Student Learning & Motivation in Active Learning Environments in Undergraduate Computer Science Education

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Introduction

Enhancing student learning and motivation is a central theme in academic research. It has now been established that pedagogical approaches to learning are known to enhance student outcomes, motivation and self-efficacy. While the significance of such learning methodologies in enhancing student outcomes and success have been studied extensively in STEM fields, little is known about the specific consequences of such learning pedagogical approaches in undergraduate Computer Science classrooms. Our work aims to understand the impact of such pedagogical approaches on student learning and motivation. Through our findings, we propose a CSCL-POGIL implementation geared towards enhancing student learning and motivation.

Background

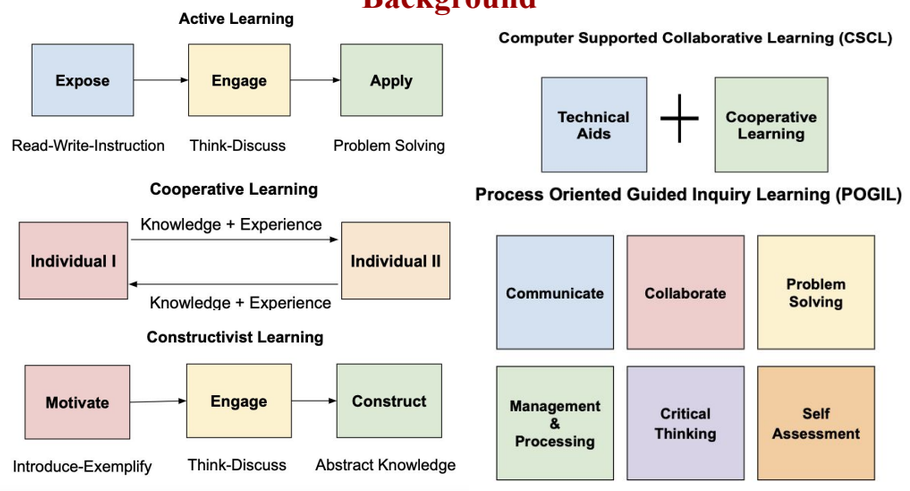

Figure 1: Learning pedagogies in STEM classrooms

Methods

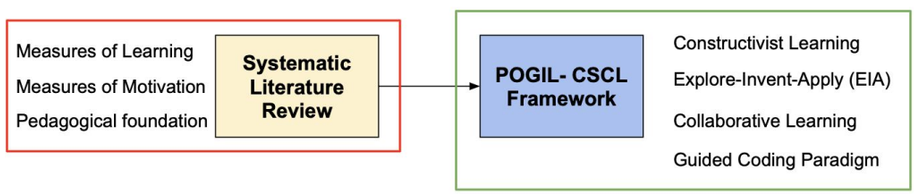

Figure 2: Methods

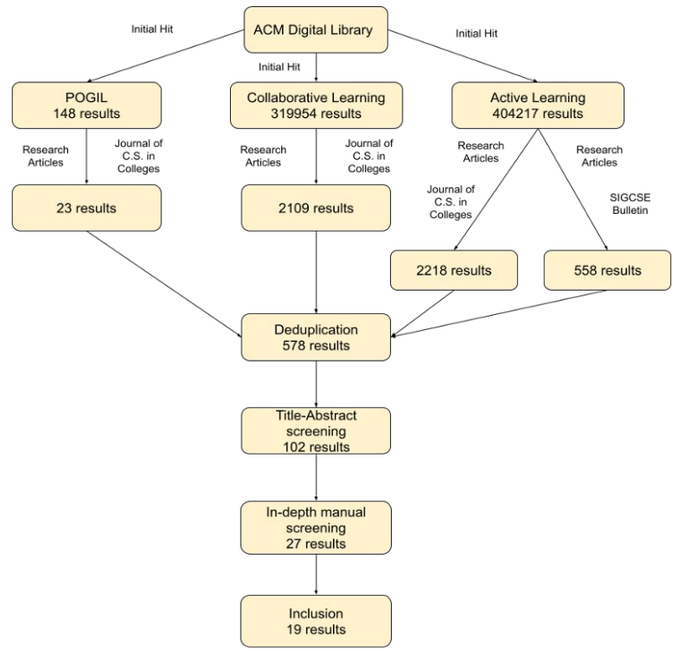

Figure 3: Literature review selection and inclusion process

Results

- Highly controlled, coordinated, well-organized and guided collaborative learning environments are more explicitly constructivist.
- POGIL models and critical thinking prompts are inherently constructivist in nature.
- Measurement of student learning is much more prevalent across the studies in our collection in comparison to student motivation.
- There seems to be a tendency to employ course-related numeric parameters to quantify student learning. This includes scores on learning assessments, grades on assignments, final course grades/cutoffs and pass/fail/drop/withdraw rates.
- Student perception about their learning, student perception about teamwork and self-efficacy emerge as the dominant measures for student motivation across the studies.
- Our proposed model adopts POGIL's structured collaborative learning and Explore-Invent-Apply (EIA) cycles supplemented by CSCL tools to facilitate Experiential Learning. We propose a guided coding paradigm as a part of EIA motivated by CSCL.

```
Ans: put(val){
    Step 1: Calculate the index.
    index = val % N
    Step 2: Create a node that stores the value to be hashed.
    newNode = LinkedNode(val)
    Step 3: Think about the case where there is no collision during insertion and handle it.
    if(HashTable[index] == null){
        HashTable[index] = newNode
    }
    Step 4: Think about the case where there is a collision during insertion and handle it.
    else{
    cur = HashTable[index]
    while(cur.nextNode != null){
        cur = cur.nextNode
        }
    cur.nextNode = newNode
    }
    We're done! YAY!
```

Figure 4: Guided Coding Paradigm

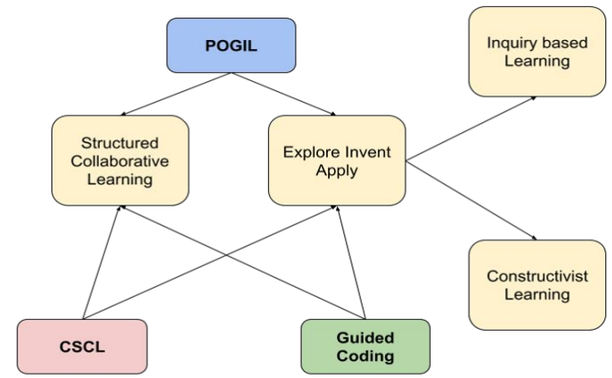

Figure 5: Our proposed POGIL-CSCL implementation

Implications

Our analysis reveals that very little is known about POGIL intervention in upper level undergraduate CS classrooms. Future research should, therefore, study the implications of POGIL in such classrooms. We invite future researchers to implement our proposed model in undergraduate CS classrooms of statistically significant sample sizes and report their observations and statistical analysis so that our model may be refined.

This research project was completed under the esteemed supervision of Dr. Neena Thota.