Making, Innovation, and Science Education: Considering Two Layers of Analysis
Fresh Ontological Lenses Provide Novel Insights

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KEY IMPLICATIONS

• Abductive reasoning underpins creativity, uniting the creation of new knowledge claims in science and creative efforts in other fields.
• Makerspaces can serve as community centres of innovation if attention is paid to setting up positive sociocultural factors underpinning knowledge creation.
• An ontology of science distinct from current perspectives may contribute to an appreciation of the nature of knowledge creation in science.

BACKGROUND

Makerspaces are rapidly gaining attention in the local education community as sites for innovative STEM education. While this attention is welcomed in that renewed attention to STEM will inevitably lead to some positive changes, a concern exists that schools may “repackage old wine in new bottles”. Similarly, it is important to avoid fetishisation of technology, and work on the underlying sociocultural patterns of learning prior to amplifying these patterns with technology. This study then takes as givens that: technologies do not “plug-and-play” for learning; idiosyncratic goals within specific contexts have large influence on eventual learning goals; and learning is a multifaceted phenomenon requiring integration of studies on levels ranging from cognition to sociology. The general approach here is to respond to the question of educative value of makerspaces: how exactly are makerspaces of value to learning in the Singapore context?

FOCUS OF STUDY

With innovativeness as a focus, how do: (a) making activities in makerspaces, and (b) social organisation of makerspaces, contribute to student's learning to be innovative individuals and organisations? For Study 1, an embodied cognition lens was used to interpret participants’ actions in creative problem-solving activity. For Study 2, a successful school-based makerspace was studied for cultural patterns of behaviour.

KEY FINDINGS

The reasoning process underlying creativity appears to be abductive in nature: given a puzzling scenario in either the natural sciences or in creative problem solving, an initial abductive speculation needs to be made, and predictions arising from this speculation tested against reality. Through an iterative cycle, one gets progressively nearer to the truth or the creation of novelty. In controlled studies of participants’ problem solving, a greater degree of such speculation is correlated with better creative outcomes. As these speculations are
forms, opportunities need to be given for students to generate new knowledge claims that require empirical investigation. Makerspaces, while loaded with things that often have prescribed means of interaction, should be configured for maximal flexibility for student driven inquiry instead. It is imperative that we relook the teaching, learning, and nature of science in school classrooms. Conventionally perceived, the successes of science and technology in everyday lives can obscure the uncertainty that is associated with knowledge production. If we continue to portray science as responsible for bringing us utopian visions of the future, we risk misrepresenting the tentativeness and the role of the humanities in imagining the future, to our own peril.

**SIGNIFICANCE OF FINDINGS**

If innovativeness is perceived as central to Singapore education, it may be of much theoretical and practical interest to reconsider our approach to science instruction. Besides ensuring accuracy to canonical forms, opportunities need to be given for students to generate new knowledge claims that require empirical investigation. Makerspaces, while loaded with things that often have prescribed means of interaction, should be configured for maximal flexibility for student driven inquiry instead. It is imperative that we relook the teaching, learning, and nature of science in school classrooms. Conventionally perceived, the successes of science and technology in everyday lives can obscure the uncertainty that is associated with knowledge production. If we continue to portray science as responsible for bringing us utopian visions of the future, we risk misrepresenting the tentativeness and the role of the humanities in imagining the future, to our own peril.

**POPULATION**

Approximately 25 students and six adult volunteers from two schools were involved in this study.

**RESEARCH DESIGN**

A video-based case study was used in the first part of the study. An ethnographic investigation was used in the second.

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