Design Thinking from Multiple Perspectives

Aik Ling Tan | ORCID: 0000-0002-4627-4977
Nanyang Technological University National Institute of Education (NTU NIE), Singapore, Singapore
aikling.tan@nie.edu.sg

Abstract

Design thinking is interpreted and implemented in various ways as detailed by the five articles in this special issue. Besides offering a summary of the five articles, this editorial commentary advocates for the need to view design thinking more holistically by considering the larger system in which the solution resides and also giving thought to the end-point of design thinking cycles.

Keywords

systems thinking — design thinking — design-based learning

Design thinking is a framework comprising cognitive, strategic, and practical processes for developing design concepts that address user needs. The specific attention paid to understanding users when designing solutions is one that is worthy of attention as it allows for problems to be addressed from holistic perspectives that take into consideration not only technical and logical aspects but also emotional and social aspects. This could likely result in solutions that are useful and meaningful for the intended user and not just meaningful to oneself. Integrated STEM learning and problem solving could benefit from the inclusion of a framework that considers user needs in the design of solutions.

Existing research in both integrated STEM learning and design thinking emphasizes the idea of empathy development in helping learners better understand the experiences of users. Different curricular designs, implementation and evaluation methods have been deployed and reported to uncover the uniqueness of a design thinking framework in integrated STEM learning. While the research in design thinking and integrated STEM learning is robust,
specific understanding of curriculum design considerations, contextual peculiarities of design thinking in integrated STEM learning and evaluation of learning outcomes remain as areas that would benefit from more in-depth research.

Specifically, the application of design thinking in integrated STEM learning warrants attention in three key areas. Firstly, the benefits of design thinking as a framework over other ways of implementing integrated STEM learning can be explored more empirically. Secondly, the construct of empathy in design thinking as applied to integrated STEM learning can be more carefully unpacked and discussed in the context of aspects of empathy such as cognitive and emotional empathy. Lastly, means of evaluating outcomes of design thinking informed integrated STEM learning remain largely elusive and could benefit from more research, debates, and discussions.

The five articles in this special issue pay attention to and elaborate on the theoretical and methodological assumptions/underpinnings of the research as the authors reflect on how the integration of the STEM disciplines and design thinking influences the design of learning experiences and analytical methods. More specifically, it is evident from the articles that there are diverse intellectual perspectives and definitions of design thinking and integrated STEM across different grade levels and learning contexts.

In the first article, Teo and her colleagues argued for a need not only to pay attention to problem solving aspects of STEM learning but also to focus on the design aspects of STEM. In their article, they discuss the various humanistic aspects that should be considered in the STEM learning experience. For instance, they show how students were given opportunities to develop humanistic qualities such as self-actualisation, reflexivity, resilience, and interpersonal skills. Of particular importance was that students gained the realization that working in teams to solve problems required each of them to be personally responsible for their part. They thought about how the quality of their output would affect the work required by the next person. This is an important consideration since working in teams and collaboration is one of the key outcomes of future education (World Economic Forum, 2013).

Following Teo et al.’s article on augmenting STEM problem solving with design and humanistic experiences, Tan and his colleagues describe how undergraduate students learnt about design, starting from unpacking and understanding how the mosquito trap works. By ‘dissecting’ the different components of a mosquito trap, students developed other possible designs and tested their design for increased efficacy compared to the original design. The article presented a means of STEM learning that starts from a solution rather than an existing problem. Students’ attempts to improve on existing designs rather than focus on solving problems mirrors the solution-centric STEM
learning as described by Teo, Tan, Ong, and Choy (2021). Starting with a solution rather than problems allow students to focus on improvement of existing designs and has been shown to increase students’ creative experimental ability and their ability to improve the technical product with compared with students who were engaged with problem-centric STEM learning (Tan et al., 2022).

Continuing with the perspective on viewing STEM learning and design thinking more holistically, Lyn English’s article examines the nature of design and its application in society-centred design. She reports design thinking learning experiences for sixth graders that centre around ideas of sustainability and the design of a livable town. She focuses on “learning about” and “learning through” design – learning the principles of design and learning disciplinary knowledge by engaging in design. English’s specific emphasis on the disciplinary knowledge that is applied to solve the problem is important (Honey et al., 2014). For elementary grade levels, it is important that STEM activities are challenging but manageable for students (Bronsens et al., 2022) and tapping on students’ familiar experiences of living in a town is one way of making the activity more approachable.

Besides understanding users and brainstorming, inspiration for design can also come from nature. Vasinatanuwatana and Plianram describe a programme in which preservice teachers learned about biomimicry and used nature’s design as inspiration to solve problems they encountered. For instance, to improve the design of vacuum cleaners, the preservice teachers studied the movement of millipedes (many legs hence repeated contact with the surface) and designed a millipede robot vacuum cleaner. The other innovations inspired by nature that are described in their article include examining the movement of squid to design a squid boat and designing a safety jacket that can inflate when needed just like the puffer fish. Biomimicry presents a novel way to examine design thinking.

Finally, to enable researchers and readers to better understand the extent of design thinking as applied to educational and non-educational research, Park et al. review research of application of design thinking over the last 20 years. They used scientometric analysis and visualization and concluded that design thinking is more widely applied in non-educational settings such as business organisations seeking to improve work conditions and outputs. Design thinking research found in educational contexts typically focused on possible frameworks for application of design thinking as well as teacher professional development for design thinking. Challenges faced by schools and teachers in implementing design thinking include insufficient resources, lack of experience, lack of good ideas and lack of training (Razali et al, 2022). It is hence unsurprising that research on design thinking in education focused
on professional development of teachers. Further, researchers are also trying to understand how design thinking can be incorporated in schools since, as a form of learning, it is a deviation from the mono-disciplinary form of teaching and learning that is the default operation mode of k-12 schools.

The articles in this special issue illustrate multiple ways of understanding and implementation of design thinking. Consequently, this varied interpretation and application in education has made design thinking a difficult idea to evaluate accurately. Design thinking may be different when applied in educational and non-educational contexts and hence it might be difficult to achieve accurate comparison across different contexts. Rather, it would be more meaningful to focus on the intentions of each integrated STEM design thinking activity and evaluate if the specific intentions are achieved from engagement with specific learning experiences.

An important observation that is made from the articles is that design problems identified were usually located in a place in collaboration with the end-user and their needs. The place anchors designers in how they connect their solutions to the problems. While design problems focus on users, one important aspect of design problems when applied in schools and classrooms is often neglected – connecting the solution to the larger system beyond the immediate users. Specific solutions may be useful to the intended users but when considered under the larger social systems and contexts, these solutions may be rendered unsuitable. Take a moment to think about the Soccket (an energy-harnessing soccer ball) invented by Jessica O. Matthews (Hartmans, 2016). The Soccket was invented to supply reliable and cleaner energy to impoverished communities, that is, the invention was intended for specific users. Imagine if the inventors merely focused on the invention and did not tie up with the users and potential donors to fund the invention – their ‘invention’ would have failed because the people who needed the Soccket were not able to afford it while the people who can afford the Soccket would not need it. Incorporating elements of systems thinking in design problems would enable learners to position their solutions in a more strategic manner.

While the iterative cycle of design thinking encourages continuous improvements enabling learners to seek different ways to make their solutions better, learners must appreciate that the number of refinement cycles is finite. In other words, unlike the decay of radio-active isotopes that ultimately only comes close to (but not actually) zero, design thinking cycles should not go on infinitely. Rather, students need to be taught to evaluate and make a decision as to when their solutions are ready to be tested by people that the solution was intended for so that they can collect feedback for future improvements.
References


