Final Report for DePaul SoTL Funded Project

Proposal Title: Obstacles to Remote Cooperative Learning in Computer Programming Courses

Overview

This project investigated how students were using collaborative learning technologies in an introductory programming course (CSC 241). Following approval from the DePaul Institutional Review Board (IRB), 5 student researchers interviewed 12 students from the CSC 241 class. Interviews were analyzed using a theoretical framework developed by Jeong and Hmelo-Silver that established a set of affordances for successful. Common difficulties were summarized and reported at the DePaul Conference on Teaching and Learning. A poster proposal is under preparation (see appendix for a draft) for submission to the internationally recognized conference on computer science education (SIGCSE).

Logistics, Staffing and Fund Disbursement

The SoTL grant provided a total of $2400 for the project. Five student researchers conducted interviews: John Lynch, Jenny Chang, Benjamin Green, Brandon Johnson and Katie Domines. Each received a stipend of $400 for the contribution to the project. Funding also provided for $20 gift card incentives for each interview, up to 20 interviews. With 12 interviews granted, $240 was spent, leaving $160 unused.

Dissemination

The project proposal identified plans for dissemination at three levels: college, university and international. This has either been achieved or is in the process of achieving it:

- Results are being integrated in a QIC-funded project for retaining students in the CSC sequence. Entitled “Why do students leave the introductory programming sequence?”, this project aims to incorporate some of the learned best practices for retaining students in the introductory computer science sequence.
- This work was accepted and presented at the Teaching and Learning conference. See appendix for the proposal.
- John Lynch and Ben Smith are leading the effort to submit a poster proposal for the premier conference on computing education (SIGCSE: Technical Symposium on Computer Science Education). A draft of the poster proposal is included in the appendix.

Appendix Materials

- Accepted proposal for the DePaul Teaching and Learning Conference.
- Draft poster proposal for the SIGCSE conference.

Accepted proposal submitted to the DePaul Teaching and Learning Conference

Fostering Effective Student Experiences with Remote Collaborative Learning

The move to offering courses online has led to new opportunities for how students can collaborate to support their learning. Example collaborative activities include the use of Zoom breakout rooms, online discussions, and shared Google documents. For this session, we will review research in computer-supported collaborative learning (CSCL) to summarize benefits and drawbacks of various collaborative activities. Example themes include how well an activity fosters inclusion or provides a productive structure for interaction. We will also summarize student experiences of collaborative learning that we have acquired from interviews and survey responses to one of our courses. Then, using breakout sessions, we will ask audience members to identify a collaborative learning activity that they have employed or would like to try. Considering themes established in CSCL research and the student experiences from our study, we will ask session participants to characterize their activity by noting benefits, potential drawbacks, and ideas for mitigating them. Participants report their collaborative activities and analysis in a shared Google doc, which then serves as a collective set of notes from the session. As a final analysis, we will reflect on our own learning experience from the session and how it fit the themes from the presentation.

Outline of Presentation and Interactive Session

1. Present examples of collaborative learning activities.
2. Summarize themes and issues from CSCL research. Example: a well-designed collaborative learning activity provides clear opportunities for all students to contribute.
3. Present our study of student experiences in an introductory course in the School of Computing. Drawing from interviews and survey responses, present at least one activity and report what worked for students and what were problems.
4. Form Zoom breakout sessions, with 4-5 participants per session. The research students who conducted the interviews are also available and will join the sessions to help with logistics.
5. Each breakout session participant shares a collaborative activity they have used or would like to try.
6. As a group, participants work out benefits of the activity and potential drawbacks. Ideas for mitigating the drawbacks are discussed.
7. Each collaborative activity and discussion elements are reported on a Google doc shared by all audience members.
8. Final discussion: how did these breakout sessions work as a collaborative learning experience?

Acknowledgement: the research from this proposed presentation is supported in part by a Scholarship of Teaching and Learning (SoTL) Grant funded by the Center for Teaching and Learning.

Questions:

What is a collaborative learning activity that you have used in your course? Or would like to try in your course?

How does this collaborative learning activity support learning?

What are potential drawbacks to this collaborative learning activity?

Learning Goals:

Participants will be able to choose a remote collaborative learning activity that is appropriate for their class.

Participants will be able to identify potential drawbacks of a chosen remote collaborative learning activity and consider strategies for mitigating them.

Diverse learning contexts:

While the presentation provides concrete examples of student experiences from one introductory course sequence in computer science, session participants will be asked to identify collaborative learning activities that are appropriate for their own courses. The CSCL research summary will apply to diverse disciplines.

Resources:

The session will produce two concrete resources for participants:

1. A list of references of computer-supported collaborative learning (CSCL) research from the presentation.
2. A shared document that lists the collaborative learning activities that were discussed in the breakout sessions.

Fostering Effective Student Experiences with Remote Collaborative Learning

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ABSTRACT

Our team interviewed students taking an introductory programming course (CSC241) about their efforts to interact with peers for learning the course content. By using these interviews alongside end of course surveys for CSC241, we attempted to answer the following two research questions. What collaborative activities and tools are students engaged in? What are obstacles to effective collaborative learning? The responses to these questions were then analyzed in the terms of affordances proposed by Jeong and Hmelo-Silver [2]. We used these findings to create a modified framework adapted from Jeong and Hmelo-Silver that was used to discuss with other educators from various fields about how they facilitate collaborative learning in their coursework and to examine how the framework could be used to produce future collaborative coursework.

CCS CONCEPTS

• **Social and professional topics** → **Computer science education**; • **Human-centered computing** → *Ethnographic studies.*

KEYWORDS

Remote Collaborative Learning, Online Learning, Effective Student Experiences

1 INTRODUCTION

Computing educators have long recognized learning to program as a difficult, painstaking process. The past year provided many challenges for educators and students when shifting to the use of collaborative technologies for learning Computer Science. Collaborative technologies are a promising tool to help enhance students comprehension and interactions with fellow peers, yet previous research into computer-supported learning tools displayed pitfalls that students experience. Such pitfalls include a lack of motivation, lack of belonging to a community, and social interactions not occurring due to assumptions that they will occur naturally due to ecosystem. [3] [4] To help address drawbacks of collaborative learning in current education environments, this article first introduces the definition of collaborative learning, discusses the need for the usage of learning frameworks that can be applied to collaborative learning activities, molds existing frameworks based on student surveys, and extrapolates this framework to be readily available for usage in domains outside of Computer Science.

2 THEORETICAL FRAMEWORK

Computer Supported Collaborative Learning emphasizes constructing and developing knowledge artifacts through a group discourse followed by individuals and the group making meaning out of these knowledge objects. [5] The application of these ideas to learning environments does not guarantee success however, as research shows that "groups with experience in collaboration outperformed and were more cognitively efficient than inexperienced groups" [6], and outside factors can negatively contribute to students participation and motivation during these collaborative learning experiences. [1]. The overarching goal of Collaborative Learning coupled with the need to ensure successful collaborative work occurs despite experience differences and outside factors lend to the need of a framework that combines these various attributes for review. Jeong and Hmelo-Silver define this type of framework alongside the main outcome of collaborative learning; to advance the knowledge of individuals as well as the collectives. Jeong and Hmelo-Silver present seven core affordances of technology for collaborative learning in this framework. 1) Engage in a joint task 2) Communicate 3) Share Resources 4) Engage in productive collaborative learning processes 5) Engage in co-construction 6) Monitor and regulate collaborative learning and 7) find and build groups and communities.

3 METHOD

Using CSC241 end of course student surveys, we created a code-book that consisted of three categories; the referent (tool/activity) the student spoke of, their feeling about the tool/activity (negative/mixed/positive), and 12 broad themes that encompassed what the referent encouraged or failed to encourage (see Table 1).

After applying our modified code-book to our collected interview results we synthesized a framework based off of Jeong and Hmelo-Silver's framework that covered the most prevalent themes that students were encountering in their use of collaborative remote technologies (see Table 2). This framework examines both ways to facilitate collaborative learning, and the obstacles that prevent it.

4 MODIFIED FRAMEWORK AND USAGE

These 7 themes from the framework can be applied in a pedagogic context to facilitate collaborative processes. The themes are intended to be applied by teachers to their courses structure in order to encourage collaborative learning or to student feedback to help focus where certain aspects of the course and coursework can be improved in the context of collaborative learning.

Table 1: Coding categories

Theme	Description
Participation	Referant promoted participation, student felt participation was encouraged, wanted, and included.
Motivation	Referent motivated the student to participate with extrinsic rewards.
Direction	Referent created a clear direction (or lack thereof) for how to do activities.
Relevance	Referant felt relevant to homework, course goals, and provided a diversity of examples
Usability	Referent or tool was clear on how to be used. Applies to problems with organization and information architecture
Functioning	Referent was / was not working because of a problem not related to its usability.
Feedback	Referent provided proper feedback to student work and provided information if their work is satisfactory or not.
Responsive	Referent provided quick response times for students to get feedback.
Convenience	Referent was easily accessible and convenient.
Timeframe	Activities/Referent either had enough time to complete, were too time consuming.
General	Overall assessment of referent / activity without any specific reasoning
Other	Other areas not covered by the above 11 themes.

Table 2: Affordances adapted from Jeong & Hmelo*Silver*

#	Name	Description
1	Joint Task	Activity provides a joint task that students share.
2	Communication	Environment and technology support communication.
3	Shared Resources	Environment allows students to share examples, references and notes.
4	Structured Process	Activity or environment provides structure
5	Co-construction	(collaborative, not just cooperative)
6	Feedback	Activity supports students in knowing how well they are doing.
7	Community	Environment connects students to collaborate.

5 OUTCOMES

For example, a student stated the following in their interview.

"So I think breakout rooms are a really useful tool. Um, the problem is, is that when breakout rooms start, there's no like, administrator, there's no ta or teacher in there. Um, so like, there's an urge to not want to do it. And that makes sense, right? Because it's like, they're not being it's like a second grade mentality, right? The teacher leaves the room, you can do whatever you want."

Using our modified framework, we can deduce that this student lacked the affordance of Structured Process (4) as their group went on tangents not related to the goal, and they lacked the affordance of Feedback (6), as there wasn't a teacher or TA present to recognize the work they were doing. Another usage case could be an instructor evaluating the collaborative processes in their python coding course. If the instructor compares their courses processes with the 7 affordances above they might find that the course structure does not offer a way for students to communicate between themselves, or perhaps that the course assignment structure does not offer any tasks that could be completed collaboratively. Both of those findings would limit the possibility of student collaboration, however the instructor will know what areas to improve the course for the next quarter.

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REFERENCES

[1] Phyllis C Blumenfeld, Toni M Kempler, and Joseph S Krajcik. 2006. *Motivation and cognitive engagement in learning environments.* na.
[2] Heisawn Jeong and Cindy E Hmelo-Silver. 2016. Seven affordances of computer-supported collaborative learning: How to support collaborative learning? How can technologies help? *Educational Psychologist* 51, 2 (2016), 247–265.
[3] Ann Jones and Kim Issroff. 2005. Learning technologies: Affective and social issues in computer-supported collaborative learning. *Computers & Education* 44, 4 (2005), 395–408.
[4] Karel Kreijns, Paul A Kirschner, and Wim Jochems. 2003. Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: a review of the research. *Computers in human behavior* 19, 3 (2003), 335–353.
[5] Gerry Stahl. 2002. Contributions to a theoretical framework for CSCL. (2002).
[6] Jimmy Zambrano, Femke Kirschner, John Sweller, and Paul A Kirschner. 2019. Effects of group experience and information distribution on collaborative learning. *Instructional Science* 47, 5 (2019), 531–550.