How Are Different Educational Cultures Incorporating Maker Education? The Case of China

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Abstract: This study aims to understand how maker education is interpreted and applied in China. We observed eight makerspaces and interviewed one educational researcher, twelve maker educators, and two principals in different parts of China. Results show that implementation of maker education in China is deeply influenced by the country's educational culture, national policy, and societal agenda.

Literature review and problem description

The maker movement has enabled people to make creative, personalized artifacts that were previously only available in the industrial mass manufacturing realm. According to Martin (2015), maker education involves the usage of "newly affordable digital tools," such as 3D printers, laser cutters, microcontrollers, and traditional crafts, bringing into schools "playful, asset- and growth-oriented, failure-positive, and collaborative" accompanying "engineering- and design-relevant learning activities." The process of ideating, designing, and making in the makerspaces represents the core concept of constructionism (Blikstein, 2013). This process has also incentivized middle and high schools in China to integrate maker education into their programs. In 2016, the term "maker education" was first mentioned in a national government document (Ministry of Education [MOE], 2016). In our literature review, we noted a lack of empirical data examining how maker education is being adopted in Chinese educational environments. Zheng and Peng (2018) reviewed and summarized four issues: "practitioners' cognitive biases," "polarized use of tools," "insufficient teacher ability," and "difficulty of evaluation." However, no supporting empirical data was found in this paper or the cited literature. Thus, it seems like there is a considerable gap between the rapid adoption of maker education in China and the research and theoretical formulations on the topic, which led us to our main research question: *How are maker programs being designed and implemented in Chinese schools with what goals and instructional approaches, compared to maker programs in the West and in the US?*

Methods

Twelve maker educators in Chinese middle and high schools, two principals, and one government researcher from five economically developed cities in China were interviewed. They included fourteen males and one female, with an average of 19.2 years of teaching experience. Each interview, done through video calls, lasted approximately 60 minutes, was conducted in Chinese, and then translated by the first author. Based on the research questions, different interview protocols were created for educational policy researchers, principals, and maker educators. Also, makerspaces/labs in seven high schools and one government makerspace located in three of China's economically developed cities were visited, and a protocol was designed for these observations. For the analysis of the interviews, we used a grounded coding approach (Heath & Cowley, 2004). The transcripts were examined for common themes through three cycles of refinement.

Findings

Our analysis revealed five main themes: (1) 5 out of 15 interviewees believed that the concept of maker education from western countries is similar to what they had been teaching prior to the emergence of maker education through the national "General Technology" curriculum. They believed this qualified them as maker educators. However, our data suggests that most interviewees did not exhibit a clear understanding of what is novel about maker education and nearly all interviewees defined maker education based on the technologies but not pedagogies. When describing their experiences, few referred to educational theories or models such as project-based learning, STEM/STEAM, interdisciplinary work, John Dewey, or Constructivism—nor scholars such as Freire, or Papert. (2) Government and "top-down" implementations play a significant role in the promotion and deployment of maker education programs. (3) 10 out of 15 interviewees mentioned that one of their principal goals in setting up makerspaces is to encourage students to attend competitions which teachers believe will impact their students' academic achievements, and nine out of twelve interviewees brought up competitions when they were talking about innovation education or cultivating students' creativity. (4) 12 out of 15 interviewees believe maker education is a part of "innovation education" which can help them find and cultivate gifted students. It

reveals a focus on finding advanced STEM students instead of targeting the entire student population at the school. (5) 9 out of 15 interviewees mentioned that many teachers struggled to be creative and interdisciplinary in their teaching practice. The makerspace observation data revealed one clear pattern: trophies and awards are displayed prominently in most spaces, reinforcing some of the findings from the interviews (see Figure 1 and Discussion).

Figure 1. Medals and trophies displayed in 4 schools' makerspaces.

Discussion

The way Chinese educators understand the concept of maker education is deeply influenced by various internal factors, such as their previous teaching experience in relevant domains, and external factors, such as the government's education policy and the country's own cultural and societal issues. We found a deep sense of alignment with the government's effort for "mass entrepreneurship and innovation." It also seems the implementation of maker education in China is a much more centralized process in which government policies, funding, and initiatives have a central role, compared to the relatively decentralized realities of school systems in the US. Also, competitions and awards were found to be a central factor for schools to engage in maker education. These findings were coherent with the prevailing placement of maker education as "innovation education" and a pipeline for outstanding students, which revealed a discourse around excellence rather than educational equity. Finally, the difficulties around teacher professional development for more creative and interdisciplinary practices point to the possibility that more technocentric, vocational versions of maker education are becoming prevalent in China. The seemingly lack of theoretical principles that are usually associated with maker education in the West could point to an attempt by Chinese educators to define this pedagogy in their own terms within China's social, cultural, and educational context. Also, it could be simply due to the lack of tradition in researching specific authors and approaches in China compared to Europe and the US. However, the disconnect we found between maker research in China and the rest of the world is of concern; most recent international debates revolve around equity, creativity, and interdisciplinary work – moving away from conversations around the job market, gifted students, and the "STEM pipeline." It seems that these more recent debates have not yet reached Chinese educators in a significant way. It parallels the development of maker education in the West, in which competitions and the "Maker Faire" were significant initial motivators, but were found to be detrimental for inclusion and diversity. Another parallel with the early days of maker education in the West is the technocentric approach, which regards maker technologies as more important than the development of new *pedagogies*. The fact that Chinese maker educators believe that maker education is merely a new name for "old" practices suggests the lack of a clear definition of what maker education is, even in the US (Martin, 2015) – opening up possibilities to reinterpret it in ways that could be quite far from the predominant culture of the maker movement in education, which is mostly characterized by valuing student agency and less rigid pedagogies. Even though this paper is limited to a few schools, stakeholders, and regions, it seems that the development of maker education in China is very connected to the country's own societal and educational issues and would benefit from integration and exchanges with maker education in the rest of the world.

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