

Special Session: ICER UP CS Ed Research Workshop Summary—Essence of Illustrative Projects

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1. SUMMARY

This SIGCSE special session provides an opportunity for new researchers in CS education to learn the elements of successful computing education research of different types through a series of exemplar projects. Specifically, this session reports on the findings and example, successful CS education research projects that were discussed and presented at *ICER 2016 UP (Understanding and Propagating) CS Ed Research Workshop*, sponsored by the National Science Foundation. One goal of the session is to provide a way for proposers of computing education research to ensure that they have well identified education research questions and evaluation mechanisms that are appropriate for the proposal (exploratory vs. design & implementation) according to the Department of Education guidelines. The ICER Workshop was designed to focus exactly on this goal and report to the community.

Categories and Subject Descriptors

• Social and Professional Topics → Professional Topics
→ Computing Education

Keywords

Evaluation, guidelines, research criteria, research design, research questions, types of research

2. OBJECTIVE

With computing becoming pervasive in all aspects of society, a critical need exists for computer science education to reach a broad audience, beginning with elementary education. At the same time, research in understanding how computing can be effectively communicated to a diverse audience is still quite preliminary as compared to established disciplines such as mathematics and science. To streamline education research, the Department of Education and the National Science Foundation have jointly developed a report that discusses different types of educational research, provides guidelines for justifying and presenting results of such research, and gives examples of each type of research with details [2].

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In conjunction with ICER 2016 in September 2016 at Melbourne, Australia, with support from the NSF, we organized an UP (Understanding and Propagating) CS Ed Research workshop. The ICER workshop brought together computing education researchers and education researchers who have conducted successful education projects. Workshop participants discussed the categories in [2] in depth with the goal of providing computing-specific examples. It provided a forum for researchers to present their efforts spanning different types of research. A key goal of the ICER workshop was to synthesize and understand key outcomes from most relevant projects and to identify—through discussions of exemplar research efforts and lessons learned—how best to communicate to newcomers the elements of computing education research. Workshop proceedings are available at [1].

The outcomes of the ICER workshop includes case studies in computer science education for research types identified in [2]. The outcomes document specific educational research questions asked and methods for experimentation and evaluation to address those questions.

The proposed special session will summarize and disseminate the results from the ICER workshop at SIGCSE. It will present to computer science education investigators exemplars of different types of successful educational research projects in computing, the essence of what made them successful, and help them achieve a better understanding of well-formed education research projects.

3. OUTLINE

The organization of this session is impacted by the discussions from the ICER workshop. Given below is a listing of the types of projects that were discussed at the ICER workshop. Authors of selected exemplar projects who attend SIGCSE will present their work.

- Introduction (10 minutes): Overview of [2] and summary of ICER workshop findings [1].
- Presentation (5 minutes) followed by questions/discussion from special session attendees (5 minutes) for six exemplar projects (60 minutes total)
- Conclusions (5 minutes)

The following papers were accepted, presented, and discussed at the ICER UP CS Ed Research Workshop [1].

- Programming Problem Solving Pedagogy [3]
D. Loksa, A.J. Ko, W. Jernigan, A. Oleson, C. Mendez, M.M. Burnett

- Plagiarism and Related Issues in Assessments Not Involving Text [4]
B. C. Simon, J. Sheard, C. Johnson, A. Carbone, M. Minichiello, and C. Lawrence
- Data-driven Support for Novice Programmers [5]
T. W. Price and T. Barnes
- Automated Tutor for Pinpointing Code Reasoning Obstacles and Improving Student Understanding [6]
M. Cook, J. O. Hallstrom, J. E. Hollingsworth, M. Pfister, and M. Sitaraman
- IUUSE: Design, Development, and Implementation Projects: Computational Creativity to Improve CS Education for CS and non-CS Undergraduates [7]
D. F. Shell, L-K. Soh, E. Ingraham, B. Moore, S. Ramsey
- Gidget – A game for computing education [8]
M. J. Lee and A. J. Ko
- Empirical CSED (NSF DUE 1525373 Transforming Computer Science Education Research Through Use of Appropriate Empirical Research Methods; Mentoring and Tutorials)
J.C. Carver, S. Heckman, M. Sherriff
- Applying Complexity Leadership Theory to the Adoption of Active Learning Strategies
C. Kennedy, X. Jiang, E.T. Kraemer, R. Marion, and M. Sitaraman
- Case Studies of Programming Problems [9]
M. Linn and M. Clancy
- Effectiveness of Analogies in CS Education [10]
Y. Cao, L. Porter, and D. Zingaro

4. EXPECTATIONS

Computer science education investigators will be presented with concrete examples of successful projects that can help develop well-formed education research proposals and projects, with appropriate educational research questions and suitable assessment methods depending on the research category.

5. SUITABILITY FOR THE SPECIAL SESSION

The special session provides a report from an education workshop with the goal of propagating to computer science education researchers how to develop successful education projects. A special session is the ideal vehicle for this purpose.

ACKNOWLEDGMENTS

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6. REFERENCES

- [1] Kraemer, E.T., Sitaraman, M., Lawson, A. *Proceedings of the UP CS Ed Workshop at the 12th International Computing Education Research conference (ICER '16)*. Technical Report RSRG-16-04, School of Computing, Clemson University, Clemson, SC 29634, December 2016, 35 pages; <https://www.cs.clemson.edu/resolve/research/research.html>
- [2] Earle, J., Maynard, R., Neild, R. C., Easton, J. Q., Ferrini-Mundy. 2013. Common guidelines for education research and development. Technical Report. U.S. Department of Education Institute of Education Sciences and the National Science Foundation. Washington, DC.
- [3] Loksa, D., Ko, A. J., Jernigan, W., Oleson, A., Mendez, C. J., & Burnett, M. M. 2016. Programming, Problem Solving, and Self-Awareness. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, CA, USA, May 07 – 12, 2016). DOI=10.1145/2858036.2858252.
- [4] Simon, C. B., Sheard, J., Johnson, C., Carbone, A., Lawrence, C., & Minichiello, M. 2016. Plagiarism and related issues in assessments not involving text. Retrieved August 25, 2016, from <http://www.olt.gov.au/project-plagiarism-and-related-issues-assessments-not-involving-text-2012>.
- [5] Price, T. W. and Barnes, T. 2015. An Exploration of Data-Driven Hint Generation in an Open-Ended Programming Problem. *Proceedings of the Workshop on Graph-Based Data Mining* held at EDM'15, 2015.
- [6] Drachova, S. V., Hallstrom, J. O., Hollingsworth, J. E., Krone, J., Pak, R., and Sitaraman, M. 2015. Teaching Mathematical Reasoning Principles for Software Correctness and Its Assessment. *ACM Trans. Comput. Educ.* 15, 3, Article 15 (August 2015), 22 pages. DOI=10.1145/2716316 <http://doi.acm.org/10.1145/2716316>
- [7] Shell, D. F., Soh, L., Flanigan, A. E., & Peteranetz, M. S. 2016. Students' Initial Course Motivation and Their Achievement and Retention in College CS1 Courses. In *Proceedings of the 47th ACM Technical Symposium on Computing Science Education* (Memphis, TN, USA, March 02 – 05, 2016). DOI=10.1145/2839509.2844606.
- [8] Lee, M.J., and Ko, A.J. 2015. Comparing the Effectiveness of Online Learning Approaches on CS1 Learning Outcomes. In *Proceedings of the eleventh annual International Conference on International Computing Education Research* (Omaha, NE, USA, August 09 - 13, 2015). ACM, New York, NY, USA, 237-246. DOI=<http://dx.doi.org/10.1145/2787622.2787709>.
- [9] Linn, M. C., & Clancy, M. J. 1992. The case for case studies of programming problems. *Communications of the ACM*, 35(3), 121-132. DOI=10.1145/131295.131301.
- [10] Cao, Y., Porter, L., and Zingaro, D. 2016. Examining the Value of Analogies in Introductory Computing. *Proceedings of the 2016 ACM Conference on International Computing Education Research*. 2016.