2015

Learning from What Works: Improving an Introductory Computing Course for Architects with Teaching Methods from Media Computation

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Learning from what works

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Using best practices from Media Computation...

Media-based instructional content:

Students today create and consume media through computing. They find media-based content more relevant than abstract lessons in computing concepts.

Pair programming:

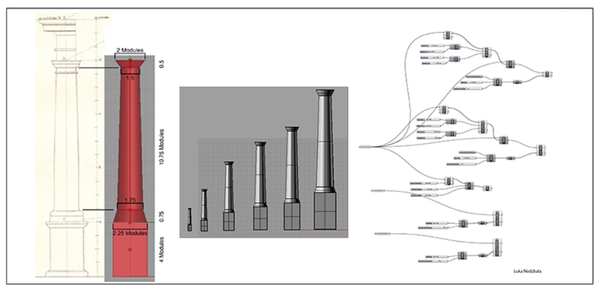
Programming with partners helps reduce cognitive load and makes coding a more social and supportive experience

Peer instruction:

Peer instruction creates a student-driven learning culture. Responding to questions for discussion and reflection makes learning active rather than passive.

...to improve an introductory computing course for architects

Relevant tools and topics:



Students learn a node-based language called Grasshopper, which many firms use for design and fabrication. Topics center around design ideas that connect to computing principles.

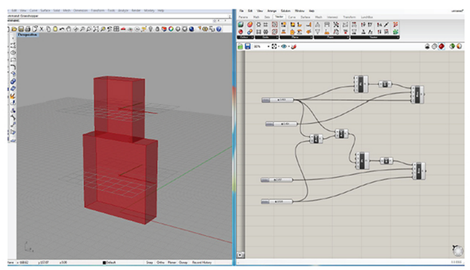
"Active" labs:

- New course uses a flipped classroom model
- Students watch tutorial videos to prepare for class

- Students work in a pair programming arrangement
- Instructor provides coaching while students work on exercises and scaffolded design projects during lab

Lab reports:

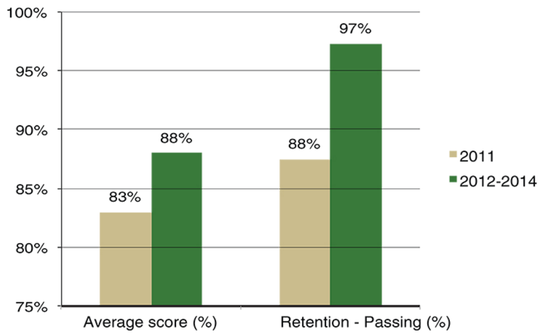
Reports support peer instruction by asking students to reflect upon the computer science principles in the tutorials and solve design problems with their partners.



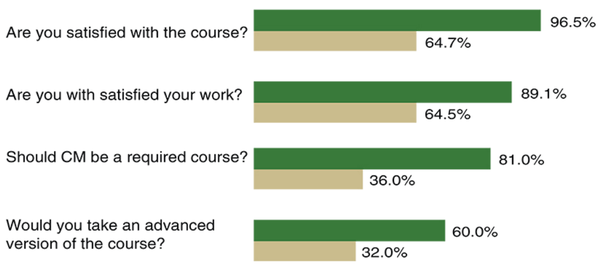
"At 11:30 in the video, what did I do in the script? How does this method prevent the two boxes from overlapping in their Z-axis when you change their height parameters?

Explain what happens in the code."

Results and future work



Implementing best practices improved retention rates by an average of 11% and average scores by 5% over three years.



Student attitudes about the course improved by an average of 32%. In particular, 50% more students thought the course was relevant and would take and advanced version of it in the future -- promising results for an introductory course.

Future work:

While this study suggests that Media Computation practices have a positive impact on student retention and affect, we have no data showing improvement in student understanding of computing principles or computational design abilities. In a follow-up study, we plan to conduct a pre- and post-treatment test of students performing design tasks, in an attempt to measure any cognitive effects of the course.

References:

[1] Porter, L., & Simon, B. (2013, March). Retaining nearly one-third more majors with a trio of instructional best practices in CS1. In Proceeding of the 44th ACM technical symposium on Computer science education (pp. 165-170). ACM.

[2] Gerber, D. J., Khashe, S., & Smith, I. F. (2013). Surveying the Evolution of Computing in Architecture, Engineering, and Construction Education. Journal of Computing in Civil Engineering.

Research summary

Background:

Media Computation is an evidence-based educational framework for teaching introductory computer science. Studies show that a trio of practices from it can improve student retention and affect.

Challenges in architecture:

A recent survey[1] listed programming as the second most important computing ability architecture students need, but ranked it near the bottom of those abilities (9th out of 10) in terms of student competence.

While computer science courses for non-majors exist, they are not designed to overcome architecture students' apprehension about the subject nor do they address the immediate interests and concerns of architects.

Research question:

Can instructional best practices from Media Computation improve student outcomes in a computing course taught *by* and *for* architects?

Course:

Computational Methods is a required computing course for undergraduate and graduate students in the UNCC School of Architecture. The average enrollment is 60 students.

Methodology:

- Comparison of course taught with traditional lab / lecture structure (1 semester) vs. Media Computation practices (3 semesters)
- Pre- and post- class surveys with Likert-style, short answer, and essay questions
- Collection of scores and University student evaluations

Conclusion:

Our research found that best practices from Media Computation improved retention and affect in architecture students learning computing.

By showing that these methods can improve performance in computing courses from other fields, our study points to the possibility that a general set of methods for teaching computer science concepts and skills may exist.