Assessing Small-group Learning in a PBL Undergraduate Chemistry Laboratory
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Abstract: PBL advocates self-directed and collaborative knowledge building. Tracking the learning experiences of students while working in a small-group is, thus, important to understand students' engagement with knowledge construction. In this study, which is a part of larger research work, we have tried to explore, a) the interactions leading to knowledge construction in a small-group, and b) students' perceptions about small-group learning. We infer that the disagreements between the group members and subsequent discussions are one of the important ways of knowledge construction. Besides, lab-work supports student engagement with cognitive dimensions such as apply, analyse, and evaluate for the execution of their experimental design.

Instructional Design
PBL experimental module on Indigo dyeing wastewater treatment
Participants: First year undergraduate students (n=18)
Allotted time- 5 days, 15 hours
Pre-lab → Lab-work → Post-lab
Designing the task → Execute the design → Data analysis/report writing

Methodology
Qualitative study to understand the knowledge construction in small-group learning

Data
Field-notes: by non-participant external observer, shadowed one small-group (n=3, mixed gender)
Semi-structured Interview: by researcher about how they constructed knowledge while working in a small-groups (n=3)
Open-ended questionnaire: to capture students' perceptions on small-group learning (n=15)

Qualitative Analysis
Krathwohl’s Analytical Framework for field notes
Field notes were coded using the knowledge and cognitive dimensions of Krathwohl’s analytical framework, analysis validated by external evaluator

Interpretive analysis of semi-structured interview

Exemplars
Conceptual (interrelationship within larger structure): drawing the structure of cellulose to explain how bonding between indigo and cellulose was possible.
Evaluate (make judgment based on some criteria): Reason for choice of cellulose for treatment; cellulose-indigo hydrogen bonds are stronger than cellulose-cellulose hydrogen bonds.

Drawbacks perceived by students
Outcome is shared with those who contribute less
Multiple opinions stall decision-making
Less motivated members or conflicts may affect the performance

Questionnaire responses analysed based on Novak’s Theory of Meaningful Learning

Exemplars
Cognitive: Discussions, exchange of ideas, learning something new, errors and mistakes are handled better
Affective: Group work is enjoyable, fun, receive support, help, confidence is improved
Psychomotor: Reduces burden, task-distribution, achieve more, parallel processing