Interdisciplinary Journal of Problem-Based Learning

Volume 12 | Issue 2 Article 11

Published online: 9-13-2018

Guest Editors' Introduction: Tinkering in Technology-Rich Design Contexts

Mete Akcaoglu
Georgia Southern University, makcaoglu@georgiasouthern.edu

Ugur Kale
West Virginia University, Ugur.Kale@mail.wvu.edu

Recommended Citation
Akcaoglu, M. , & Kale, U. (2018). Guest Editors' Introduction: Tinkering in Technology-Rich Design Contexts. *Interdisciplinary Journal of Problem-Based Learning, 12*(2).
Available at: https://doi.org/10.7771/1541-5015.1828

The Interdisciplinary Journal of
Problem-based Learning

GUEST EDITORS' INTRODUCTION

Tinkering in Technology-Rich Design Contexts

Mete Akcaoglu (Georgia Southern University) and Ugur Kale (West Virginia University)

Tinkering is an iterative problem-solving process (Bevan, Gutwill, Petrich, & Wilkinson, 2015; Martinez & Stager, 2013; Resnick & Rosenbaum, 2013). It is interest driven, usually informal, and often playful. At the heart of tinkering is the *will* and *skill* to be able to design successful systems, and solve problems. Tinkering is central to making, and can be facilitated through technology-rich (e.g., 3D printers, robotics kits, coding software, etc.) and non-technological tools (e.g., plastic cups, rubber bands, papers, etc.) by allowing learners to be the designers and makers of objects, projects, or ideas (Resnick, 2017).

Following the footsteps of Papert's constructionism (1980), makerspaces, STEM or STEAM labs, or studios are increasingly finding a place in formal school settings (Becker et al., 2017). While there is a lack of visibility of these efforts to guide, unify, and possibly help replicate future practice and research, various design-based models and pedagogical approaches to learning may provide options. As a learner-centered instructional approach, problem-based learning (PBL) can serve as a framework to support learners' problem-solving efforts in makers' context. Learners could be guided to tackle the problem through iterative problem definition, exploration, design, sharing, and elaboration (Savery, 2006; Schmidt, Rotgans, & Yew, 2011).

The six papers that were accepted for publication in this special issue present ways and approaches to address potential issues while implementing PBL approaches to tinkering and making activities in various contexts. One suggested theme across multiple papers is that engaging in such processes is not always straightforward. The authors highlight opportunities and challenges for both inservice and preservice teachers, and they share their experiences related to inquiry, problem-solving, and design in tinkering contexts.

Below, we provide a brief description of each piece. We hope that they not only provide examples but also encourage the PBL and makers community to explore new tinkering and making activities in PBL contexts to further enhance our understanding of them.

Approaches to Tinkering in Technology-Rich Design Contexts

Jill Marshall and Jason Harron present their framework and a rubric for introducing and evaluating maker activities in preservice teacher education. Through a literature review and a survey of educators and others in the field who are engaged in integrating making in education, they identify five elements of making in STEM education: ownership/empowerment, maker habits, production of an artifact, collaboration, and STEM tools. In their article, they provide examples of these elements from their work with preservice teachers and give the readers opinions regarding how to implement maker activities in teacher education.

Monica Chan and Paulo Blikstein present results from a case study conducted to understand the outcomes from middle school students' participation in engineering activities in a makerspace (i.e., FabLab). Through their observations and interviews with students, they identify that makerspaces allow for problem-based learning and inquiry-based activities, and lead to student collaboration and negotiation. They also detail how, in some cases, student preferences can shape instructional approaches. Students may not be willing to work in teams but prefer working individually, but this does not prevent them from engaging in problem-based learning and inquiry.

Shaunna Smith explores how children in a summer camp use visualization skills to negotiate and inform their experiences with both non-digital and digital techniques during making activities that incorporate design-based learning. The results from a qualitative content analysis of the data show the ways in which scaffolded activities support children's spatial skills, and how facilitators' interactions with them aide the hands-on design experience.

In their design experiment, Priyanka Parekh and Elisabeth Gee examine the tinkering and making (meaning) process in an informal educational context by focusing on how artifacts and ideas transition from beginning to end. They specifically

http://dx.doi.org/10.7771/1541-5015.1828

focus on the use of non-technological and low budget tools such as rubber bands and broken toys in promoting tinkering and problem-solving. Through engagement in iterative design and problem-solving in playful, informal learning contexts, Parekh and Gee argue that children discover, learn, and find a use for important STEM knowledge, which may serve for future interest and learning in these domains.

Keri Valentine explores the use of Logo with undergraduate preservice students in a mathematics education course to promote coding and computational thinking skills. In her study, she provides a detailed account of how to support elementary preservice teachers' computational thinking by engaging them in Logo activities targeting K–5 geometry concepts. Valentine argues that providing first-hand experiences as makers of authentic artifacts (i.e., geometric shapes drawn in Logo) supports the development of future teachers' knowledge of geometry, as well as computational thinking and coding skills.

Darran Cairns, Reagan Curtis, Konstantinos Sierros, and Johnna Bolyard describe and discuss how middle school math and science teachers integrated 3D printing into their lesson plans. The authors discuss the process of tinkering and problem-solving involved in the digital design process of 3D objects coupled with processes involved in working with the printed artifacts. Interested readers can find samples of the professional development activities in this practice-focused manuscript.

Conclusion

In this special issue, our contributors highlighted the importance of tinkering in various design contexts, using a wide range of tools, with different populations, and listed various components necessary for its successful implementation. Tinkering and problem-solving do not require funding or technology, as noted in the various papers in our special issue, as long as the teachers are willing to create experiences for their students that give students the freedom to explore, design, and sometimes fail.

Acknowledgments

We would like to thank all the contributors for their papers, the *IJPBL* editors, Drs. Michael Grant and Krista Glazewski, and the great support provided by their editorial assistant, Ms. Haesol Bae. We also would like to thank all our reviewers who have contributed to this special issue.

References

Becker, A. S., Cummins, M., Davis, A., Freeman, A.,Giesinger, H. C., & Ananthanarayanan, V. (2017). *NMC horizon report: 2017 Higher education edition.* Austin, TX: The New Media Consortium.

Bevan, B., Gutwill, J. P., Petrich, M., & Wilkinson, K. (2015). Learning through STEM-rich tinkering: Findings from a jointly negotiated research project taken up in practice. *Science Education, 99*(1), 98–120. https://doi.org/10.1002/sce.21151

Martinez, S. L., & Stager, G. S. (2013). *Invent to learn: Making, tinkering, and engineering in the classroom*. Torrance, CA: Constructing Modern Knowledge Press.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books..

Resnick, M. (2017). *Lifelong kindergarten*. Cambridge, MA: MIT Press.

Resnick, M., & Rosenbaum, E. (2013). Designing for tinkerability. In M. Honey & D. Kanter (eds.), *Design, make, play: Growing the next generation of STEM innovators* (pp. 163–181). New York: Routledge.

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning, 1*(1). https://doi.org/10.7771/1541-5015.1002

Schmidt, H. G., Rotgans, J. I., & Yew, E. H. (2011). The process of problem-based learning: What works and why. *Medical Education, 45*(8), 792–806. https://doi.org/10.1111/j.1365-2923.2011.04035.x