Student Reflective Experiences in a Problem-Based Unit

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Fall 2012 – R685
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Thesis: Student Reflection in the PBL process is important in assisting student learning, retention of knowledge, and helps create ownership of learning.

Introduction

Reflection is an important aspect of the educational process, and has an especially key role in Problem-Based Learning (PBL) (Kolb, 1984; Schon, 1983). Whether students are in a graduate-level course, or using PBL in an elementary science class, the opportunity to look back on the processes, procedures, actions, and collaborations in answering the guiding question are key to the cognitive and metacognitive development of the student. However, problem-solving reflection may not be enough, as while students may be adequately reflecting on their own experiences, there are underlying assumptions and biases which may get in the way of the accurate construction of knowledge (Reynolds, 2002).This literature review explores the role that reflection, and in particular, critical reflection, play in the PBL process.

Problem-Based Learning

Problem-based learning (PBL) is an instructional strategy based on cognitive-constructivism, social learning, and the development of the problem-solving process (Barrows, 1996; Savery and Duffy, 2001). Originally designed for use in the training of medical doctors by Howard Barrows, many disciplines have tried to adapt PBL for their own curricula, from medical education, to schools of education, and into high schools.

The PBL model has been defined by its core principles, as described by Barrows (1996), Savery and Duffy (1995), and Savery (2006):

- A focus on student-centered learning over teacher-centered pedagogy.
- Student collaborative groups of no more than 6-10 students
- An authentic, "messy" problem which the students will address, and will guide the students through the problem-solving and learning process
- Facilitators and tutors over teachers and instructors
- Students engaging in Self-Directed learning activities.

These core principles set up a learning experience where students will engage in a problem-solving process focused on the exploration of content required to address and answer the problem which has been presented to them as a group. Students set their own goals, tasks, and guidelines under the guidance of the facilitator or tutor, and are constantly assessing their own progress, as well as their group's progress through the problem-based unit.

It is in examining the last principle (Principle 8) of the PBL constructivist instructional sequence as identified by Savery and Duffy (1995) that we find an important opportunity for students to address the cognitive and metacognitive portions of cognitive constructivism through the use of reflective activities and techniques. In order to better understand the place of reflection within the PBL process, it is important to explore how reflection aids in the cognitive process first.

Reflection

In their discussion on an online tutoring program, Goodman et al. (1998) discuss the importance of reflection in the educational process, noting that reflective activities provide students with opportunities to analyze their decisions and actions, compare other student decisions and actions with their own, and enable students to make more educated decisions later in the learning process. While Goodman and his fellow researchers were speaking towards the use of computer supported collaborative learning tools in regards to reflective activities, there is much research which supports this

viewpoint, even to the point of calling reflective activities “essential to cognitive strategy learning” (Driscoll, 1994), and one of the necessary components to being considered an “expert” learner (Ertmer and Newby, 1996).

This notion of reflection as being essential for the learner is not a new idea, and has its roots at least as far back as John Dewey, who outlined four criteria on for reflection: (1) Reflection should be a meaningful process; (2) Reflection should demonstrate a rigorous way of thinking; (3) Reflection needs to happen in a community, in interaction with others; and (4) Reflection requires attitudes that value the personal and intellectual growth of all involved (Rhodes, 2002). Should these four criteria be met, the student will be able to grow from the reflective process – a lack of any of these will make the process less effective or meaningful . Several researchers have built on this Deweyan tradition, stating that reflection is a pivotal element in the instructional process, focusing on the knowledge created through the “transformation of experience” (Schon, 1983; Kolb, 1984).

The opportunity to reflect on one’s experiences, as stated above, is key to the learning process. Not only does the reflection process allow the learner an opportunity to examine the information they have covered, the process they went through during the activities, and how the solution addresses the issue being examined, but also allows students to develop their metacognitive knowledge (learning strategies which work best for them, as well as how to connect prior knowledge to address the issue), and develop their metacognitive control (also known as self-regulation – the ability to Plan, Monitor, and Evaluate their learning on a constant basis) (Ertmer and Newby, 1996).

Taking the combined notion of Dewey’s reflection criteria, and the metacognitive development as described by Ertmer and Newby, a broader picture of the reflective process begins to emerge, a meaningful process in which the students looks back on the processes, information, and ideas covered

in order to address a particular issue, and the identification and internalization of plans and strategies to use in order to successfully address future issues. But is this enough?

Critical Reflection

It may be necessary to take the reflective process one step further, into what Jurgen Habermas described as "Critical Reflection" (Habermas, 1972). Critical reflection goes beyond the Deweyan view of reflection, and tries to assist the student in addressing epistemological issues which can cloud true reflection with assumptions. Reynolds (1999) discusses four principles of critical reflection, which can be broken down into the idea that objectivity should be questioned, and fosters the idea that assumptions should be questioned, particularly when exploring ideals related to social connections when formulating knowledge.

This postmodern epistemological view of reflection adds another layer to the reflective process of the student, one where not only do they think back and discuss the content explored and process they have gone through, but also the potential biases which may be present in the content, colleagues, experiences, and thought processes which may exist (Van Manen, 1977). By taking these items into account when reflecting, students learn to not only look back, but also to examine the meaning of the knowledge they have explored, constructed, and/or discovered.

Reflection in Problem Based Learning

With the above information, it is apparent that reflection is not an easy undertaking for the student (or teacher, for that matter), but is still a very important aspect of the Problem-Based Learning approach. As discussed above, the 8th Principle of constructivist instructional design (which PBL is based on), "provides opportunity for and support reflection on the content learned and the learning process" (Savery and Duffy, 1995). When adding Critical Reflection to the traditional notion of problem-solving

reflection, the 7th Principle of constructivist ID (encourage testing ideas against alternative views and alternative contexts, social negotiation) can be grouped in this PBL reflective process as well.

Based on the above research, we can see how reflection would be important to the PBL process *in theory*. But is it valuable in the field? What does this reflective process look like? Is it always successful? As with many questions of this nature, the results of existing research identify strengths and limitations of the reflective process, as well as varying degrees of depth within that process.

According to Lim's 2009 study, there were three types of student reflectors within the study's PBL unit:

- Non-reflectors, who reported higher levels of habitual action, and lower levels of reflective action when participating in the PBL unit, and felt they were "just going through the motions,"
- Dependent reflectors, who reported higher levels of both habitual action and reflective action, indicating they performed the reflective activity only with the prompts, suggesting that without these prompts and scaffolds, they would have difficulty with, or would not engage in, the reflective process,
- Independent reflectors, who rated themselves with low habitual action and high reflective action, indicating they had little to no need for the prompts and scaffolds in order to engage in the reflective process.

Similar categories are indirectly indicated in Kumar and Kogut's 2006 study on student perception of the PBL process. However, instead of only exploring the reflective activities on an individual basis, the researchers explore the notion of collaboration as a necessary component of the reflective process; addressing Dewey's third criteria for reflection (Reflection needs to happen in a community, in interaction with others – Rhodes, 2002). Through this collaborative reflection practice, students were able to not only reflect at the problem-solving level, but at the critical reflection level as well, by "collectively analyze multiple perspectives on various issues through the lens of critical openness and identify the strengths and pitfalls of each of these viewpoints" (Kumar and Kogut, 2006).

In both studies listed above, many students (particularly those identified as the dependent and independent reflectors) constructed their knowledge through deep thinking and analysis of the problem

and potential solutions, and upon completion of the activity, had created meaning through the construction of knowledge, and an understanding of the importance of the process of problem-solving over the rote memorization of facts (Kumar and Kogut, 2006). This metacognitive understanding falls in line with the goals of Savery and Duffy's 8th principle of knowledge construction, and further showcases the importance of meaningful critical reflection in the PBL process.

At this point, it may be valuable to identify a key difference between the reflective methods used in these two studies, as the avenue for reflection can be as important act of reflection itself. Lim's 2009 study utilized questionnaires where students self-reported their perception of their reflective thinking habits on a 5-point Likert scale (it may worth noting that the alphas range from 0.62 to 0.76, which may raise questions related to the internal validity of the instrument, which the authors address and admit in the article). Aside from the questionnaire related to student self-perception, there is no indication on how these reflective activities took place, meaning that the researchers may not have taken into account where, when, and with whom (if with anyone) these students reflected, all of which are key parts of the PBL learning and reflective process. This is in contrast to the Kumar and Kogut (2006) study, which utilized student reflective journals which were qualitatively examined under a model where "participants and users…are encouraged to express their values and rationale for their evaluation decisions in cooperation with others."

This is not to say that the reflective activity was always a smooth or meaningful process. Lim (2009) indicates that 47% of third-year respondents were merely "going through the motions" of PBL, and not seriously attempting to reflect on the process or knowledge gained. Nearly half of the students in that particular cohort did not have meaningful participation in the process. Kumar and Kogut also identify a similar issue in their research, but explore it categorically, focusing on the structural/operational problems (most notably communication issues), transitional issues and new expectations for the students who were all attending a new school, and concerns over personal and

group assessment throughout the entirety of the PBL process. These issues are all connected through student prior experience and expectation on how the educational process should occur. On one hand, they welcomed the change and identified the importance of communication and collaboration in meeting the learning goals, but also pointed out potential injustices in the assessment process, and the difficulty of changing a mindset from the traditional methods of education to this new experience.

Research Question

Keeping the above empirical studies and frameworks in mind, my goal was to address the following research question: How do students in an undergraduate technology integration course reflect on the PBL process? It is important to note that these students have had little to no previous exposer to Problem-Based learning in a formal educational setting.

Context of the Study

This pilot test took place in an undergraduate technology integration course for pre-service teachers at a large Midwestern university. There were a total of 11 students in the course. Each of the students in this course described their previous knowledge of Problem-Base d Learning as a method of student inquiry as limited, and described themselves as novices in this context. The class met twice a week for 1.5 hours each session, over a fifteen week period. The PBL potion of the class consisted of 9 weeks, with a one week school break at approximately week 6 of the unit. Students completed 4 major projects over the course of this unit with a mix of individual and collaborative tasks, attempting to address one overarching question: “How can we best prepare students for lifelong learning while addressing content standards for standardized tests?”

In order to address this problem, students ranked their interests in exploring three types of student-centered learning: Inquiry-based learning, Problem-based learning, and Project-based learning.

Students were then divided into three groups of 4 (with one group of 3), and asked to address the problem based on the context of that approach to learning.

Each class session was broken up into 4 sub-sections:

a. Class reflection discussion on Field Experience (if applicable) and how it relates to our overarching question
b. Group Status Report regarding the PBL project.
c. Workshop time for projects (Facilitator makes rounds to work with each group)
d. Closing – Goals to be completed by next session

Each week, students were asked to complete a reflective blog at the end of each week, where they were asked to address the following prompts:

- What did you do this week to address the problem?
- What worked well as you worked on addressing the problem?
- What issues are you experiencing in addressing the problem?
- How do you feel about your individual progress in addressing the problem?
- What do you need to be successful in addressing the problem?
- What additional questions, comments, or concerns do you have?

Each of these items was designed to guide students through a critical reflective experience, and bolstered with class and group reflection time as well. Please see Appendix A for an overview of the course structure and content covered.

Research Methods

This study is intended as an informal pilot study, to examine how effective the projects and prompts are in addressing the research question.

Each week, the researcher read the blogs of all 11 students, performing a topical analysis of each week related to the prompts above for each individual blog. The topical analyses were then compared to explore similarities and differences within the class. At the end of the course, students were asked to complete a final reflective entry, where they discussed the items above, but with the

entirety of the unit in mind, instead of just a reflection of that week. This approach is similar to, but not a replication of, the approach taken by Kumar and Kogut.

For this study, only the individual reflective blogs were used as the content analysis – any formal or informal reflective activities during class time were not recorded or documented, and meant as a means of formative evaluation for the students. In all instances for content analysis, the researcher consulted an independent researcher to perform a similar analysis and compare notes, until they came to consensus.

Results

a. Participation in Reflection on Blogs

As described by Lim (2009), there are three levels of participation in reflection (Non-Reflectors, Dependent Reflectors, and Independent Reflectors). In order to categorize each student based into one of these three levels, the researcher examined the amount of participation in the class blog community (number/frequency of posts, comments fellow students blogs), content covered and discussed (breadth and depth, as well as exploration beyond the classroom discussion), and attitudes towards the blogging process if indicated in the blog itself. The researcher consulted an independent researcher to perform a similar analysis and compare notes. Based on these criteria, we can examine trends based on these categories, as shown in Table 1.

Table 1: Categorization of Student Reflectors

	Non-Reflectors	**Dependent Reflectors**	**Independent Reflectors**
Number of Students	4	4	3

Within the non-reflectors category (4 students), a common trend was seen based on frequency and depth of content and reflection – all of the non-reflector missed several required blog postings throughout the course of the unit, while when posts were made, they tended to be shorter (average of 5 sentences) when compared to the dependent (10-14) and independent reflectors (10+). These trends continued throughout the semester, including the final reflective activity. One particular blog summed up their reasoning for a lack of habitual and reflective blogging in their final blog post:

"The hardest part of this class was the blog. I don't blog, simply put. I have never been good about voicing my opinions and have little desire to write them down" - Student MM.

The dependent reflectors (4 students) provided more structure, frequency, and reflective activity on their blog posts. However, while this group may have met the standards required for the course, the reflections did not go beyond the requirements – the prompts were answered on a weekly basis, as required, but went no further, indicating a higher rate of habitual action.

The independent reflectors (3 students) moved beyond the requirements of the unit and prompts, providing outside information or more-frequent blog posts and comments than their peers. For this group of students, the act of writing and reflecting was an activity done in order to organize their thoughts on the specific activities they had engaged in both inside and outside of class, and often posted about information and reflection from outside of class (news articles which related to content, fieldwork experiences, etc.).

b. Reflection on Course Content

Reflection related to course content varied student to student, though trends did emerge. An examination of the student reflective blogs revealed that students were primarily focused on their own

personal growth and understanding related to the PBL unit. The students focused on three themes in particular when reflecting:

I. What did I do this week?
    i. Example: "*Week Twelve was solely focused on instructional design and working on our video projects. Tuesday we spent a majority of the time on working with our groups to get our videos into action. One of my partners developed a newscast setting for our project. So my role was to get all my interview questions and responses in to segments and then send it to him where he would then just place it in the final video. I am very eager to see how things look on Tuesday. Thursday we discussed the timeline and the requirements for our next assignment of instructional design*" – Student SL
II. How does this relate to my future teaching?
    i. Example: "*Personally I feel like I made a lot of progress in thinking about how to use online classrooms with my students. I brainstormed some ways to use this type of learning. For instance maybe do online classrooms with another school with a different culture to fulfill the history and culture standards*" – Student RR
III. What do I need to do to address the problem in my future professional life?
    i. Example: *"I need more discussion with fellow future teachers. I say this because after this week's discussion I learned a lot about other people's points of views and doing something like that will also help prepare me for when issues on a technology broad come up and I need to take other people's views into consideration*" – Student RR

These themes were embedded within the structure of the required reflected activity to a different degree for each student, but were included in each student blog at some point throughout the unit.

c. Reflection on Metacognition

As described by Ertmer and Newby (1996), the reflective activity allows students to develop their metacognitive knowledge (learning strategies which work best for them, as well as how to connect prior knowledge to address the issue), and develop their metacognitive control (also known as self-regulation – the ability to Plan, Monitor, and Evaluate their learning on a constant basis). To some degree, each blog reflects this to some degree.

i. Strategies: Within each blog, students reflect on the strategies used during the week by the instructor, as well as during their projects. Students discussed how a particular approach or strategy worked (e.g. *" I…feel like I learned some more strategies to how to complete group work. The point of a group assignment is not always to simply complete it and turn it in. There are hidden goals and that is working with other people and the steps and individual takes to get the project done while working with other people."* – Student SL) or did not work for them; and if the latter, tried to think about different alternatives to achieve their goals for that particular week or in learning their content.

ii. Metacognitive Control: As part of the reflective process, students were required to discuss their next steps in their process, with the intent to create an overall plan of action on addressing both the overarching problem, as well as to solve problems that they were experiencing. These responses ranged from understand the importance of just sitting down to do the task needed ("*To be successful in addressing the problem I need time to work on my projects while also being able to ask questions of my instructor"* (student BE), to thinking about how to re-organize tasks for group work (*" A couple things I struggle with in group with are the desire to complete everything myself and the desire to divide and conquer instead of collaborating. I always seem to think that everything will be done the best if I just do it, but I need to realize that other people have good ideas as well, so I need to step back and listen to what they have to say"* – student SJ). There is no evidence that students created an overall roadmap of a plan in the blog posts. There is, however, ample discussion regarding evaluation of projects and activities. These reflective posts discussed the overall experience of the project, the product completed, and on some blogs (particularly those of the Independent Reflectors), discussion on projects the other groups completed. For this last group of

students in particular, the discussion focused on how the content of the projects others completed may affect their own teaching and learning.

d. Critical Reflection

Based on a review of the student blogs, there is little evidence of written critical reflection as described by Reynolds (1999) criteria. Out of the eleven students enrolled in the course, it was of the opinion of the researchers that two students engaged in a critically reflective activity, and each student did so only once throughout the unit in a limited capacity. During this time, one student (SL), in a discussion regarding their research and exploration into Inquiry-Based Learning and comparing their own experience as a student to this approach, remarked on the complexity of planning for such a lesson, as they needed to continuously re-evaluate their own understanding of the material, as well as methods used to lead students to an understanding of the content. The other student (DZ), during their field experience, commented on the difficulty of the overarching question when talking with their practicing teacher:

> I think it is beneficial to be able to talk to professionals who are in the field of teaching and struggle with this problem everyday instead of just in theory like our class…The issues I am having in addressing the problem is being able decided how to teach students in a meaningful way and still produce good test scores and meet standards. It is hard to make this connection. For instance, in my field experience the teacher was only able to spend a day and a half on me like Carnegie, Rockefeller, J.P Morgan, Henry Ford, and Cornelius Vanderbilt. For me this is a huge disservice to students because I can think of many ways that would create lifelong learning experience for these students when learning about these men. However, the teacher does not have enough time to create those experiences and make all the other standards, so that is all of the time he can give that topic... I now feel that at this phase it is time for me to start putting together my own plans and ideas on how I can marry these two challenges together in my teaching.

Discussion

Based on the literature, reflection has a very important role to play in the PBL process. This includes the elements of participation in the reflective process (Lim, 2009), reflection on metacognitive strategies (Savery and Duffy, 1995; Ertmer and Newby, 1996), and critical reflection (Habermas, 1972; Reynolds, 1999). However, based on the analysis of student reflective blogs, there is no clear indication that all three levels have been successfully achieved.

The analysis reveals that the students are adequate identifying the metacognitive portion of reflection - describing their own growth, thoughts, and process, can evaluate their own learning, and identify when and where they need to make changes. However, the transition from a problem-solving level of reflection (identify, evaluate, plan next steps) to a critical reflection (identify the underlying assumptions in order to assess what is really occurring) is not one that occurs throughout these blogs. This may be due to several factors, such as a lack of training on reflecting critically, or the reflective prompts not guiding students into reflecting critically.

The use of blogs as a sole data sources may also constitute a problem in examining student reflection process. As stated in the context portion of this paper, there were several layers of reflection both inside and outside the class, with the reflective blog being the only documented portion. Several students identified issues with the blogging process either through discussion in their blog, or neglecting to post their reflections. A more holistic approach to the capturing of student reflections would be more beneficial, to allow each student their own choice on how to reflect. This adjustment may alter how students participate in the reflection process, particularly with addressing the non-reflector group.

Conclusion

The role of reflection in any educational process, but especially for the PBL process, is clear – for a student to make meaning of the information they have explored, they must reflect on content and process. In doing so, they build the metacognitive skills which transfer not only from project to project, or problem to problem, but to everyday life situations. PBL also offers students to take their

understanding beyond the scope of the context they are exploring – to move beyond the situation the problem lies, and to examine the assumptions they make while addressing that problem. By being aware of these assumptions, students can make a clearer, more effective attempt at solving the problem they are confronted with. This is not an easy task, and one that needs to be properly scaffolded by the instructor/tutor/facilitator to support student success in this endeavor.

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Appendix A: Assignments and Structure for W210 Problem-Based Unit

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1. The Overarching Question: How can we best prepare students for lifelong learning while addressing content for standardized tests?

2. Projects within this Problem-Based Unit (Detailed information within the hyperlinks:
    a. Technology in our Schools Video Assignment
    b. Android Application Development using MIT App Inventor
    c. Instructional Design and Web Design
    d. Reflective Blog Posts
3. Course Structure:
    a. Class reflection discussion on Field Experience (if applicable) and how it relates to our overarching question
    b. Group Status Report regarding the PBL project.
    c. Workshop time for projects (Facilitator makes rounds to work with each group)
    d. Closing – Goals to be completed by next session
    e. Blog Posts (completed weekly, outside of class)
4. Summative Evaluations
    a. Technology in our Schools Video
    b. Instructional Design Document
    c. Webpage
    d. Reflective Blog Posts