

Learning trajectories in Open Source Software: Implications for designing problem-based learning experiences in support of higher order thinking

Problem Statement

There are problems with retention of students in CE and lack of women and minority participation. In tandem while CE is primarily about problem solving however instruction still focuses on knowledge acquisition (O'Grady). Studies show women and minorities need more applied learning and that may also help in retention. PBL, a form of constructivist learning, focuses on problem solving and can consist of a full-blown approach to partial implementation of process (Ellis) has been touted as a learning experience that helps with HO thinking skills. (refs) It would appear that a wider spread adoption of PBL may help with attraction to the field, while also help develop the HO skills that are necessary for success in CE but also the workforce. (refs)

What is PBL, why is it thought to help with HO. Discuss other claims (lower failure rates, higher retention, appeal to women)

However, despite those claims little adoption of CE has occurred. There are many reasons for this—institutional, pedagogical, and learning-wise. This research focuses on the pedagogical and learning outcomes. Regarding the pedagogical there's the difficulty of developing adequate problems and the process infrastructure needed to support. What if there existed a ready-made learning environment that provided authentic problems for students to learn from that also may provide some of the support structure needed for PBL? Open source software systems, as informal learning environments, have the potential to do so. Elaborate.

However, while there has been some involvement of participation in OSS for CE there is a lack of instructional design support, lack of rigorous measure of skills exercised and learning

outcomes. This research proposes to study OSS communities to identify the resources provided that support PBL activities and their relationship to higher-order skill learning practice. This research will be used to influence the instructional design of PBL-based learning activities in support of higher-order thinking skill development. Success in achieving learning objectives will be determined through testing of activities with undergraduate computing students.

Vision statement (wrap it up)

RQ

1. What opportunities does OSS community participation provide to exercise higher-level thinking skills? What is relationship to resources provided by the community (e.g., tasks, technology)?
2. Can PBL- tailored student involvement in OSS communities assist with the development of higher-order thinking skills while satisfying CE learning goals?

Lit review

RQ 1-

State of PBL in CE (adoption, empirical study in relation to HOT skill development)

What is PBL, why PBL?

Problem-based learning (PBL) is a method of constructivism, a philosophy of how people learn.

Constructivism has three central tenets: 1) Understanding comes from interacting with the environment, 2) the stimulus for learning comes from problems which in turn direct the learning process; and 3) knowledge is derived through social interactions. Savery 01 lists instructional

principles following from this philosophy, noting that among the many learning environments,

PBL addresses these most closely:

1. Anchor all learning to a larger task or problem- learning must have a purpose for the learner.
2. Support the learner in developing ownership for the overall problem or task –align learner goals with instructional goals
3. Design an authentic task-the cognitive demands should align with the cognitive demands where the learner will perform ultimately.
4. Design the task and the learning environment to reflect the complexity of the environment they will function in at the end of learning
5. Give the learner ownership of the process used to develop a solution-don't simplify the environment, but support the student within the complex environment
6. Design the learning environment to support and challenge the learner's thinking.-don't "proceduralize" how the student approaches solving the problem.
7. Encourage testing ideas against alternative views and alternative contexts-Because knowledge is socially constructed, interactions in collaborative group can be used to test individual understanding.
8. Provide opportunity for and support reflection on both the content learned and the learning process-this aids in developing self-learning skills.

Problem-based learning is conducted in small collaborative groups working on realistic ill-structured problems (non-deterministic). The teacher acts as a facilitator guiding the learning process helping them learn the cognitive skills involved in problem solving and collaboration. Student groups analyze and define the problem by identifying the important components of the problem scenario. From there, they generate hypotheses of how to solve the problem. During this process self-directed learning is employed as students encounter knowledge deficiencies. From there they apply their new knowledge and evaluate their hypotheses and reflect on what they've learned. For students to be successful they must learn how to be self-directed learners which requires they be reflective and apply critical thinking about what they are learning. (04 Hmelo-Silver)

Comment [MP1]: Hamalainen also lists steps.

Comment [MP2]: I think material from constructivism _practical_historical_context can be added in here. Look in learning sciences PBL folder.

In general, it has been proposed that PBL helps students: 1) develop an extensive, flexible knowledge base; 2) develop problem-solving skills; 3) become self-directed learners; 4) become effective collaborators and 5) become intrinsically motivated learners. With regard to knowledge this also means students learn to connect information across multiple domains. Effective problem solving requires developing metacognitive and reasoning strategies. Metacognition development is important to both evaluating problem solving progress as well as learning progress for self-directed learning. Developing collaboration skills involves working with others to identify actions needed, come to agreements over issues and effective communication within the group and also aids in the facilitating the social aspect of learning. PBL can aid in intrinsically motivating students that through involvement in problems that are proximal and relate closely to their own learning goals. (04 Hmelo-Silver)

Research studying learning effectiveness of PBL

Evidence suggests ... Caveat, most research has been in medical and ? domains. Evidence is still needed for collaboration and motivation (04 Hmelo Silver) (need to fill in this, but first need to finish reading Hmelo-Silver)

Why PBL in CE?

Problem-based learning lends itself well to computing education because computing is driven by problems; requires life-long learning to stay current with emerging technology; work is mainly done in project teams and it generally crosses multiple disciplines. (98 Ellis) In addition, while not the focus of this proposal, studies have shown also that when used in CE it may help attract more female students (04 Hamainen, 98 Barrows (need to read), improve retention (04 Hamainen), motivation (04 Hamainen, 10 Wang), and passing rates (04 Hamainen, 03 Parham).

However, CE is still mainly via knowledge transmission, not focusing on the development of higher-order thinking or advanced reasoning skills, which are critical for a career in the computing industry. Effective instructional design in support of this skill development is still an open question. (12 OGrady) Furthermore, give the potential for PBL in CE to increase female enrollment (why?) and improve retention (sources) there is further reason to investigate. (need to tie PBL to females and application and retention from literature)

PBL in CE, measurement of skill development

Limitations in empirical study of PBL in CE/(limited HOT)

What other methods have been used to help generate HOT that aren't PBL? Have they worked?

Why OSS?

What is OSS? What has been studied?

How is it a form of PBL?

What are the benefits of OSS? (describe some of the general learning in OSS papers here and how map to PBL and constructivist learning)

Readymade authentic problems

Technology to support

Social structure may also support some of the PBL functions

What is the extent of OSS participation for learning?

What skills are developed? Discuss methodological concerns and lack of study of HO skills?

RQ 2 -

While there has been student participation in OSS for learning there is a lack of instructional design for using. Discuss lack of formalism from literature and many problems in applying. Here making a case to set up a case study of students participating in OSS that follows an ID incorporating the PBL process to measure HO and other skill development.

