

# Puzzles in Many Places: Closing the Loop on Propagation

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## ABSTRACT

As one develops instructional innovations, it is important not only to propagate them into new and different environments, but also to study their efficacy in these new locations with different demographics of students. Previously, we showed that introductory CS assignments based on various pencil-and-paper puzzles are valuable, but this study was done at a single university. In this poster, we report on propagation of puzzle-based assignments to many universities and collection of the resulting data from these different contexts. This allows us to study the efficacy of the assignments in these disparate environments. In order to ease adoption at other universities, we are also interested in the experience of the instructors in implementing the assignments in their courses. Our overall goal is to “close the feedback loop” by collecting and analyzing all of this data to improve both their effectiveness and adoptability. This poster presents details of the deployment and data collection process, including working with the respective IRBs, selecting and implementing the various assignments, collecting student grades and survey responses, and conducting instructor interviews, in the hopes that it will help other educators to more efficiently and effectively close the feedback loop for their own innovations.

## CCS CONCEPTS

• **Social and professional topics** → **Computing education**; *Computational thinking*.

## KEYWORDS

Propagation, collaboration, multi-site data collection

## 1 PROJECT GOALS

Our previous work showed the value of *pencil puzzles* (such as sudoku, but including many others) as a context for introductory computing assignments [1]. Pencil puzzles can be naturally used to demonstrate a variety of introductory computing concepts. This domain also offers instructors the flexibility to incorporate puzzles into any type of assignment, allowing for easy adoption into existing courses. Our initial study was undertaken at a single university and primarily with students majoring in a computing discipline, so it remains to be shown if pencil-puzzle-based assignments are equally effective with more diverse student populations situated in different contexts. While our overall goal is to conduct educational

research to understand the value of these assignments in different contexts, here we describe our process for working with instructors (who are not part of our project team) at a variety of institutions to deliver pencil-puzzle-based assignments in first- and second-year computer science courses. Our aim in this poster is to summarize the steps (and the pitfalls we encountered) to help others conduct multi-site research and close their propagation feedback loop.

## 2 PROCESS SUMMARY

In brief, our process of propagation and data collection involves:

- Finding willing collaborators in diverse academic contexts
- Working with collaborators’ Institutional Review Boards
- Selecting puzzle-based and comparison assignments
- Generating and deploying location-specific surveys
- Collecting comprehensive data throughout the term
- Cleaning and preparing data for analysis

By design we encourage each instructor to deploy a puzzle-based assignment of their choosing within their own course structure and style. As such, there is some heterogeneity in the data, such as in grading standards and rubrics, but the survey questions and grade data collected are homogeneous across all cases. This serves our purposes to investigate the efficacy of pencil-puzzle-based assignments in different contexts.

## 3 CONCLUSIONS

Deployment of assignments in disparate contexts and the corresponding data collection involves a number of hurdles, both expected and unexpected. However, to date, using this process, we have successfully collected robust data from 17 deployments at 8 locations, with more underway, and begun analysis. To the best of our knowledge, previous multi-site studies have either widely deployed instructional innovations, but are not focused on publishing research results on efficacy (e.g. [2]), or have surveyed students at various universities without the context of narrowly-defined instructional innovations (e.g. [3]). Through the process presented in this poster, we intend to show that multi-site investigations of propagation that involve data collection are feasible and significantly contribute to the knowledge base of CS educational research.

## REFERENCES

- [1] Zack Butler, Ivona Bezáková, and Kimberly Fluet. 2017. Pencil Puzzles for Introductory Computer Science: An Experience- and Gender-Neutral Context. In *Proceedings of SIGCSE 2017*. 93–98. <https://doi.org/10.1145/3017680.3017765>
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- [3] Miranda C. Parker, Mark Guzdial, and Shelly Engelman. 2016. Replication, Validation, and Use of a Language Independent CS1 Knowledge Assessment. In *Proceedings of ICER 2016*. ACM, 93–101.

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