

A Tangible Art Learning Tool with a Behavioral Metaphor

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Abstract. The use of metaphors is an important approach in interactive design. A metaphor uses a vehicle to carry a similar concept from another commonly unrelated topic to facilitate understanding. A behavioral metaphor is a kind of metaphor combining referred objects and related action. For teaching and learning in an art course, two famous paintings were converted into two three-dimensional settings. Each setting represents a state of human consciousness or unconsciousness. The changes in position and rotation of objects in the settings may represent a story or mind state. To apply the concept of behavioral metaphor, an interactive tool with a tangible user interface was designed with wood-framed boxes, tangible objects, and interactive media software/hardware consisting of magnetic sensors, a microcontroller, and a tablet display.

Keywords: Metaphor · Tangible user interface · Interaction design · Learning tool

1 Introduction

The use of metaphors is an important approach in interactive design. A metaphor uses a vehicle to carry a similar concept from another commonly unrelated topic to facilitate understanding. In a graphic user interface (GUI), the metaphor is widely utilized as a basic design method. The computer desktop environment is the most successful example of a metaphor. It helps users easily understand a new concept from previous experience [6]. The goal of a tangible user interface (TUI) is to connect the digital and physical space [4]. It also utilizes metaphors to facilitate the perceptual and representational abilities of human beings. The object meaning in a TUI can affect the understanding of operations [3, 8].

Previously, Chen et al. developed an information space navigation system with a TUI [1, 2]. To compare the effects of metaphors between a TUI and GUI, the system utilized a common noun metaphor. A noun metaphor is related to the original object/concept by a similar or typical object. In this research, we focus on the verb metaphor and the behavioral metaphor to develop a tangible user for an information navigation system. A verb metaphor is the movement or operation that is related to the original concept of movement/operation. For example, we use a trashcan to represent a container to store unwanted data. When we remove garbage from the trashcan, we clear the data. This research uses behavioral metaphor to represent a metaphor that combines noun and

verb metaphors. Users can operate it with a similar form and operation that is related to the original concept.

In most arts education curricula, digital media are only used to present traditional course content. It is possible to integrate the content and digital media to develop new forms of curriculum. While young students engage with new media, it can encourage active learning in an art course [7]. In the present research, a course and its interactive teaching tool are developed to illustrate the concept of art and society and to provide the opportunity to let students tell their own stories.

2 Method

For teaching and learning in an art course, two famous paintings were converted into three-dimensional (3D) settings. Each setting represented a state of human consciousness or unconsciousness. The change in position and rotation of objects in the settings may represent a story or mind state. To apply the concept of behavioral metaphor, an interactive tool with a TUI was designed with wood-framed boxes, tangible objects, and interactive media software/hardware consisting of magnetic sensors, a microcontroller, and a tablet display.

2.1 Course Development

Overview and Purpose. This lesson is a unit of a visual art course for Grade 7. It explores the relationship between art and society. The purpose of the lesson includes art form's construction, cultural attribute, creation, and spatial representation.

Objectives. Students can understand the relationship between art creation, society, and culture. Students can identify and apply the social and cultural meaning of arts. Students can have habit of art appreciation.

Material. Paintings of Joan Miró (Fig. 1) and Van Gogh (Fig. 2) are selected to make a pair of boxed settings representing outer and inner space. The two settings were connected through a door.



Fig. 1. Joan Miró: The Tilled Field (Source: www.guggenheim.org)



Fig. 2. Vincent van gogh: the bedroom (Source: www.artic.edu)

Information. Background knowledge about personal information and artwork of Joan Miró and Van Gogh is provided. Detailed contents of Miró's *The Tilled Field* and Van Gogh's *The Bedroom* are helpful for a better understanding.

Activity. After introducing the artists and their artwork, students tell their own story based on the two settings formed from the paintings. Objects, such as animals and furniture, can be used as characters to perform actions and emotions.

Verification. From the recounted stories, the structure and content can show the students' ability to identify and apply the social and cultural meaning of forms.

2.2 Conceptual Design

The two settings were made of wood-framed boxes with open ceilings and movable front and side walls. Objects (animals and furniture) in the paintings were made of models with 3D printing technology. The paintings were image processed as a background to the settings after removing the objects. A tablet computer could display images outside of windows as interactive feedback (see Fig. 3).



Fig. 3. Two boxes setting the stage

2.3 Interaction Design

Tools. Tablet-size (15 × 20 cm) magnetic sensors (GaussToys: GaussSense) were used as the main sensors to perceive the objects’ position and rotation. An Arduino micro-controller was used as the I/O interface. Processing programming language integrated the input information and generated the image output. A tablet was used as the output display and computer.

Design. Two wood-framed boxes were used as containers of the settings. 3D objects (animals and furniture) attached with magnets were used as the TUI. The magnetic sensors were installed in a platform under the boxes (see Fig. 4) and could receive different input signals (see Fig. 5). The display changes the color temperature of the background according to the distance among animals (The Tilled Field) or order of furniture (The Bedroom). A closer or more orderly state results in a warmer background color.

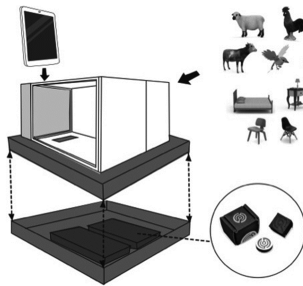


Fig. 4. Installation design

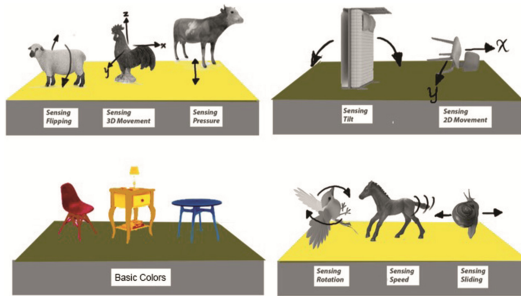


Fig. 5. Input signals received by the magnetic sensors

Use. Users could move or rotate the animals or furniture to play and tell their own story. The image and background of the display respond to changes in shape and color as feedback.

3 Results

In the preliminary test by the researchers, the settings in the teaching tool were used as miniature stages and users manipulated the characters by hands. Through playing with the paintings, details can be observed and perceived with more concentration and sensibility. From the converted and interactive 3D setting, we could see how original images are formed. The energy and atmosphere in the paintings could be imagined vividly, leading to a better discussion of the meaning and possibility of the paintings. We also found that sounds can be an important part of storytelling. We can simulate sounds of animals or other sound effects to play and tell the story (Fig. 6).

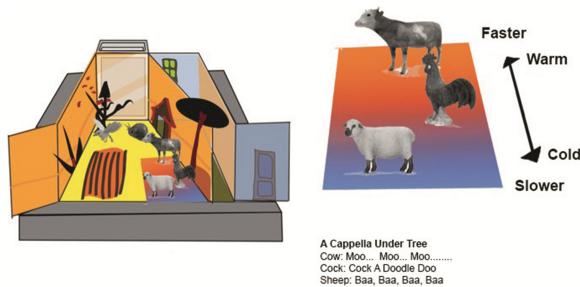


Fig. 6. A sample storytelling

4 Discussion

The form and manipulation of tangible objects can reflect behavioral metaphors in narrated stories, showing that metaphors in artwork do not have only *symbolic* or *operational* meanings. From the corresponding display feedback, the manipulation of the animals and furniture could be recognized as status/attitude/intention of the outer/inner human mind. Unpredictable patterns attract users to try to identify the rules behind the phenomena, especially when the feedback is not so linearly direct. A method to probe the mind of artwork or artists as if to have a conversation with them would be interesting and educational.

The stories that are created by using the tool could introduce more and richer imagery about the artwork. More details and associated concepts will guide a more open perspective about the artwork and will help create original work. The context created in this research is about the topic of social and personal relationships. This model can be applied to other topics in teaching art.

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