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An Interactive Canvas of the Ideation Process in STEM Education

Biyun HUANG*
Centre for Learning Sciences and Technologies, The Chinese University of Hong Kong, China
*lucyhuang99@gmail.com

Abstract: The ideation process is essential for fostering high-quality STEM education outcomes. Although the use of technological tools in STEM education may improve students' learning efficiency and promote students' learning engagement, few studies were devoted to scaffolding the thinking of students in this area. This study proposes to develop an interactive canvas to facilitate the ideation process based on the characteristics and needs of secondary students. In the development of the interactive canvas, we referenced the EDIPT model and other theories to support our design. The design will be tested in middle schools in Hong Kong and will be further improved after the trial.

Keywords: STEM, interactive canvas, ideation process, EDIPT

1. Introduction

Currently, both policy makers and educators are paying increasingly more attention to STEM education (Skinner, Saxton, Currie, & Shusterman, 2017). In contrast to the traditional lecturing approach, STEM education emphasizes the integration of learning with real-world tasks so as to develop students' problem-solving capabilities and twenty-first-century skills (e.g., creativity) (Lee, Chai, Hong, 2019). Empirical research on STEM education shows that idea-centered knowledge building is effective in promoting collaboration and high-level thinking as well as high-quality STEM products (e.g., Hong, Lin, Chen, and Chen, 2018). Student ideation is one of the key elements in ensuring successful STEM outcomes. However, there is a lack of technological tools supporting ideation processes targeting middle school students.

2. Research Goals

This study aims to develop an interactive canvas that facilitates students' ideation and collaboration in STEM courses, which matches the characteristics and needs of middle school students. The interactive canvas will be used and tested in actual STEM courses in Hong Kong using quasi-experiments. The research question is, to what extent does the interactive canvas influence students' 1) participation, 2) STEM product, and 3) motivation?

3. The Design of Interactive Canvas

One of the theoretical foundations of the interactive canvas is the five stage empathize-define-ideate-prototype-test (EDIPT) model (d.School, 2010). In the empathize stage, learners need to make efforts to understand the physical and emotional needs of a targeted group. In the define stage, learners need to delineate the challenges to be undertaken by considering the needs of the users and the context. In the ideate stage, learners need to generate a range of ideas for possible solutions. In the prototype stage, learners select the potential solutions and start building prototypes. In the test stage, learners use the prototypes, solicit feedback, and refine the solutions. See Figure 1.

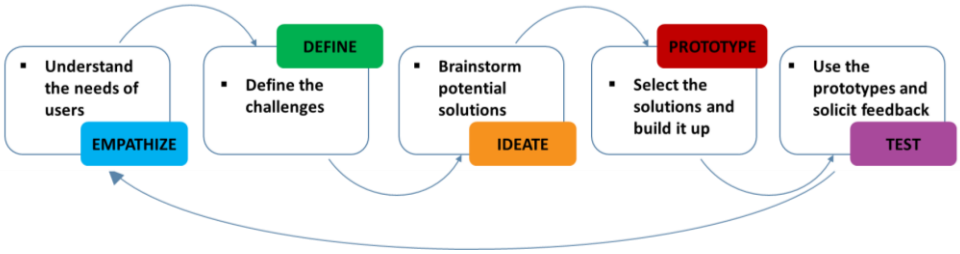

Figure 1. EDIPT Model and key procedures adapted from d.School (2010)

Conventionally, teachers followed the EDIPT model to guide the exploration process of students by using sticky notes, tape, and other non-technology based tools. While these items were widely available, their use was problematic for the following reasons: inconvenient storage and organization of notes; not facilitating the in-depth construction of knowledge (Chalmers, Carter, Cooper, & Nason, 2017); no interactive reminders; no provision of instant feedback, contextualized databases or multimedia notes; and no promotion of community building. Hong et al. (2018) established an online knowledge-building environment, which supported the functions of note-taking, searching, and community building, for university students, and found the environment promoted collaboration and inquiries. Nevertheless, the issue has not been fully addressed in middle schools' contexts as of yet. Achilleos et al. (2017) conducted a survey study to understand the impact of social media and competition on students' STEM learning experience, but they did not assess other technology-supported functions, such as interactive reminders and instant feedback. To bridge this gap, the study proposes the development of an interactive canvas that features: a convenient way of keeping and tracking the notes of each curriculum unit; facilitation of the in-depth construction of knowledge; interactive reminders or notes; instant feedback with gamification; a contextualized database; multimedia notes; and community building.

4. Discussion and Future Plans

An interactive canvas has the potential to engage learners in the STEM learning process as a community and stimulate in-depth inquiry. It is worthwhile to investigate the efforts to develop an interactive canvas that meets the needs and matches the characteristics of middle school students. The researchers may encounter the following problems when building it, such as understanding the needs of secondary level STEM educators and students, setting up a relevant and supportive interdisciplinary resource bank, and breaking through technical bottlenecks. In response to the challenges, the researchers plan to work closely with educators, professional system developers, and interdisciplinary experts to explore solutions, run trials and test the system in iterative cycles.

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