Thematic Analysis of Teacher Instructional Practices and Student Responses in Middle School Classrooms with Problem-Based Learning Environment

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Abstract

A Problem-based learning (PBL) environment is a student-centered instructional method based on the use of ill-structured problems as a stimulus for collaborative learning. This study was designed to investigate teachers' instructional practices, and students' responses to such practices, in middle school classrooms using a PBL environment through qualitative analyses. A hybrid approach of inductive and deductive thematic analyses was employed and applied to field notes and transcripts of video observations of four PBL classrooms. To do so, a codebook was created based on the descriptions of roles of teachers and students in PBL classrooms in literature, and was then applied to inductive codes that emerged from the data. This study identified a number of specific instructional practices of teachers, as well as responses that students might engage in during PBL instructions. Being able to articulate these roles is an important step in helping new PBL teachers develop their skills to facilitate student-centered classrooms.

Keywords

Problem-based learning, qualitative study, middle school, classroom observation

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Introduction

Problem-based learning (PBL) is an active, student-centered, and collaborative instructional method based on the use of ill-structured problems as a stimulus for learning (Bridges, 1992). In PBL, the instructional method consists of presenting an ill-structured problem scenario that is related to the curriculum, designed to be complex, open-ended, and often interdisciplinary in nature, to students. The problem scenario requires students to develop solutions based on the presented information, consider alternative solutions, and provide reasoned arguments to support their proposed solution. A good context for PBL is a real-world problem that may have multiple solutions, cannot be solved by a simple algorithm, and presents difficulties and complexity to students (Brown & King, 2000). The key characteristics of a PBL environment are group work and collaboration. During classes, most of the learning occurs within the context of small groups rather than teacher-centered lectures, and each member of the group supports the others when achieving the group goal and individual outcome. During PBL, individuals see the problem from different perspectives, bringing diversity to the group in the problem-solving process (Kelson & Distlehorst, 2000).

The PBL teacher plays the role of a facilitator who observes, supports, and directs students in the learning process, pushing them to think critically and deeply with minimum interference (Jonassen, 2011). Unlike a teacher in a traditional classroom, the PBL teacher uses modeling and coaching to show students good strategies for thinking and learning, and eventually dials back some of the support. The teacher plays a critical role, as a facilitator must constantly assemble the resources needed for learning, provide guidance to facilitate student learning, facilitate classroom structure, and provide feedback and evaluation. The PBL teacher scaffolds student learning through asking questions and allowing students to find answers on their own. As students progress with taking on responsibility for their own leaning processes, the teacher's interventions diminish.

Students are responsible for their own learning, actively acquiring their knowledge and working with learning resources on a project team (Brown & King, 2000). In PBL, students work in small groups collaborating with each other and trying to solve open-ended problems. Typically, the groups consist of five to seven students (Bridges, 1992). Each group member plays an active role by participating equally and figuring out the solutions to the ill-structured problems. As students acquire and exchange information that might be used to find solutions, they become increasingly independent of the teacher. It is the students' responsibility to gather information, examine the resources, share the views, and find the solutions to the problem. A social aspect of learning is central as students learn through discussion and problem solving in teams while also acquiring collaborative skills.

The purpose of this study was to gain an understanding of the instructional practices of middle school social science teachers and students' responses to such instructional practices in classrooms during PBL instructions. Specifically, this study focused on investigating the role of teachers and students in classrooms with a PBL environment using both inductive and deductive approaches to the thematic analysis, as described by Fereday and Muir-

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Cochrane (2006). The following two research questions guided this study:

1. What are instructional practices of middle school social science teachers in classrooms with a PBL environment?
2. What are students' responses to instructional practices in classrooms with a PBL environment?

Context of the Study

The PBL connected to this study is GlobalEd 2, which situates middle school students in an online simulation of decision-making environment focused on critical real-world international issues. GlobalEd 2 is an educational curriculum designed to promote scientific literacy, writing skills in science and social studies, and problem-solving skills (Brown, Lawless, & Boyer, 2013; Lawless, Brodowinska, Lynn, Khodos, Brown, Boyer, Yukhymenko, & Mullin, 2012). GlobalEd 2 situates students in 16 to 20 social studies classrooms across the country in a well-regimented PBL for one semester. Each classroom is assigned to represent a real-world country (e.g., Russia, Japan, Mexico). Students in each classroom, or "country," are further divided into four issue groups, economic policies, environment, human rights, and health in particular. Students in each issue group then interact with their counterparts in other "countries", utilizing educational technologies such as computers with Internet connection. The interaction between students is focused on one of the critical world issues, such as water scarcity or climate change. During GlobalEd 2, students in country teams are trying to negotiate a mutually agreeable resolution to the critical issue.

GlobalEd 2 is a well-regimented PBL, which has three phases corresponding to preparation, simulation, and debriefing. Four weeks prior to the beginning of the negotiations, students learn about the country they are assigned to represent, as well as the other participating countries, focusing on economical, cultural, social, environmental, and political aspects. GlobalEd 2 provides students with many resources about participating countries on the GlobalEd 2 platform. However, students are not limited to using GlobalEd 2 resources and may conduct research and search for relevant information on the Internet. The United States is played by undergraduate and graduate students majoring in political science. Once the simulation begins, the students participate daily. They are allowed to use computers in schools as well as outside of the school to search for information and communicate within and across the countries. Students in each issue group interact with their counterparts through e-mails as well as online live-chat conferences, occurring several times during the simulation. No real names are displayed and no references can be drawn to students' gender, class, or location. During the active phrase of simulation, all interactions are controlled by simulation controllers, called Simcons. Simcons monitor discussions, review communications between students, and ensure that students stay "in character" of their assigned country. The final phase of the simulation is a two-week debriefing, during which students reflect on what they learned during the simulation and whether reasonable solutions to the real-world problem were found.

The learning environment in GlobalEd 2 is centered on the students, which differs from a traditional instructional approach. The students collaborate in small groups, making decisions and trying to find solutions to real-world problems. As such, the teachers' roles are those of facilitators, providing support and resources to students, observing and directing students' learning. Prior to participating in GlobalEd 2,

teachers are required to attend a multiple-day PBL workshop, which occurs in summer prior to the simulation. The goal of the workshop is to prepare teachers to facilitate PBL lessons. The workshop addresses necessary classroom culture components of PBL pedagogy, presents details regarding GlobalEd 2 rules and regiment, and brings theory to practice by requesting teachers participate in a mini PBL simulation. During the mini simulation, teachers perform roles similar to those that their students will be performing during GlobalEd 2. At the end of the workshop, teachers are presented with feedback and a folder of relevant materials.

Research Approach

To determine and describe the instructional practices of teachers and the responses of students, a hybrid approach of inductive and deductive thematic analysis was used. This qualitative analysis allows the PBL instructional practices and patterns of student learning to emerge as the data is examined. Qualitative methods such as these are well-suited for examining emerging patterns when there is not yet an established body of literature regarding the types of practices and processes associated with PBL.

Thematic analysis is the search for and extraction of general patterns found in the data through multiple readings of the data. Fereday and Muir-Cochrane (2006) described thematic analysis as “a form of pattern recognition within the data, where emerging themes become the categories for analysis" (pp. 3-4). The process of thematic analysis involves examination of data and identification of themes that are central to the description of the phenomenon (Daly, Kellehear, & Gliksman, 1997). Themes identified during careful reading and re-reading of the data become the categories for analysis.

The identified themes were analyzed using a hybrid approach of inductive and deductive analyses, which incorporates both the deductive, a priori template of codes, and the data-driven inductive approach. As described by Fereday and Muir-Cochrane (2006), a hybrid approach of inductive and deductive analysis involves six steps. The first two steps occur sequentially; whereas, steps three through six occur concurrently, involving iterative and reflexive processes, and requires the researcher to go back and forth during the analysis process.

The first two steps focus on developing a codebook to employ in deductive analysis and testing its applicability and reliability. The next two steps involve performing inductive and deductive analyses of the data. The fifth step concerns connecting codes and themes that emerge during inductive and deductive analyses. At this step, some similarities and differences are identified across the data. The final step is corroborating and legitimating coded themes. To do so, the previous steps are scrutinized by performing several iterations of the text-codes-themes interactions to ensure that the clustered themes are representative of the initial data analysis and assigned codes. The codes are connected with each other, while themes are further clustered, resulting in identification of the core themes, and assigned brief phrases.

Deductive Analysis

Deductive analysis is used to develop and test theory qualitatively and allows for systematic testing of the theory with a wide variety of cases. There are multiple sources of theory, including previous research and theoretical concepts, professional and personal experiences, and knowledge of persons and situations that are the focus of research. Deductive analysis is an efficient way to analyze the data as it is informed by an established conceptual framework and sensitizing concepts, or based on the act of preliminary coding of a small portion of the data. In order to perform deductive analysis, first the

codebook is developed and then it is applied to the data.

The codebook serves as a data management tool for organizing segments of similar text to help interpretation of the data and provide evidence for the credibility of the study. Typically, deductive codes in the codebook are based on theoretical framework and developed prior to initial reading of the data. This approach is called template approach. However, sometimes the codebook can be based on a preliminary scanning of the data in addition to a review of the literature (Crabtree & Miller, 1999). In this case, the data are scanned and any additional codes are added to those ones that are based on literature review. Only a piece of the data is used to analyze in a preliminary manner and no exhaustive or comprehensive analysis of data is taking place during the second approach. The codes in the codebook are identified by the name, definition, and description and may be organized by broad code categories depending on research method and research questions.

Next, the applicability of the codebook to the raw data is determined and the reliability of the code is tested. To do so, a small portion of the raw data is selected as a test piece and coded using the codebook to check for the applicability of the codebook. Next, an independent researcher codes the same piece of data to compare the results. When noticeable differences exist, the codebook should be modified and step two is repeated.

Once the codebook is developed and its applicability and reliability are tested with a small portion of data, it can be used for deductive analysis of the raw data. To do so, the data are read and placed under the codes or themes developed a priori.

Inductive Analysis

Inductive analysis of qualitative data is mostly used in social science and health research (Thomas, 2006). Basic inductive analysis is a technique of qualitative analysis that involves reading raw data and making sense of it by deriving categories, themes, and sometimes even a model. The primary goal of the inductive analysis is to allow research findings to emerge from the recurrent and prevailing themes in the data (Thomas, 2006). In opposition to deductive analysis, inductive analysis allows researchers to develop the theory that emerges from the data. Deductive analysis implies testing existing theories, assumptions, and hypotheses that investigate whether research findings are consistent with the literature review. Inductive approach to analysis is goal-free, in which the role of a researcher is to describe what data actually inform about and not just what is expected to derive from the data. Inductive analysis involves the following three purposes: (1) reducing diverse raw text data into brief summary findings; (2) establishing clear transparent and defensible links between summary findings and research objectives; and (3) developing a theoretical model of the raw data that displays the underlying structure of the data (Thomas, 2006). In general inductive approach, research questions are focused on the core meanings evident in the raw text data that are relevant to research objectives. The brief summary findings derived from the diverse raw text data are merged to create meaningful themes and categories relevant to research objectives. The results of inductive analysis are presented through description of the most important themes and categories.

Before performing inductive analysis, the data need to be cleaned and prepared by editing the text and applying a common format to all data files. Then, codes should be created. According to Charmaz (2006), creating codes involves “categorizing segments of data with a short name that simultaneously summarizes and accounts for each piece of data” (p. 43). Codes

could contain actual language of the participants, called in vivo codes (Harry, Sturges, & Klingner, 2005), or can be paraphrased. Creating codes is essential to begin an analytic accounting for the data as codes show that the data were selected, separated, and sorted. The next step involves the creation of categories that contain meaningful units of text segments. During this step, the raw text data or transcripts are read several times by the researcher. The primary purpose of this step is to identify common categories and themes and create definitions for each category and theme. Thomas (2006) suggested that there are two levels of categories or themes: more specific and more general, which were labeled as lower-level and upper-level categories. Often, lower-level categories emerge from in vivo coding, whereas the upper-level categories are based on the critical and evaluative reading of the text data. Unlike quantitative coding, qualitative coding allows for one segment to be placed in multiple categories at early stages of inductive analysis (Thomas, 2006).

Inductive analysis is an iterative process with the raw data read and re-read multiple times and codes, themes and categories continually defined, refined, clarified, and amended. During the final step of inductive analysis, a researcher should not only familiarize oneself with data, but also gain understanding of the events. Hycner (1985) stated that gaining a sense of the whole is essential as it provides "a context for the emergence of specific units or meanings and themes later on" (p. 281).

Combining Inductive and Deductive Analyses

The hybrid approach of inductive and deductive thematic analyses is a thematic coding that allows a balance of inductive coding (derived from the raw data) and deductive coding (derived from theoretical framework). This process empowers researchers to clearly identify how themes are generated from the raw data to uncover meanings central to the phenomenon. For example, Fereday and Muir-Cochrane (2006) used the hybrid approach to gain understanding of how performance feedback among nurses can inform self-assessment related to their competence. After creating a template (deductive codebook with codes and themes), inductive codes are created based on the raw data and the template is applied to the inductive codes. Then, the codes are connected to discover themes across the data during an iterative process, and clustered under headings to reflect research questions.

Methods

Data Sources

The data for this study come from observations of four middle school social science classrooms in the state of Connecticut. These were four out of the 11 classrooms that participated in GlobalEd 2, a PBL simulation of international decision-making with focus on water scarcity issues, for one semester in Fall 2010. Prior to the simulation, the teachers participated in a four-day online training on PBL and GlobalEd 2 in July 2010. The training, GlobalEd 2, and PBL environment were briefly described above to provide a contextual understanding of the data collected in this study. The observations of the four middle school social studies classes were conducted and recorded on video in November 2010. At the time of the observations, the teachers had led their classes in a PBL format for approximately two months; and observations were conducted during the interactive phase of GlobalEd 2.

The data for the present study include text data of the four classrooms, which consists of the following two portions: (a) transcripts of the four video observations of teachers and middle school students; and (b) field notes taken when watching the four video observations. The two

portions include data with focus on teachers and students. For the purposes of this study, field notes were not incorporated into transcripts of video observations. Specifically, transcripts for each classroom included two separate text files: one text file contained transcript of the video and the other file contained the field notes. Nevertheless, both transcripts and field notes were analyzed and research findings were based on both transcripts and field notes, and were integrated together to provide more developed results and assure triangulation.

Data Analysis

Before data analyses, the codebooks were created separately for each research question based on theoretical concepts, which included upper-level categories combined into themes. Once codebooks were created, the raw data were prepared for the analyses, particularly videos were transcribed and structured using a common format. Then, analysis was carried out separately for each research question. First, inductive analysis was performed on the raw data to identify in vivo codes. Second, deductive analysis was performed applying the codebook (specifically, themes developed a priori) to the in vivo codes obtained based on the inductive analysis. In the third step, similarities and differences were identified based on inductive and deductive analyses. Specifically, in vivo codes that did not fall under any deductively obtained themes were identified, further clustered in categories and themes, and had succinct phrases assigned to describe the meanings that underpinned the themes.

Results

First, the codebook (or the template) was created based on the literature review. To meet this goal, three chapters in the Problem-Based Learning for Administrators book by Bridges (1992) were used, particularly, (1) Introducing Problem-Based Learning to Students (Chapter 2, pp. 19-28); (2) Role of Instructor in Problem-Based Learning (Chapter 4, pp. 58-64); and (3) PBL: What Students Learn (Chapter 5, pp. 65-87). Since this study addressed two research questions, two separate codebooks were created using Microsoft Word and Excel programs. The three chapters were read and re-read, and inductive codes of the roles of teachers and students were created. To note, Bridges (1992) suggested that some teachers' roles are optional during PBL instructions. For example, teachers may choose to assist securing additional resources, provide high levels of positive feedback, or define failures as learning opportunities yet, doing so is not prerequisite of the PBL instructional method. In this study, both required and optional codes were included in the codebook. As a result, the codebook contained 44 codes of teacher's roles and 29 codes of student's roles. These codes were then merged into major themes, producing six themes in the teacher's codebook (five prerequisite and one optional) and six themes in the student's codebook. Next, an excerpt of one classroom's transcript and field notes were coded using the codebook to test the applicability of the codebook. Additionally, a colleague was invited to code the same excerpt to test the reliability of the codebook (the second step in the description by Fereday and Muir-Cochrane, 2006). The results were then compared, discussed, and the codebooks were refined.

The refined codebook of the teacher's instructional practices in PBL classrooms includes the following six themes: a teacher (1) provides resources to students; (2) participates passively, rather than actively; (3) provides guidance to students; (4) facilitates learning process; (5) provides feedback and evaluation to students; and (6) may provide a positive, non-

threatening learning environment. Appendix A presents deductive codes and themes for teacher's instructional practices in PBL classroom environments, while the codes of optional teacher's roles are provided in italics. The codebook of the students' roles includes the following six themes: students are (1) divided into teams; (2) active participants of their learning; (3) learners who manage educational resources on their own; (4) provided with opportunities to transfer the knowledge; (5) increasingly independent and responsible for their own learning; (6) engaged in in self-directed, collaborative learning. Appendix B presents students' codebook with deductive codes by theme.

During the third step, inductive coding was carried out on the text data of transcripts and field notes for each research question. In this study, in-vivo codes were used to create inductive codes; therefore, exact words found in the data were used to name the codes. The aim of using in vivo codes was to ensure that concepts stayed as close as possible to participants' own words and used their own terms in order to capture key elements of what was described.

First, in vivo codes were created for each classroom based on the transcripts of the videos and field notes. Then, the codes were grouped by the research question. The first group consisted of all in vivo codes related to teachers' practices; whereas the second group consisted of all in vivo codes related to students' participation. Then, the codes across the four classrooms were combined and same and similar codes were dropped. As a result, 124 inductive codes of teacher's instructional practices and 116 inductive codes of students' responses to teacher's instructional practices were created. Because this study employed the hybrid approach of inductive and deductive analyses, inductive codes were not subsequently merged into themes.

During the fourth, fifth, and sixth steps using the template analytic technique as outlined in Fereday and Muir-Cochrane (2006), the themes developed a priori and described in the codebooks were applied to the inductive in vivo codes. Analysis was guided by the codebook at this stage but not restricted by the deductively created themes. The process of applying the codebook to the inductive codes was iterative and also not restricted by the deductive themes.

During the process of connecting the codes and identifying themes, inductive codes that described a new theme not specified in the codebook were discovered. Subsequently, these codes were clustered into categories and broad themes. As a result, four new categories were discovered with regards to teachers' instructional practices: a teacher (1) encourages students' engagement through positive, non-threatening communication; (2) manages the classroom; (3) provides precise directions; and (4) induces students' future actions. The four categories were further clustered into two broad themes, particularly, teacher (1) engages with students; and (2) restricts students. Table 1 provides inductive codes by category and theme that did not fit under any of the deductive themes of a teacher's instructional practices (research question 1).

Table 1.
Instructional Practices of PBL Teachers Not Presented in the Thematic Codebook

Theme	Category	Upper-Level Codes
Engages with students	Encourages students' engagement	Draw attention
		Asks questions (including rhetorical questions)
		Agrees with students
		Jokes
	Manages the classroom	Moves around the classroom
		Talks to students
		Listens to students
Restricts students	Provides precise directions	Gives precise directions when materials should be ready
		Gives precise directions where students should go
		Gives precise directions how students should split up
		Provides instructions related to when the materials should be done
		Tells students to be quite
	Prompts certain actions	Tells that students will discuss (without saying what exactly)
		Tells that students will plan (without saying what exactly)
		Tells that students will read
		Tells students they need to start

Likewise, five additional categories were discovered with regards to students' responses to PBL instructional practices, particularly, students (1) are teacher-dependent; (2) are subordinated to the teacher; (3) may manipulate location and body; (4) engage emotionally in PBL; and (5) sometimes do not pay attention. The five categories were further clustered in three broader themes. Students (1) comply with the teacher; (2) take liberties; and (3) may be off topic. Table 2 presents inductive codes by category and theme that did not fit under any of the deductive themes of students' responses to PBL instructional practices (research question 2).

Table 2.

Students' Responses to PBL Instructional Practices Not Presented in the Thematic Codebook

Theme	Category	Upper-Level Codes
Comply with the teacher	Are teacher-dependent	Ask for directions
		Ask the teacher questions
		Use the teacher's materials
		Clarify what they will do
	Are subordinated to the teacher	Silently listen to the teacher
		Agree with the teacher
		Observing teacher's modeling behaviors
Take liberties	Manipulate location and body	Stand
		Sit with their group members
		Walk around the classroom
		Sit with member of the other group
		Leave the room
		Use hands and arms to express opinion
		Stands up to express opinion
	Engage emotionally	Laugh or giggle
		Get excited
		Use exclamation intonation (e.g., "yup!")
Are off topic	Do not pay attention	Do not work in the same group
		Talk to their group members on a topic not related to the class

Findings

The purpose of this study was to gain a deeper understanding of the instructional practices used by PBL teachers implementing GlobalEd 2 in middle school social science classrooms environments and the responses of middle school students to these instructional practices. To answer the research questions of this study, teachers and students in PBL classrooms were observed and video recorded during a classroom period in four middle schools. . Then, a hybrid approach of inductive and deductive thematic analysis of video transcripts and field notes of four classroom observations was used. As a result, this study confirmed themes described in Bridges' (1992) description of roles of teachers and students in classrooms with PBL instructions, as well as identified additional themes.

Confirmed Themes

As stated by Bridges (1992), PBL changes the function and role of the teachers. In a PBL environment, the teacher is not the information provider or classroom controller. Rather, the teacher facilitates, coaches, and models good problem solving skills for their students. Teachers play an essential role guiding students and modeling students' learning. The findings in this study demonstrated consistency between the teachers' instructional practices and students' responses to such practices in PBL classroom environments, as found in the Bridges' (1992) definition. First and foremost, teachers provide

and assemble resources and educational materials to their students. They distribute research papers and handouts with facts among students, while providing encouragement. For example, while Beth was giving papers to a group of students, she said:

"And also btw, now and also… (giving papers) just some…. ideas that we can come up with. Just some ideas, that's all."

Teachers make sure that students have resources valuable in developing solutions. Because GlobalEd 2 is an online PBL that required access to computers and the Internet, teachers made sure that the computers were available for students in each issue group. In some schools, each student had access to a computer; whereas only one computer was available for each issue group of 4-7 students in other schools. In the case of the latter, teachers made sure that students used the computer collaboratively:

"So, again you know you're going to have to team up because not everyone has a computer, so, to team up and divide the work your reading, research some things (inaudible). Go ahead and jump in and uh and if you have any questions talk to me."

PBL teachers do not actively participate in teaching the class. They minimize the time they spend on giving instructions to the whole class and avoid lecturing students. The teacher observes students' participation with regards to students' roles and engagement within the issue groups, contributions to discussions, application of knowledge, and general understanding. This process is especially noticeable in the field notes:

The teacher goes around the class, stops next to students in the health issue group in front of their computers. He looks at the screen of students' computer but stands far so that he does not disturb students. Eventually, students noticed the teacher. The teacher is just observing, not saying a word. The teacher assistant approaches the round table and looks at what students in the human rights issue group are writing in their papers.

Teacher does not serve as a dispenser of the information, but rather as a coach or a tutor to students, by leading students and proposing ideas. When giving ideas to students, the teachers allow students to make their own decisions as to whether or not to use specific materials, stepping down from an authoritative teaching style and giving more freedom and control of the learning to the students. Additionally, teachers provide guidance to students, review what students know, suggest how that knowledge can be applied to the problem being solved, ask leading questions, and identify ideas that students may choose to use. When talking to students in the economic policy issue group, Thomas led students to think about barter:

"Everyone has different needs for the people of their land. Correct? You guys are dealing with that as you talk; well someone is saying 'I'm not going to pay you because we need to use our money to help our people eat.' Some places don't have enough food so conflicting cooperation right now is working on a trade, which is great."

Teachers facilitate learning process to students by asking timely questions, checking whether students understand the material, and provide directions if students need assistance. Teachers may often use such words as "perhaps" and "possibly" when providing directions to students who need help:

"Umm…So, what I'm going to ask you guys to do is to log back into uh simulation and go onto the message board there uh and see what you can do to further your policy because again according to the edited negotiations uh try to get some messages out there that will get your point of view across. Perhaps, you want to persuade some people to work with your allies uh and to prevent some people who don't agree with you."

During PBL instructions, teachers ensure a positive classroom environment, facilitating students' growth and suggesting how students may improve their solutions. PBL teachers provide timely feedback to students and evaluate students' products for educational purposes.

With regards to students in PBL classrooms, they work in small groups. Due to the regimen of GlobalEd 2, students in each classroom were divided into four groups according to the four issue areas (economic policies, environment, human rights, and health). Each group in the observed classrooms consisted of four to five students. All groups were mixed-gender. During the PBL simulation, students sit in front of a computer and participate equally. Students are active participants in their learning. Each student has a role. For example, one student can be typing on the computer what other students in the small group are suggesting, as described in the field notes:

After the teacher stopped talking, students started actively discussing what they were working on. Students in the economic policies issue group are gathered around the laptop. One student (a boy) is sitting in front of the laptop. Other students in the group are standing behind him, while one girl is kneeling. All students in the group are deciding what to respond to another "country" and dictating the boy at the laptop the sentences to type.

In PBL classrooms, students feel responsibility for what is happening during PBL and for how to find a solution to the problems. They are self-directed, often independent, and are willing to help all students in their small group. They locate and manage educational resources on their own, being increasingly independent from their teacher. For example, when Jarod mentioned that there were not enough computers in his classroom, one girl raised her hand and volunteered her own computer for the use in her issue group.

The students work in groups, helping each other and discussing issues related to the project. Students not only work collaboratively with members of their own group, but also help members of other groups in their class. They share resources, exchange ideas, discuss solutions, and apply knowledge to the problems being solved.

Added Themes

Along with similarities between the data and the theory, this study also revealed additional themes with regards to teachers' instructional practices in PBL classrooms and students' responses to such practices, compared to Bridges' (1992) definitions of the latter two. Two broad themes of teachers' instructional practices in PBL classrooms and three broad themes of students' responses to PBL practices were discovered. Teachers play an essential role in engaging students and overlooking their learning. While teachers play the role of passive observers of students' learning, they also engage with students. They walk freely around the classroom and talk to students individually and collectively in small groups; they ask questions, listen to and agree with students. When interacting with students, teachers encourage students' engagement in a good-humored way by

telling jokes and asking rhetorical questions or manage the whole classroom by moving around as well as listening and talking to students.

As students get progressively engaged with being progressively more independent at searching for solutions, they may also become sidetracked from a central issue. In this case, teachers have to guide students by establishing deadlines and prompting students' attention to certain activities. For example, Thomas gave straightforward directions to students telling them in a very direct way not to pay attention to something or to just abandon the idea:

"That's not the issue, I don't want to get into that [...] shhh... um... I don't know... um... not now, just not now."

Some students' responses to PBL practices were not indicated in Bridges (1992) work. During PBL instructions, students generally comply with the teacher. Despite an increasing independence, students rely on the teacher; they use teachers' materials, ask for directions, and clarify what they need to accomplish, as well as observe, wordlessly listen to, and agree with the teacher:

Students are silent; they are listening to the teacher while the teacher gives the papers to students (to each of them). One of the students is standing next to Thomas [the teacher], not saying much, but occasionally nodding in agreement with the teacher. Once the teacher was done talking, students asked: "Can we go [to our computers] now Mr. R.?"

Similar to classrooms with a traditional learning environment, students get sidetracked in classrooms with a PBL environment. They may not pay attention to what is happening in the classroom or remain focused on the actual problem presented, even when their teacher emphasizes and show them what they should concentrate their effort on:

The teacher is sharing information with students by projecting the webpage on the wall. Because the text is too small to be able to read, Thomas asks his assistant: "can you zoom it in," "go and zoom it in," and "now click it on." While the teacher is asking his assistant to help with the technology, students are talking to each other about unrelated to the simulation topics.

Finally, students take liberties. They are allowed to move around the classroom, engage in a conversation related to the project with members of other teams, express positive emotions, and talk to students in other issue groups. Sometimes, students get very excited about what their teacher demonstrates and explains.

Overall, students are generally excited to participate in PBL and eagerly engage in solving the problem. They take an active part in their learning, while still relying on teachers' instructions. They may get sidetracked, similar to what sometimes happens in traditional classrooms. When this happens, teachers may engage with students to make sure that students are paying attention in a positive, indirect, way by joking and asking rhetorical questions as well as listening to and agreeing with students, and ensuring that students feel empowered about their learning. Alternatively, teachers may tell students in a very sharp way to quit doing something and be back on track, using a carrot and stick approach.

Conclusions

Teaching is a complex task and even more so in a student-centered environment with a PBL instructional method when teacher and student

roles are no longer traditional. This study examined the roles of teachers and students, focusing on instructional practices of teachers in PBL classrooms and students' responses to such practices. Replicating and extending the work of Bridges (1992), the present study demonstrated that an experienced PBL teacher ensures a positive classroom environment by facilitating students' growth and suggesting how students may improve. Students become increasingly independent in self-directed collaborative learning while sharing ideas and resources, transferring knowledge actively across domains, and searching for solutions to the given problem. This study identified a number of specific instructional practices of teachers, as well as responses that students might engage in during PBL instructions. Being able to articulate these roles is an important step in helping new PBL teachers facilitate effective student-centered classrooms.

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Appendices

Appendix A
Teachers' Instructional Practices During PBL: Deductive Codes and Themes

Teacher provides resources to students

1. Teacher provides educational materials to facilitate learning
2. Teacher assembles the resources, materials, supplies, and equipment needed for learning
3. Teacher serves as a resource to the team
4. Teacher serves as a resource to students
5. Teacher assists in securing additional resources (expertise or equipment)

Teacher is a passive (rather than an active) participant

6. Teacher observes the pattern of participation along content, process, and frequency
7. Teacher observes whether students' participation is relatively high or low
8. Teacher observes whether students understand and are able to apply knowledge
9. Teacher observes who is talking
10. Teacher observes how students' comments fit into or contribute to the discussion
11. Teacher observes project meetings
12. Teacher is not a dominant participant
13. Teacher gives more and more responsibility to students
14. Teacher is involved less as students learn more

Teacher provides guidance to students

15. Teacher does not serve as a dispenser of information

16. Teacher is a facilitator, or educational coach, or a tutor
17. Teacher guides students' learning
18. Teacher reviews knowledge with students
19. Teacher provides guidance to facilitate learning
20. Teacher asks guiding questions
21. Teacher checks to see if students share these perceptions
22. Teacher demonstrates skills
23. Teacher asks timely questions
24. Teacher clarifies the meaning of concepts
25. Teacher answers questions related to the project

Teacher facilitates learning process

26. Teacher assigns roles to students of the project team
27. Teacher tones students' comments
28. Teacher provides directions if team needs assistance
29. Teacher intervenes if needed (if students are bogged down and spinning their wheels)
30. Teacher Suggests about how the team may improve

Teacher provides feedback and evaluation to students to facilitate students' growth

31. Teacher evaluates the participation with a view toward facilitating students' growth. For example:
    a. "Here's what I observed…."
    b. "Here's why it concerns (or impresses) me…."
    c. "Do you see it the same way?..."
    d. "If so, how might you do that differently in the future, or how might you try to deal with that concern?"
32. When providing feedback, teacher offers suggestions for dealing with the areas in need of improvement
33. When providing feedback, teacher provides a balanced picture of strengths and weaknesses
34. When providing feedback, teacher limits the number of concerns that are identified
35. When providing feedback, teacher discusses the reasoning behind the suggestions
36. When providing feedback, teacher uses neutral to positive tone
37. When providing feedback, teacher poses questions for further reflection by students.
38. Teacher assesses team's final product
39. Teacher shares perceptions of what seems to be happening

Teacher may create positive, non-threatening learning environment

40. Teacher strives to creates nonthreatening, supportive environment
41. Teacher defines "failures" as leaning opportunities
42. Teacher encourages students
43. Teacher supports students' efforts
44. Teacher provides high levels of positive feedback

Appendix B
Students' Responses to Instructional Practices during PBL: Deductive Codes and Themes

Students are divided into teams

1. Students are in groups of 5-7
2. Students work together in the group to problem solve and learn
3. Students work as member of a project team to solve problems
4. Most of the learning occurs within the context of small groups rather than lectures

Students are active participants of their learning

5. Each student has his or her own role
6. There is a team leader in each team
7. Each group member participates equally
8. Students are leaders in their learning
9. Students are dominant participants (not an instructor)
10. Students play an extremely active role in a PBL project

Students manage educational resources on their own

11. Students locate resources
12. Students examine the resources
13. Students use the newly acquired information to resolve problems

Students are provided with opportunities to transfer the knowledge

14. Students have opportunities to use and apply what they have learned previously
15. Students are given opportunities to elaborate on what they have learned
16. Students write essays about what they have learned
17. Students discuss with the teacher the product (when product is ready)

Students are increasingly independent and responsible for their own learning

18. Students are given more and more responsibility for their own education
19. Students become increasingly independent of a teacher
20. Students individually and collectively assume a major responsibility for their own instruction and learning
21. Students are responsible for figuring out how to accomplish objectives of the project
22. Students (not the instructor) shoulder responsibility for what happens during the project

Students are engaged in self-directed, collaborative learning

23. Students discuss the information
24. Students exchange views about how knowledge and skills might be used to deal with the problem

25. Students share with each other what they learned
26. Students acquire collaborative or team learning skills
27. Students critique one another's efforts to apply the knowledge
28. Students work with learning materials as a project team
29. Students develop their product