

A Study on Imagination Learning Assessment of New Media Public Art

Shih-yun Lu, and *YuLung Wu

Abstract—Arts education is a crucial basis for human science. The ability to appreciate art is closely correlated with imagination, both of which must be cultured from childhood. In elementary schools, art appreciation is primarily taught through oral or textual descriptions. Because of limited teaching personnel, in-depth or individual teaching can generally not be performed. This study proposes an imagination learning assessment system. By applying the proposed system, teachers' burden in assessing students' artwork criticism can be reduced and human subjective factors can be subdued to maintain stable assessment criteria. The participants recruited in this study were fifth- and sixth-grade elementary school students from art classes. The results of the system assessment indicate that the proposed system and expert evaluation results were highly correlated. Therefore, the imagination learning assessment system is reliable and reflects the learning effectiveness of students.

Keywords—Imagination learning assessment, new media, public art

I. INTRODUCTION

SINCE the twentieth century, an increasing number of public artworks have been constructed in numerous cities with policy making and promotion led by the United States. Public artworks beautify cities and enhance local participation and identification by people. Designers of public artwork are mostly professionals engaged in art fields. The viewers are generally members of the diverse public, who are adroit in decoding popular culture but not necessarily artworks in galleries [10].

Public artworks refer to artwork created for public spaces. In addition to the function of environmental beautification, whether the public understands the content of public artworks and feels empathetic toward them are crucial considerations when installing public artworks. Social development has promoted the combination of public artwork with technology. New media public arts have gradually become a contemporary tendency. Unlike traditional public artworks, new media public artworks are primarily demonstrated using digital technology methods, thereby diversifying expression forms and interaction models.

The ability to appreciate new media public artworks can be cultured from childhood. When educating children in art in a classroom context, teachers must select artworks that are suitable for students and determine how to evaluate the

learning effectiveness of students. Through artwork criticism, teachers can identify students' understanding and appreciation of artworks, which can be used as a method for assessing the ability of students to appreciate artworks. However, artwork criticism is typically conducted by stating feelings toward an artwork in writing; teachers may assess such criticism subjectively or on the basis of varying criteria. To standardize the assessment method and process of artwork criticism and reduce the burden of teachers, this study proposes an artwork criticism test system based on related words. The expert and system assessment results were organized and compared to determine whether they were consistent and able to accurately reflect learning test results.

Using the new media public artworks as the research scope, this study involved analyzing literature and assessing survey methods, as well as collecting domestically and internationally renowned new media public artworks. Among the collected artworks, those suitable for fifth- or sixth-grade elementary school education were adopted as references for teaching. The participants in this study were fifth- and sixth-grade students from elementary schools in Taiwan.

This study had the following limitations:

- 1) Examples used for the assessment study were primarily renowned artworks open to the public.
- 2) Most of the renowned artworks were not installed in Taiwan; therefore, the test was conducted in Taiwan by using official or online digital images to present the site of the artwork.
- 3) Because of the participants' limited age, textual artwork analysis focused on the description of appearance, visual effects, and meaning of the artworks. In-depth analyses, such as abstract meaning and metaphors, were not discussed in this study.

II. LITERATURE REVIEWS

The term *public art* was used officially in the Federal Art Project proclaimed by U.S. President Roosevelt in 1933. Public art is also referred to as environmental art, land art, landscaping, or percent for art. Public art must cover both publicity and artistry, at least guiding the meaning of public art [16].

New media art is a definite tendency of the current digital era. Regarding the definition of new media, in *What is New Media?*, Crosbie [14] stated that the main reason for confused cognition regarding new media is that people often mistakenly interpret transmission vehicles as being media. Computers and the Internet are not equivalent to new media; nonetheless, they are vehicles that new media can employ. Media represent

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the instruments for information communication and propagation. Thus, new media refers to a brand new form of communication model and not a new information propagation vehicle. The characteristics of new media can be summarized as follows: 1) New media can simultaneously and rapidly convey individualized information to each recipient among the public. 2) Each participant has a direct effect on or even the right to control information content. Such characteristics of involving multiple individuals simultaneously earn new media the title of many-to-many media.

Manovich [8] proposed the following five points as the fundamental principles of new media: 1) Numerical representation: by using new media, various interpretation, editing (encoding), processing, and modification steps can be performed to present and re-present artworks through numerical computation. 2) Modularity: through multiple manageable fractal structures, creators can arbitrarily change the arrangement and structure of their artwork. 3) Automation: To realize the automation of artwork software and programs, the creativity provided by machines is utilized to differentiate new media artworks from those created by sole artists. Subsequently, the variable difference can be used to create independent art. 4) Variability/liquidity: Unlike traditional artworks that present individual subjects, new media artworks, through numerical representation and modularity, are not restricted by external conditions and can change depending on people, events, and objects to substantially increase interaction with the surroundings. 5) Transcoding: Using computer graphics as an example, visual images on screen are encoded. Art (image = artwork) and technology (computer) are perfectly integrated through mutual correspondence and influence.

Unlike Manovich, who discussed new media art from the perspective of technology, Hansen [9] claimed that what distinguishes new media is the interaction between artworks and people. Because new media can be expressed in various forms, differing from the traditional interaction method of viewing artworks, new media enable viewers to comprehensively experience the design concept of the artwork, thus rendering a novel manner in which to appreciate and experience arts. In addition, Hansen believed this aspect to be the greatest difference between new media art and other types of art.

According to these studies, diversity, flexibility, and interactivity are undoubtedly crucial elements in discussing new media art from the perspective of interpersonal interaction. In the current information era, art creations presented using physical paint are unsatisfactory. An increasing number of art forms combined with precision technologies have been used to interpret artworks. Technology and art are developing toward a global unity, which is not limited to Western society.

During the process of art education and the psychological process of art appreciation, the visual thinking and rich imagination of students are commonly excited and elicited through exploration. Subsequently, through sensible aesthetic attention and rational criticism analysis, students can acquire the ability to appreciate artworks. Art criticism is developed by expressing comments that convert aesthetic and perceived

visual literacy and imagination into words through aesthetic cognition. In other words, art criticism refers to expressing aesthetic thinking and judgment by using textual discourses and proposing accurate assessments on artworks. Imagination is the ability to conduct simulations within the mind; in other words, it is the ability of the mind to represent external existing or nonexistent objects. Higgins [2] summarized various studies and defined imagination as follows:

- 1) Imagination is virtue.
- 2) Imagination is the noun form of the term *imaginative*.
- 3) Imagination is a normative predicate implying praise.
- 4) Imagination encompasses people's abilities, such as written communication, behavioral skills, and actual performance manifested in artworks.
- 5) Imagination is a skill acquired after encountering the complexity of the real world.

Egan [7] indicated that imagination is closely related to the mental process of learners. Imagination is a complex concept. Before the eighteenth century, artists' imagination imitated reality and painted pictures based on perceptions. Thus, imagination was considered to play a passive and replicating role.

Imagination can expand the possibilities of thinking and develop thinking by using unconventional or novel methods [1][7][13].

According to the aforementioned discussion, imagination is a capacity and thinking characteristic specific to human beings. By combining feeling and perceptions of real experiences, new methods of thinking are developed.

Because imagination is an abstract ability that is difficult to quantify for evaluation purposes, studies on imagination assessment have been conducted from various perspectives. Horng et al. [12] developed an imagination test of concept combination based on concept combination theory and recruited 602 undergraduate and graduate students as participants. The data obtained from the test were statistically analyzed and scored, and finally adopted for creating a scoring manual. Chiu et al. [5] surveyed 198 undergraduate students' definitions of *imagination* to collect imagination-related words. Then, they classified the words into 14 categories and compiled an Imagination Concept Evaluation Task. Subsequently, experts in relevant fields were invited to evaluate the distinctions among the imagination-related words by applying paired comparison. Feng [15] adopted questionnaire survey and interview methods to determine the influential factors on imagination training of elementary school teachers. Hsu and Chang [3] used 40 undergraduate students from the design department as participants and employed content and statistical analyses to identify whether conceptual mapping was beneficial for creative thinking. Liang, Huang, Hsu and Chou [4] used a sample of 380 pre-service teachers as the factor construct group and a sample of 318 working teachers as the factor validation group to examine the structural model that influenced teaching design imagination. Huang, Hsieh, and Tsai [17] applied a semantic differential approach and a Likert scale to design a questionnaire including 30 adjective phrases and summarized crucial imagination factor characteristics and correlations.

Evidently, relevant studies in recent years have collected data and reviewed literature as an imagination assessment method for selecting and summarizing imagination-related words, concepts, and generation environments. The collected imagination-related words or factors have then been compiled into a test or scale to conduct a survey. These studies have then analyzed imagination generation and structure according to the assessment results.

In the present study, the art criticism method was adopted to train participants to describe and analyze artworks, thereby enabling them to learn how to interpret and evaluate artworks.

By organizing expert criticism data, this study summarized the following four focus points of art criticism and analysis:

- 1) Describing: Through observation and thinking, people describe what they see and the theme and characteristics of artworks in written form. Bearsley [11] suggested that viewers can use a) a partial description of the artwork, b) description of a partial relationship, c) description of regional or overall quality, and d) comparison between artworks to describe paintings. Artworks can be described by observing characteristics such as the following: cool or warm colors, large size, small size, width, flatness, far or near perspective, softness or hardness, lighting and shadow, and traits of depicted people.
- 2) Analyzing: The visual cues obtained by observing and describing artworks are analyzed, summarized, converted, and elevated to abstract concepts, such as similarities, comparison, symmetry, rhythm, and composition balance between artworks, and integrity of artworks.
- 3) Interpreting: According to the artwork data obtained from previous descriptive analysis, critics determine how to interpret the implied intrinsic value of artworks from the aspects of comprehensiveness, persuasiveness, personal experience, affect, visual correspondence, and originality.
- 4) Judging: On the basis of abundant experiences, art critics evaluate artworks and determine the historical position of artworks to help readers assess their value. Wang [6] proposed three points regarding the standards of artwork evaluation: a) Evaluate the development and contribution of the artwork in the overall history of art, b) evaluate from the perspective of the artwork's presentation, and c) evaluate whether the artwork possesses implications of innovativeness and reeducation.

The objective of this study was to cultivate the ability of artwork analysis and written description in fifth- and sixth-grade elementary school students. By using classroom activities and learning assessment methods, imagination evaluation tests were conducted to identify whether students could appreciate and analyze new media public artworks and describe the artworks in written form after teacher guidance.

III. DESIGN OF THE IMAGINATION LEARNING ASSESSMENT SYSTEM

This study employed literature analysis to obtain and organize the required data for assessment and latent semantic analysis to determine the relationship between keywords or words and sentences, thereby creating an imagination learning assessment system (ILAS).

The database collection process is presented as follows:

First, domestically or internationally renowned new media public artwork data, including images, pictures, and text, were collected and classified to facilitate archiving in database files. Data of each case included the title of the artwork, author name, image, and artwork criticism. As an example, *Counter Void* by Tatsuo Miyajima (1996) is shown in Fig. 1.

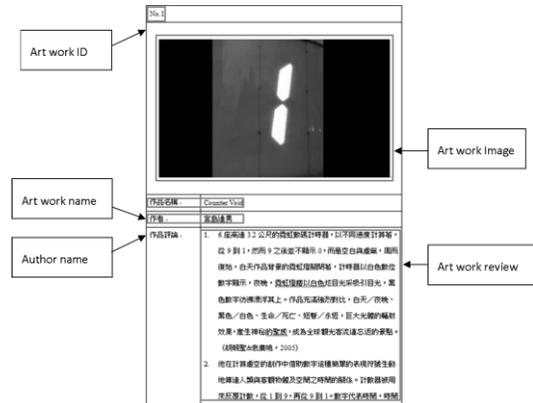


Fig. 1 Example of the artwork database

Two tools of latent semantic analysis were adopted for system scoring, namely word segmentation and near neighbors. The tools used in this study referenced the research outcomes of Ko (<http://www.lsa.url.tw/modules/lisa>). Word segmentation is employed to extract meaningful words and phrases from an article. Near neighbors are used to determine the degree of closeness between two words or phrases. A high degree of closeness indicates that the two words or phrases frequently appear concurrently in the article, suggesting that they have similar meanings or uses.

Artwork criticism sources include art criticism, magazine reports, comments on the Internet, official introductions, and reviews by experts in relevant fields. After screening and organizing artwork criticism, word segmentation was used to determine keywords. After meaningless redundant words and conjunctives were removed, the remaining words were stored in an expert review database, as shown in Fig. 2.

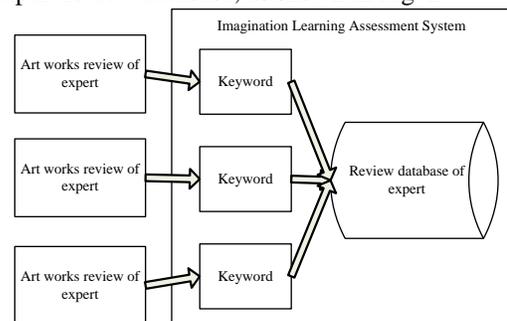


Fig. 2 Artwork review archiving process

The artwork keywords were the evaluation criteria of the ILAS. After the artwork data and keywords were archived in the expert review database, the imagination learning assessment test commenced.

According to the visual characteristics and difficulty of the artworks, the researchers selected three domestically or internationally renowned new media public artworks from the database as the assessment items to compile an imagination

learning assessment sheet on which the students expressed their feelings and thoughts toward the artworks by written assessments.

The scoring method involved determining the similarity between keywords from the expert review database and student assessment keywords (near neighbors) by comparing the keywords. The keywords of the students identical to those in the expert review database were allocated 1 point, whereas those that differed completely from those in the expert review database were allocated a 0. When near neighbors exhibited a high similarity, such as “warmth” and “sunshine,” scores between 0 and 1 were assigned on the basis of the degree of closeness the keywords.

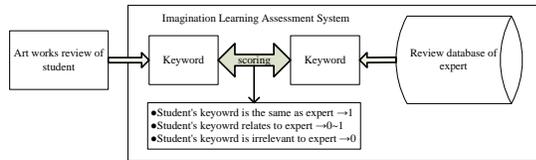


Fig. 3 Scoring method of artwork criticism

For example, the scoring results of *Dolly's Dream* by Lin (2004) are presented in Table 1. The table shows that when the keywords describing the artwork were “futuristic,” “technological,” “humanity,” “sense of life,” or “close to the public,” students who mentioned these keywords on the test paper received 1 point for each matching keyword. When the students mentioned words such as “amicable,” which is relevant but not identical to being close to the public, they received a point between 0 and 1. When the response was irrelevant to the keyword, the students received no point. The students attained high scores when the similarity between their responses and the keywords was high.

TABLE I
SCORING METHOD EXAMPLES

Keywords	Responses	Scoring results
Futuristic, technological, humanity, sense of life, close to the public	This artwork is futuristic and technological, demonstrating advanced and precision characteristics of the research institute. The software adopts soft, imaginative, and appealing content to express humanity and a sense of life that people should preserve when applying technologies. The delightful presentation of the artwork enables the institute to be close to the public and conveys the essence of the research institute through simple interactions.	The response content involved all keywords, attaining 5 points.
	This artwork appears futuristic and offers a feeling of amicability.	The response content matched only one keyword and one near neighbor, attaining 2 points.
	This artwork is lovely and gives people a sense of novelty.	The response content is completely irrelevant to the keywords; thus, no points are allocated.

A. Learning Assessment

This study invited three experts from relevant fields to select artworks suitable for elementary school students and compile imagination assessment tests. The experts asserted that artworks suitable for fifth- and sixth-grade elementary school students must present the following characteristics: concrete presentation forms, clear visual effects, and specific meaning. The elements used in the artworks had to resonate with the students. Finally, the three selected artworks exhibited considerably clear and understandable visual elements and connotations that were relevant to the daily life of the students.

- 1) Lin Ren-Hsin, *Diamond Meets Diamond*, 2006
- 2) Techart Group, *Nokia Interactive X'mas Tree Design*, 2005
- 3) Lin Pey Chwen, *Chrysalis*, 2005

The researchers discussed the assessment content structure, theme expression methods, and item difficulties several times with the advising professor and modified the items accordingly to complete a preliminary draft of imagination assessment work sheets. Subsequently, content validity was established.

The assessment work sheets employed expert validity in content validity. Three elementary school fine art teachers, who were experts in domestic art education, were invited to provide opinions regarding the work sheet content and evaluate the appropriateness of all items; the items were modified after summarizing the expert opinions. The item descriptions were simplified into words and phrases to meet the reading capacity of the students. Subsequently, imagination assessment work sheets were compiled for use in the test.

B. Learning Assessment Participants

The participants of this study were sixth-grade students from a fine art class in a public elementary school in Taichung City, Taiwan. A total of 25 students were recruited for the learning assessment. Before the assessment experiment, the students were already equipped with basic fine art knowledge and possessed a rudimentary understanding of public art. The learning assessment outline was as follows: First, the researchers introduced new media public art to the participating students and guided and explained the assessment activity to them. This step required 30 min. The students were then allotted 50 min to complete the assessments of three artworks.

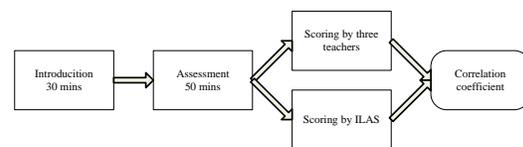


Fig. 4 Learning assessment process

After the assessment test, the artwork criticism tasks of the students were scored by three teachers and the ILAS separately. Three teachers (encoded as Reviewers A, B, and C) with art or design backgrounds were invited to score the

assessment tasks of the students. To maintain consistency in scoring criteria among the reviewers, a scoring criteria table comprising five rankings was established for the reference of the reviewers. The scoring criteria are provided as follows:

TABLE II
MANUAL REVIEW SCORING CRITERIA

Ranking	Scoring criteria
5	Mentioned seven or more keywords or key points or depicted the appearance of the artwork, elements, and other near neighbors.
4	Mentioned five or more keywords or key points or depicted the appearance of the artwork, elements, and other near neighbors
3	Mentioned three or more keywords or key points or depicted the appearance of the artwork, elements, and other near neighbors
2	Mentioned less than three keywords, key points, or near neighbors
1	Mentioned less than three near neighbors.

To validate that the ILAS scoring results reflected student learning performance, correlation coefficients were used to examine the correlation between the ILAS scores and the scores provided by teachers. High correlation represented that the ILAS scores were similar to those provided by the teachers. Correlation coefficients represent the level of closeness between two variables, ranging from -1 and 1. The value of $r = 0$, $r > 0$, and $r < 0$ refer to zero correlation, positive correlation, and negative correlation, respectively. Common criteria for determining strength of correlation based on correlation coefficient values are listed in Table 3.

TABLE III
DETERMINATION CRITERIA OF CORRELATION COEFFICIENTS

Absolute values of correlation coefficient	Strength of correlation
0.80-1.00	Very high correlation
0.60-0.79	High correlation
0.40-0.59	Moderate correlation
0.20-0.39	Low correlation
0.1-0.19	Very low correlation

After comparing manual and system review results, the analysis results regarding correlation between the scores provided by the teachers and the ILAS were presented in Table 4. The results showed that the correlation coefficients between the system-provided scores and the scores provided by Reviewers A, B, and C were 0.78874, 0.615932, and 0.74958, respectively. High correlations were observed for all three relationships. Thus, the ILAS was inferred to be able to accurately evaluate the learning effectiveness of students.

TABLE IV
CORRELATION COMPARISON BETWEEN SYSTEM AND MANUAL EVALUATION

	ILAS	Reviewer A	Reviewer B	Reviewer C
System evaluation	1			
Reviewer A	0.78874	1		
Reviewer B	0.615932	0.525755	1	
Reviewer C	0.74958	0.682755	0.596492	1

In summary, by screening and comparing near neighbors, the ILAS proposed in this study exhibited consistent scoring

results with those of the experts, suggesting that the proposed method and system can be used as a teaching aid. In addition to being able to objectively assess results according to standardized criteria, the proposed system can effectively save manpower. Art is unique and multidimensional. According to the experimental result analysis of this study, although the expert review database cannot encompass the comprehensive perspectives of artworks, the database can still be used as a diagnostic tool to rapidly understand student learning situations. However, special situations such as additional unique comprehensions or misunderstandings may cause the system to provide extremely high or low scores. In such cases, teachers can select the extreme test papers and score them manually. Through each assessment, new viewpoints can be added to complete the database, thereby achieving the goal of saving manpower and assisting teaching.

IV. CONCLUSION AND FUTURE RESEARCH

Regarding the teaching of new media public art appreciation, the ILAS was proposed to assist teachers in administering artwork assessment tests, score the tests, and understand student learning situations. A comparison of the scoring results of the ILAS and the invited experts revealed high correlations. Thus, the ILAS scoring was proved reliable. The ILAS assessment method can support teachers during teaching activities and provide objective assessment of student learning situations and effectiveness.

Artwork appreciation is multidimensional and includes numerous perspectives; although the viewpoints in the current ILAS database did not necessarily encompass comprehensive understandings, content can be added and removed from the database. When new viewpoints appear, they can be added to the system database after expert evaluation, gradually increasing the comprehensiveness of the overall system. Teachers can rapidly and objectively determine the learning outcomes of students by using the ILAS to score assessments. Based on the scores, the teachers can select test papers with extreme scores for manual scoring; thus substantially conserving the time and effort expended by teachers and increasing teaching effectiveness.

This study provided the following suggestions regarding the practical applications of the ILAS and new media public art education as references for future related studies.

- 1) The keyword sources of the system database should be extended, including artwork viewpoints of experts from various fields. New media public art is closely connected with technology. In addition to collecting viewpoints from art experts, the system database should include expert viewpoints in fields such as programming and mechanical engineering to score criticism objectively.
- 2) Full-text art criticism should be recorded in the system database, instead of extracting segments of text or conclusions. To meet the comprehension abilities of fifth- and sixth-grade elementary school students, the review of the database in this study was focused on the description and connotations of the visual elements of artworks. However, if the participants were senior students at high schools or in higher education, their language skills, life experiences, and aesthetic literacy should enable them to appreciate artworks from multiple aspects and

resonate profoundly with the artworks. To prevent an overly narrow criticism excerpt, the full-text criticisms should be selected for recording. Built-in keywords of the database should avoid bias toward visual descriptions, which leads to a lack of keywords regarding abstract concepts and in-depth analysis as well as unsatisfactory objectiveness in the system scoring results.

3) Criticism tasks scored overly low by the ILAS should be reexamined. Although the ILAS can identify the learning effectiveness of most students, reexamination is required for tasks that received overly low scores. The reasons causing low scores are provided as follows: a) the student misunderstood the artwork, b) the response time was insufficient, c) the response time was unevenly distributed, and d) the student proposed novel concepts that were not present in the database. Teachers can reexamine such papers to determine the reasons for low scores and adjust teaching methods, test time, and subsequent counseling according to individual student situations.

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