



Course Delivery Methods, Student Success, and Self-efficacy in Introductory Programming

Christopher Bogart
cbogart@cs.cmu.edu
Carnegie Mellon University
Pittsburgh, PA, USA

Can Kultur
ckultur@cs.cmu.edu
Carnegie Mellon University
Pittsburgh, PA, USA

Eric Keylor
ekeylor@cs.cmu.edu
Carnegie Mellon University
Pittsburgh, PA, USA

Jaromir Savelka
jsavelka@cs.cmu.edu
Carnegie Mellon University
Pittsburgh, PA, USA

Majd Sakr
msakr@cs.cmu.edu
Carnegie Mellon University
Pittsburgh, PA, USA

ABSTRACT

Self-efficacy has been claimed to be a predictor of students' motivation and learning [1]. It has been found to be sensitive to students' success, and to affect their academic achievement. In the CS/IT education context, where the drop rates are high, it is important that students not only gain knowledge and skills, but also self-efficacy, so that they persist in the program. In this study, we investigate 602 students taking an introductory Python course via different delivery methods: (i) traditional in-person; (ii) cohort in-person; (iii) synchronous online; and (iv) asynchronous online. Although modality predicted retention and success, we found no apparent links among learning, student retention, and self-efficacy. However we found evidence that cohort learning may in particular help struggling students catch up with their peers.

ACM Reference Format:

Christopher Bogart, Can Kultur, Eric Keylor, Jaromir Savelka, and Majd Sakr. 2024. Course Delivery Methods, Student Success, and Self-efficacy in Introductory Programming. In *Proceedings of the 2024 Innovation and Technology in Computer Science Education V. 2 (ITiCSE 2024)*, July 8–10, 2024, Milan, Italy. ACM, New York, NY, USA, 1 page. <https://doi.org/10.1145/3649405.3659500>

1 CONTENT

We administered a self-efficacy survey for course learning objectives at the start and end of each term for 37 instances of a course delivered by instructors at 15 schools, mostly community colleges. We measured the effects of different course delivery methods on the changes in students' self-efficacy, and its relationship with success in the course.

Instructors were allowed to deliver the course in any modality they wished; their choices fell into four main categories.

- (1) **In-person (Traditional):** Classes met regularly in a physical classroom face to face (F2F). Students do not necessarily take other courses together. (11 sections; totaling 140 students)

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

ITiCSE 2024, July 8–10, 2024, Milan, Italy

© 2024 Copyright held by the owner/author(s).

ACM ISBN 979-8-4007-0603-5/24/07

<https://doi.org/10.1145/3649405.3659500>

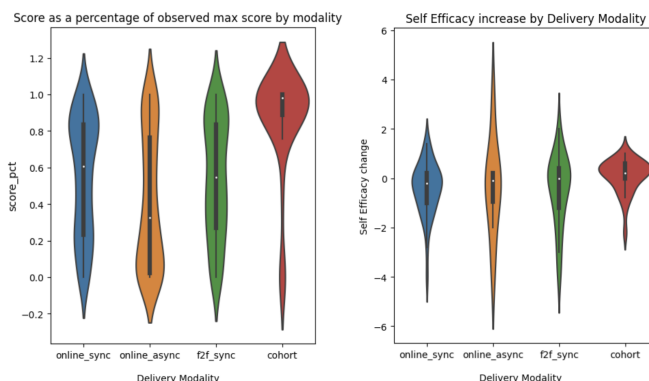


Figure 1: Score (proportion of possible points) and self-efficacy change, by course modality

- (2) **In-person (Cohort):** Students take multiple courses together as a group, often following a set curriculum and timeline. (2 sections; 34 students)
- (3) **Online (Synchronous):** Course offered online, with synchronized shared deadlines and online sessions or support to keep students in a similar pace. (10 sections; 205 students)
- (4) **Online (Asynchronous):** Students proceed at their own pace, and instructor provides online support as needed. (14 sections; 223 students)

Fig 1, shows that students in the cohort modality had significantly higher scores than the other modalities. (F test, $p < .01$ and R-squared 0.09). Spread of student scores was less in cohort learning (s.d. = 29% of grade) than in other modes (s.d. = 35% of grade) and skewed towards the top of the scale; some factor in the cohort modality helps struggling students catch up to their peers.

ACKNOWLEDGMENTS

This material is based upon work supported by the U.S. Army Research Office, the U.S. Army Futures Command under Contract No. W519TC-23-C-0043, and NSF Grant No. 2111305.

REFERENCES

- [1] Albert Bandura. 1999. Social Cognitive Theory: An Agentic Perspective. *Asian Journal of Social Psychology* 2, 1 (1999), 21–41. <https://doi.org/10.1111/1467-839X.00024> arXiv:<https://onlinelibrary.wiley.com/doi/pdf/10.1111/1467-839X.00024>