# The Impact of Teacher Facilitation on Student Metacognition in Middle School Problem-Based Learning Settings

by Clayton Spencer

Abstract

This quantitative study proposal seeks to determine the impact of novice and expert teacher facilitation of discourse within middle school problem-based learning settings on student metacognition.

*Keywords:* problem based learning, discourse, facilitation, metacognition

Problem-based learning (PBL) is a constructivist approach to education in which students solve ill-structured problems based in real world situations. Many PBL programs make use of collaborative learning and teacher facilitated discourse to help students develop problem solving strategies as well as construct understandings of topics being studied (Hmelo-Silver & Barrows, 2008). An understanding of teacher facilitation strategies (i.e., verbal interactions with students during educational activities) may enable teachers to help students learn the content of a particular discipline as well as help students learn the cognitive strategies associated with that discipline (Hmelo-Silver & Barrows, 2006). Yet which teacher facilitation strategies PBL teachers should use to help students develop problem solving skills is not entirely clear from available research. The purpose of this study is to determine whether or not, within a middle school PBL setting, expert teacher facilitation impacts student metacognition differently than novice teacher facilitation.

## Literature Review

Teachers seeking to effectively implement PBL classes may find it desirable to have an understanding of effective teacher facilitation strategies for problem solving discourse. A number of qualitative studies have illustrated strategies for facilitation that are assumed to improve students' metacognition (Hmelo-Silver & Barrows, 2008; Stone & Gutierrez, 2007). Metacognition is the awareness and management of one's own thought (Kuhn & Dean, 2004). Metacognition is important to PBL because metacognitive "skills are empirically distinct from general intelligence, and may even help to compensate for deficits in general intelligence and/or prior knowledge on a subject during problem solving." (Lai, 2011, p. 5). According to Kuhn and Dean (2004), children will progress through early stages of metacognitive development with or without instructional assistance but that progression out of the adolescent stage of metacognitive development requires instructional effort. Kuhn (2000) posed the question, "How can metacognitive development be facilitated?" (p. 180).

Hmelo-Silver and Barrows (2008) called teacher facilitation practices that lead to students' metacognitive growth 'expert teacher facilitation' practices. One of these practices is for teachers to ask questions that stimulate thinking but are not evaluative. Another is for teachers to ask more questions related to mediating processes than questions related to content.

Another is for teachers to interject inferences based on student questions and statements in order to help students evaluate their own thinking -- this is also referred to as 'revoicing' (Hmelo-Silver & Barrows 2008; O'Connor & Michaels, 1992). Another practice is for teachers to allow for students to ask most of the questions and offer all ideas related to solving the problem. The final practice is for teachers to focus students' attention on important aspects of their learning activity, such as themes in a discussion or passages in a reading. These practices put students in an active role where, over time, they are able to internalize the problem solving strategies of the teacher. This, in theory, leads to enhanced metacognition for students (Hmelo-Silver & Barrows, 2008; Kuhn 2004).

Teacher facilitation practices that are considered by researchers to be unbeneficial to student metacognitive growth are sometimes termed 'novice teacher facilitation' practices. One of these practices is to have more or less scripted interactions with students (Hmelo-Silver & Barrows, 2006; Schoenfeld, 1998). Another novice teacher facilitation practice is to question students using a format of asking a question, listening for a student response, then evaluating the response (Cadzen, 1988). The final novice teacher facilitation practice is assisting students in problem solving by giving students serialized, teacher determined, step by step questions that logically lead students to solving the problem at hand (Stone & Gutierrez, 2007). All of these practices place the student in a comparatively pass2ive role where they are not responsible for regulating their own learning. None of these practices are therefore thought to improve student Metacognition.

Quantitative studies demonstrating a relationship between teacher facilitation practices in PBL settings and metacognition are, however, lacking (Kokotsati, Menzies, & Wiggins, 2016; Sweller, Kirschner, & Clark, 2007). Understanding the relationship between teacher facilitation practices and student metacognition will help teachers choose which facilitation practices are more desirable in PBL settings.

## Research Question and Hypothesis

In this study, I will attempt to determine whether or not, within a middle school PBL setting, expert teacher facilitation impacts student metacognition differently than novice teacher facilitation. My hypothesis is that, within a middle school PBL setting, expert teacher facilitation will increase student metacognition more than novice teacher facilitation. The independent variable for this study will be teacher facilitation practices. In this study, teacher facilitation refers to the verbal interaction between teachers and students during educational activities. I will measure the impact novice teacher facilitation and expert teacher facilitation on student metacognition. The dependent variable will be students' metacognition.

## Methods

### Design

This study will use a pretest-posttest group comparison true experiment design. The experiment will involve two treatment groups. The experimental group will receive expert teacher facilitation. The comparison group will receive novice teacher facilitation. To answer the research question, I will compare the metacognitive gains of the experimental group to the metacognitive gains of the comparison group.

**Participants**

Research will be conducted in PBL schools in twenty seventh grade classes of 15-20 students per class. Ten classes will be assigned randomly to either the experimental group or the control group. Classes will be selected using a convenience sample. All students participating in the study will be required to have signed permission slips from parents or legal guardians.

**Group Conditions**

Classes will be assigned randomly to either the experimental group or the comparison group. Over the course of one semester, students in each group will develop plans in small work teams within their classes to alleviate water poverty in the Nyanza Province of Kenya for their assignment.

Classes in the experimental group will be led by experienced PBL teachers using expert facilitation practices. These teachers will facilitate activities using three prescribed behaviors, as described by Hmelo-Silver and Barrows (2008). First, these teachers will ask questions that are not evaluative. Second, these teachers will ask more questions related to mediating processes than questions related to content. Third, these teachers will interject inferences based on student questions and statements in order to help students evaluate their own thinking (revoicing) (Hmelo-Silver & Barrows 2008; O'Connor & Michaels, 1992). Fourth, these teachers will allow for students to ask most of the questions and offer all ideas related to solving the problem. Fifth, these teachers will focus students' attention on important aspects of their learning activity, such as themes in a discussion or passages in a reading.

Classes in the comparison group will be led by experienced PBL teachers using novice teacher facilitation practices. These teachers will facilitate activities using three prescribed novice teacher facilitation behaviors, as described by various qualitative studies. First, these teachers' interactions with students will be scripted (Hmelo-Silver & Barrows, 2006; Schoenfeld, 1998). Second, these teachers will primarily question students using a format of asking a question, listening for a student response, then evaluating the response (Cadzen, 1988). Third, these teachers will assist students in problem solving by giving students serialized, teacher determined, step by step questions that will logically lead students to solving the problem at hand (Stone & Gutierrez, 2007).

**Outcome Measures**

The dependent variable, students' metacognition, will be measured by think aloud protocols developed by Meijer, Veenman, and van Hout-Wolters (2006). This measure involves students thinking aloud during cognitive activities, such as reading or solving a math problem. Judges categorize each of their think-alouds, categorize them according to the think aloud protocols, and then score their think-alouds overall based on how well students formulate action plans, monitor learning, etc. Each student's overall score is used as a measure of their Metacognition.

In this study, judges will be blind to the goals of the study. Each student will be judged by two separate judges before and after the treatment. For the pretest, students will individually read several texts about rising sea levels, identify possible problems to solve, and brainstorm possible solutions. For the posttest, students will individually read several texts about the increase of human population on Earth, identify possible problems to solve, and brainstorm possible solutions. Both tests will take place during students' class time in their classroom.

**Procedures**

First, classes will be randomly assigned to one of the two treatment conditions. Students' individual metacognition will then be measured using the think aloud protocols pretest. The pretest will be overseen by two blind judges per student.

Next, within each class, students will be put into three teams of five students. Each team will spend the remainder of the semester attempting to develop a plan to alleviate water poverty in the Nyanza Province of Kenya. In each group, teams of students will be given scaffolds (either in the form of novice teacher facilitation or expert teacher facilitation) that will guide students towards certain resources and assist students in organizing their thinking so that they will be able to complete the assignment.

Finally, following this semester long activity, students' individual metacognition will be measured using the think aloud protocols posttest. The posttest will be overseen by two blind judges per student.

## Discussion

This experiment has two major strengths. The random assignment of students to groups within the study eliminates a selection threat that would otherwise reduce the internal validity of the experiment. Also, by ensuring that both groups use the same activity and are taught by experienced teachers, the threat of compensatory equalization to this experiment's internal validity is avoided.

This experiment contains a threat to external validity as well as a potential threat to internal validity. External validity is threatened by the interaction of setting and treatment in this experiment. Given that PBL schools vary a great deal in their definition of PBL (Kokotsati,

Menzies, & Wiggins, 2016) and that some classes may also be larger or smaller than the required class size of 15-20 students, it is safe to assume that the findings of this experiment will not be generalizable to all seventh grade PBL classes. Due to the length of this experiment, it is possible that some participants will need to leave in the middle of the experiment (for example, a student may switch schools mid semester). This mortality would be a threat to the internal validity of the experiment because their experiences in the study will not be considered in the findings. This would make the groups not comparable, introducing a confound. However, given that the sample size consists of 20 classes, the threat of mortality may not be large enough to be significant.

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