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Teach Art Students to Code: Will the computational thinking boost the creativity?

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Abstract

Teaching computational thinking is one of the most important strategies in STEM education. Students perform better in problems solving, systems building and solutions projecting within the benefits and limitations of computing tools. While it is generally regarded that creativity, especially in art and design field, is about "thinking outside the box". The paper proposed a different opinion by viewing computational thinking and creative thinking as the same. Four students from different majors (all art and design related) and educational backgrounds (US and China) are selected as case studies. The goal is to promote a bridge between STEM education and art-based education.

Key words: Computational Thinking; Creativity; Art and Design Practices

Introduction

It has been long and intensively discussed that how the computational thinking fosters the learning results of STEM and non-STEM students. According to Wing, computational thinking will be critical and go beyond the computing related subjects for it combines the “automation” and “abstractions” [1]. The idea of breaking down a complex task or problem into small tangible steps and questions powered up the scientific or engineering discipline by adding a “third leg” to the traditional theory and experiment [2]. Since the computational thinking is heavily drawing on the concepts of computer science, it was always about the interaction between human and machine. However, many researchers started to view programming, computers and computational thinking separately and look at the results of computational thinking in terms of learning [3, 4, 5]. Naturally, computational thinking was regarded as a skill aliasing with the computing tools in order to solve the questions within and beyond science and engineering [6]. As early as 1977, Kay and Goldberg tried to adopt a computing tool “Smalltalk” to let the students to create drawings and paintings via writing codes. Mathematical equations were even used for creating graphic patterns, which opens the door of creative coding [7].

In Kay and Goldberg’s works, they even touched the creation of music in addition to creating visual arts via programming. The possibility of using computational thinking and practicing across the art and design creation relies on the foundation of digitalization of media. Till now, it is not rare to use computing tools to inspire art and design related creations. In terms of education field, the spread of computational thinking into art and design disciplines enabled the cooperation across the majors and fostered the advancement of computational thinking. For example, the concept “sound thinking” is proposed during the practices between the department of music and the department of computer science in the University of Massachusetts Lowell. While the learnings and doings of students are not only about creating living music and performances through the computational tools, but also about encourage the students to create tangible devices to help other music creators to create music [8].

While looking back at original definition of “computational thinking” from Jeannette Wang, it is about “solving problems, designing systems, and understanding human behaviors, by drawing on the concepts fundamental to computer science” [1]. It is very humanistic and emphasizing the ideas over artifacts. However, in the practical teaching and learning environments, the participation of computational tools (such as coding) actually becomes the key to boost creativities and open new possibilities. According to Epstein, creativity can be judges as four core competencies: capturing novelty, challenging established thinking and behavior patterns, broadening one’s knowledge beyond one’s limitation, and surrounding oneself with new social and environmental stimuli [9]. Definitely, learning new computational tools will put the students into different scenarios and let them challenge and broaden what they have already handled. However, the creativity is about reaching the certain goals and then go further of that. In another word, different from the traditional science and engineering disciplines, the great breakthroughs in art and design field comes from the moving forward and backward of expectations. Computational thinking would help students to break down goals and tasks, guide them to do researches and find references, but the students must be used to modify plans, change strategies and even reset goals in terms of achieving creative works. Besides that, using computing tools to create art and design works is challenging for the students have to switch between two sorts of thinking: Creative thinking and computational thinking. When dealing with a creative project, the student must use computational thinking to go closer to the results and challenge the stereotypes with the power of creative thinking. For art and design major students, the first and fundamental step is to push them out of the comfort zone and make them exposed to the computing tools and train them to analyze problems and goals using computational thinking.

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Computing Education in Art and Design

Since 2016, I started to teach art and design majors students to use creative coding tools to achieve their interactive projects. Processing and Arduino are two main software in my teaching practices. After the short foundational and intro-level courses about Processing, Arduino and creative coding, I always encourage students to learn based on projects. Usually, students come with some initial ideas about their interactive works. Since most of them are undergraduate students, they already have some knowledge and skills about graphic design, digital media, product design, interaction design and so on. A combination of their original skills with creative coding helps them to put forth new ideas and concepts, as well as a mixed of their old design strategies and the computational thinking. Previous researchers explored the learning results of engineering students under the methodology of blending computational thinking with creative thinking [10]. One of the key successful points of implementing the mixed approach is that the students will keep absorbing new knowledge and skills and setting up goals inspired by creative thinking. This questions or problems based scenario boosted students' motivation and the abilities of self-regulations. In my teaching practices, I found it is useful for mostly students will lose interests if they could not find the "meanings" of doing that. The accomplishments of small challenges actually encouraged them to keep going.

I selected four of my students from two majors - two from visual communication and two from digital media - to look closer at their creation and thinking processes.

Project 1. Research on the Visual Illusion

This project is motivated by the strong interest in an area of visual communication - visual illusion. It is already a mature topic in the visual psychology area, however, rarely explored under the context of interactive media. Using Processing, it is not hard to recreate the visual illusions, and took the advantages of the repeatable drawing function of the software to turn the visual illusion graphics into motion graphics.

With limited time, I encouraged the student to add another layer to this project. The student made the mock-ups of moving the mouse to change the value of the variables (x position, alpha), so I introduce Microsoft Kinect and the body detection techniques. Finally, the visual illustration effect will move with the user's body position (Fig. 1)

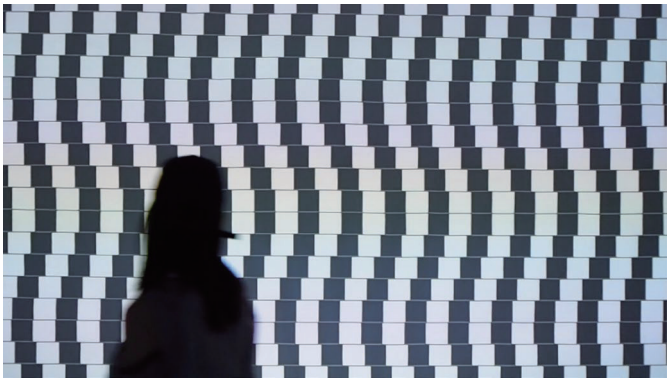

Fig. 1 Project "Research on the Visual Illusion"

Project 2. Cutting Troubles

The concept comes from a metaphor made by a Chinese poet that one's hair is the "lines of troubles". In Buddhist culture, cutting all hair down means keep away from the earthly world. The different hairstyles also represent different genders, personalities, social statues, etc. In light of this, cutting hair is about saying goodbye to the old.

When the student came to me with the concept, I immediately thought of their long training on sketches and drawing portraits. The idea of using lines and curves to represent a figure or portraits is the basic step of learning fine arts. After a short discussion, to use hair-like curves to draw portraits dominated. With the help of Processing, it is not hard to draw hairs in different shapes. However, I encouraged the student to do researches and find some tutorials or references about drawing curves to stimulate the human hair (Fig. 2). Shortly, the student provided me a solution with some tryouts (https://processing.org/tutorials/curves/). The advancements of this project are pushed by proposing questions and doing researches. For example, the camera should recognize the human face in order to start the interaction so the "face recognition" became a main research topic for the student. After an exploration on the technical backgrounds, the student resembled it and planned the interaction, then iterated.

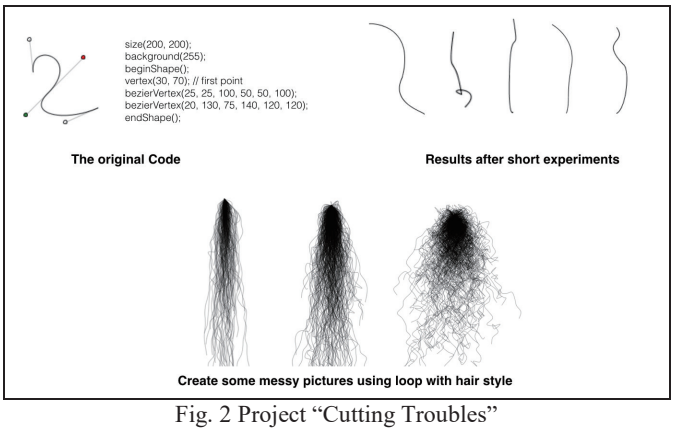

Fig. 2 Project "Cutting Troubles"

The final interactive effect is: when the audience approached the certain position, the camera starts to capture the edges and draw the figure of the audience with the hair-style lines. When s/he left, the hair will disappear accordingly.

Project 3. City Saving Plan

"City Saving Plan" is an interactive educational installation (Fig. 3). The aim of it is to challenge the traditional educational toys and teach the kindergarten-level kids knowledge through storytelling. The children could interact with the different sensor (wind, light and temperature) to stimulate the different ways of generating electricity.

During the development of this project, storytelling experience was highly valued by us, because this installation is supposed to be intuitive. In one aspect, it should be clear and easy to follow so that engaging the users. On the other hand, the proposed user experience has to be fulfilled by the interactive technologies.

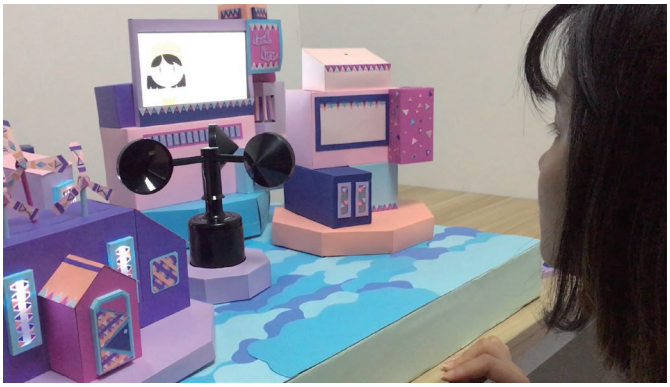

Fig. 3 Project "City Saving Plan"

Project 4. Will You Call Me

This work contains two crucial parts: Arduino that builds connection between code and the user's interaction; real voice recordings of people from different social statues and identities. When audience pick up the telephone, he or she will hear different pieces of voice recordings that being played randomly. By participating in this project, audience will be touched by the actual calling that they never pay attention to, and understand each person's life is different from what it looks like from the surface.

While the student took a lot of effects on coding and fumbling with the computational logic. This project is more about the artistic expression. The original statement of this work is on the true value of an object, such as the producing procedure behind an artwork, the hard time a person was experienced, and a history of a structure or place. It is also a reflection on being surrounded around the "quick information" from digital media. In order to turn a vague abstract art concept into a tangible and specific artifact. We tried to recall the narrative scenarios around the concept. In each scenario, the abstraction of the logic clue is useful for us to view a connection between them. With the help of computational thinking, the student is able to divide the concept into scenarios, set the aims and goals of the interaction, backbone the logic clues between a concept and the work.

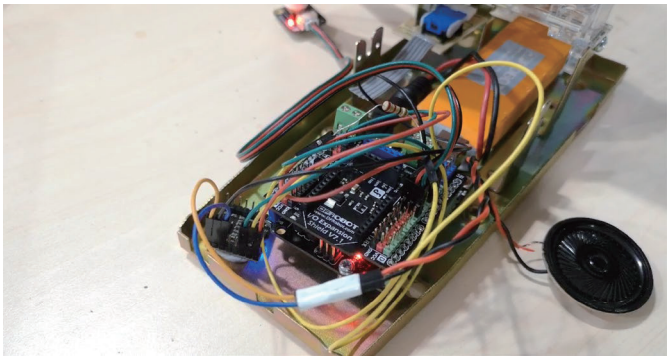

Fig. 4 Project "Will You Call Me?"

Summary of CT on Art and Design Practice

While the computing processes relied on the adoption of the computational thinking, the students show the clear variety depending on their different knowledge backgrounds and structure. In light of this, I would rather to view the computational thinking as a methodology to inspire students. Take the *Project 4* for example, the computational thinking works well in the early concept generation stage. From another perspective, computational thinking is the strong way to motivate students via breaking down the large goals into small tangible questions. *Project 2* is a demonstration of getting touch to some very technical knowledge for art and design student. Without deconstructing and researches, it is impossible for the student to finish this project.

The computational thinking and computing tools are intermingled on some levels. For one thing, in order to realize the ideas, they have to learn much new knowledge. However, it is not just look at some examples and mimic them. If they need to go deeper into the solution, computational thinking is necessary even though they didn't notice that. This will work reversely to round up their initial concepts and make it more reasonable. For example, the *Project 3* is heavily on the user experience side. However, when the storyline fit with the computing logic, the interaction turned to be smooth.

Discussion

One of the challenges in computing education is the language barrier of the non-native English speakers. Guo put forth that the non-native English speakers are hard to read and write the code, do researches, ask for help and communicate if their English is not so good [11]. However, I found the language problem is deeply linked to the thinking process. If the students cannot articulate the questions, the changes are high that they don't understand and will be stuck. It could be from the language barriers and lack of the native language data. However, more frequently I found the problems located in their thinking processes and knowledge structures. The creativity is far more than generating innovative ideas but assembling both logic thinking and artistic thinking. To define artistic thinking, I believe it is a stand point from the human instead of the machine. The computing tools or the coding will clarify the logic of the students, however, the computational thinking is far more than that. Even the behaviors like sketching, writing, explaining to others helps the students. There will be a balance

between the inputs and outputs during the learning process. From the everyday teaching practices, it is better that the tutors consider it and use it.

It is also tricky to clearly divide art and science, logic and creativity. One could argue that science and logic are like the fundamental layers on which art and creativity are built. But scholars tend to view them as a joint way for teaching and monitoring the learning results [10]. However, given the limited time and resources, the tutors have to consider how to teach or at least guide the art and design students to learn techniques. Emphasizing either side too much will risk the jeopardizing the creativity. But how to balance it and foster the students to achieve the best learning results. From my suggestion, computational thinking will be the crucial step for art and design student to take and for the educators to adopt.

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