057.1997.tb00797.x

Wojan, T.R., Lambert, D.M., & McGranahan, D.A. (2007). Emoting with their feet: Bohemian attraction to creative milieu. *Journal of economic geography*, *7*(6), 711–736. https://doi.org/10.1093/jeg/lbm029

Yokochi, S., & Okada, T. (2005). Creative cognitive process of art making: A field study of a traditional Chinese ink painter. *Creativity Research Journal*, *17*(2–3), 241–255. https://doi.org/10.1207/s15326934crj1702&3_9

Yokochi, S., & Okada, T. (2020). The Process of Art-making and Creative Expertise: An Analysis of Artists' Process Modification. *The Journal of Creative Behavior*. https://doi.org/ doi: 10.1002/jocb.472

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20 Swierkowa St., 15-328 Bialystok, Poland
tel. +48 857457283
e-mail: creativity@uwb.edu.pl
http://www.creativity.uwb.edu.pl