The role of reflection in student learning: a study of its effectiveness in complementing problem-based learning environments.

Rachel Ong
Centre for Educational Development
Republic Polytechnic
1 Kay Siang Road, Singapore 248922

Abstract

Reflection journals can help to increase the value of the learning experience by facilitating learners to make meaning out of the process they are engaged in. It enables the learners to relate the new material of learning to prior knowledge and hence a better understanding of the discipline. It also enhances the learner's meta-cognitive awareness.

The aim of this qualitative study is to examine the daily reflections of students enrolled in a Problem Based Learning-delivered programme at the Republic Polytechnic, Singapore. The reflection journal is introduced with the intention to enable the students to be more aware of their own learning.

The data set is drawn from daily electronic journal entries. A sample of 10 students' entries were examined over 16 weeks. The themes evident are:

- *The student demonstrates an increasing awareness of his own learning.*
- *There is a increasing complexity of the cognitive skills. The student demonstrates an enhanced ability to handle and process concepts.*

The evidence lends support to the importance of reflection in the learning process in a problem based learning environment and how it helps students make meaning and construct understanding of new knowledge.

Introduction

This paper looks at the role of reflection and how it complements the problem-based learning environment. It looks at the reflection journals of 10 students enrolled in the Republic Polytechnic's problem driven curriculum over a period of a semester (16 weeks). It explores the ability of the reflection journal to track changes in cognitive strategies and meta-cognitive abilities of students. It argues that the reflection journal, in getting students to reflect on their problem solving processes, enables students to demonstrate an increasing awareness of their own learning and an enhanced ability to handle and process concepts. This will help the learners to relate new knowledge to prior knowledge and hence aid in student's knowledge construction.

PBL at the Republic Polytechnic

Republic Polytechnic uses problem-based learning as the exclusive pedagogical approach in all its diploma programmes. A unique feature of PBL at Republic Polytechnic is a one- problem-a-day cycle. In a problem solving day students typically

receive a problem as a trigger for learning at the beginning of the day. With the help of a facilitator and team mates, students examine the problem, identify learning issues and employ research strategies so as to present a possible solution at the end of the day. The findings are presented and discussed in a larger group. Students reflect on the way they have learnt in their groups and record key learning milestones in their on-line reflection journals.

Literature Overview

Reflection and learning

Reflection is a mental process of thinking and learning often used in everyday life. It is more than just a common sense wisdom.

Dewey's (1933) approach to reflection tended towards the psychological and educational. He focused on the nature of the processes by which we manipulate knowledge towards a purpose; in other words reflection generates knowledge.

John Cowan (1998:16) gives an example of what reflection is:

> "A student is reflecting when she notes that there is something different about the case that she is considering, in comparison with the examples she has encountered in class; and when she also identifies what the difference is, and what she should do about it."

The concept of reflection may also be viewed in several ways. Reflection can be seen as being intimately involved with the process of learning and the representation of that learning. Reflection here entails giving consideration to the details. Reflection can be towards a purpose, processing information that leads to a useful outcome. Reflection can also refer to mental processes that go beyond merely thinking and recalling information. Hence, reflection would 'imply a form of mental processing with a purpose and/ or an anticipated outcome that is applied to relatively complicated or unstructured ideas for which there is not an obvious solution. This suggests close association with, or involvement in, learning and the representation of learning' (Moon, 1999:4).

Reflection in the work of Schon (1983, in Moon, 1999) makes a distinction between 'reflection–in-action' and 'reflection–on action'. His ideas are mainly applied in the realm of the practitioner and how a practitioner draws on espoused theories when they act. Nevertheless, Schon suggests that reflection bridges the gap between theory and practice and hence changes practice.

So how does reflection feature in learning?

Learning is not just a process of accumulation of information. Instead it is about how the new knowledge that the learner encounters is integrated with his existing schemata of prior knowledge. Ramsden (1992:82) notes that learning is 'best conceptualized as a

change in the way in which people understand the world around them, rather than a quantitative accretion of facts and procedures'. Savin-Baden (2000:9) defines learning as 'cyclical process' where students develop understandings of themselves and their contexts, and the ways and situations in which they learn effectively. Ramsden (1992:16) refers to it as a 'long and uncertain process of changes in understanding'.

This increasingly popular view on learning is in line with the constructivist perspective on learning. Learning in constructivist terms is about constructing knowledge and understandings of the world around, through questioning, interpreting and analyzing information. It is about using the processed information to integrate current experiences with past experience and knowledge (Marlowe et al, 1998: 10).

Reflection thus forms the important link between processing the new information and integrating it with the existing understanding of the world around. The value of reflection in learning lies in its ability to help learners to clarify their thoughts, to gain insights and to deepen their understanding of the information that they receive (Higgs, 1988:47). According to Andrusyszyn (1997:2), reflection is a deliberate cognitive activity where learners connect thoughts, feelings, and experiences related to the learning activity in which they are involved in.

Reflection as an integral part of problem-based learning

Problem-based learning (PBL) is a pedagogy where problems drive the learning. It is an approach that makes students confront problems from practice which provides a stimulus for learning. Typically, the basic elements of a PBL session will consist of a session to introduce the problem trigger, collaborative group discussions, and a presentation of findings. A form of reflective practice is often introduced with the intention to enable the students to be more aware of their own learning.

In PBL approaches, students do not merely learn through accumulating knowledge, but through constructing an understanding of the concepts they encounter. Through a problem trigger, the learner explores ideas within contexts, and in doing so, integrates the new concepts with his prior knowledge, and through reflection, constructs a personal understanding of the knowledge.

Proponents of PBL recommend a reflective activity at the end of the problem solving cycle. Engels (1999:203) recommends that the tutor should 'perhaps once every 2 weeks' call 'time out' and 'stimulate the group to reflect on how their studies are progressing and how their learning fits together'. Students at this point should be encouraged to reflect not just on the propositional knowledge they have encountered but also on the processes involved in understanding the content. They should also reflect upon how they functioned as a team member and how they have contributed to the group's work.

Woods (1995: 3.3) takes the reflection process a step further and suggests getting students to reflect and to write reflection journals as a means to help them to 'explicitly see the process skills that they have employed to solve the problem'. The act of reflection allows the student to take apart the process skills involved in solving the problem, and enables the student to feel empowered and confident through integrating and applying the skills.

Problem based learning is learning by reflective thinking. Shermis (1999) defines a problem as a situation where a student is 'curious, puzzled, confused or unable to resolve an issue'. Dealing with problems requires the learner to reflect on the questions that arise from the confusion. These questions prompt the reflection which generates learning, and the acquisition of content. Learning within the PBL environment occurs when students engage with the processes of reflective thinking. 'It is through careful (reflective) application of PBL that students can learn in a deeper fashion, content knowledge, professional skills and cognitive and meta-cognitive processes' (O'Grady et al 2002:2).

In the problem solving framework, the student is presented with numerous opportunities to develop and practice meta-cognition. Meta-cognition, often described as 'thinking about thinking' is an important part of learning. It is about 'consciously making connections between what is known and what is new. It is the intentional structuring and storage of information for later retrieval; self management of learning' (Weissinger, 2004:50). Reflection can help to develop these skills as well as the habits and disposition to use them. This is because students, through reflection, open their minds and become more confident about using these reasoning skills.

Reflection through journal writing.

Reflection, as a form of thinking process, is difficult to pin down. Reflection journals can serve as evidence from which we can draw conclusions about a student's progress. Moreover, writing can even help to facilitate reflection.

According to Luidens (1997:141), writing is a manifestation of thinking, and the written piece is the artifact that reveals the thinking. Writing facilitates learning and enables the learner to integrate new knowledge as it involves the 'active effort to state relationships' between pockets of information that is so integral to the heart of learning (Crowe et al, 1986:218). Writing forces the learner to think so as to clarify and modify his ideas. The learner need to re-present knowledge that was gathered in a different form. In doing so , the 'manipulation and transformation of knowledge can facilitate new understanding and learning as one perceives information in a different light'. Writing transforms experience and meaning (Yinger et al, 1981:4).

This lends credence to the use of reflection journals in a PBL environment. In encountering different concepts in varying contexts, the journal becomes the vehicle in getting the students to actively make their own connections between new and prior

knowledge. In writing the reflection journal, students build, bridge and extend their own experiences. They build on their understanding of the knowledge, through bridging between old and new knowledge, and they extend by reflecting how they can further use the skill in their other courses and in their everyday life (Woods, 1995). This in a sense relates to the constructivist ideas that knowledge is constructed in context. Writing is thus an avenue for learners to represent reality, and to construct meaning. Keeping a journal can help students to develop and recognize the habits of mind associated with problem solving (Stephien et al, 1998: 153) .

Writing is like a distillation process that gets a learner to filter, to reconstruct, organize, gather, process, and feel the experiences that he has undergone. Hence, the reflection journal serves as a window to the learner's mind. It can be used a monitoring device in a student's understanding in the following aspects:

- The student's ability to understand concepts.
- His analytical and critical thinking skills needed for the discipline.
- His ability to think independently i.e his meta-cognition (Crowe et al, 1986:217).

Summary of literature

Although reflection and reflection journals are recommended as a form of closure in a constructivist problem solving framework, limited literature is available on how reflection increases the effectiveness of learning in a constructivist environment. The overwhelming theme is that reflection aids the thinking process and hence the construction of knowledge and meaning making for the learner. This is especially important in a PBL set up where the students often face the process of having to explore knowledge concepts within different problem contexts; and where learning is about sense-making.

Research Questions

The following research questions were addressed in this study:

1. Do students demonstrate an increasing awareness of this learning?
2. Do students demonstrate an enhanced ability to handle and process concepts?

Methodology

This was a qualitative study that focused on reflection journals that were submitted on-line as part of a daily requirement in the course of study at the Republic Polytechnic. The journals of 10 students (randomly chosen) from different modules and discipline backgrounds were examined in the study. The data were drawn from their daily submissions onto the e-learning platform after one semester of study, so as to be able to observe the trends. There was no further interaction with the students.

Results

There are three themes that emerged from the reflection journal trail over 16 weeks. Firstly, the reflection journals captured an increasing awareness of the students' own learning, as evident through their ability to adjust and cope with the demands of the problem-based learning system. Secondly, students also demonstrated an enhanced ability to handle and process information. This was evident through the increased complexity of their cognitive processes. There was also increased mention of how they were managing their own learning – meta-cognition. Finally, it was interesting to note that there was quite a lot of reflection on the on the social dimension of learning, often with references to how their peers helped them to learn.

1. Managing their own learning

In this study, the reflection journal allowed the students a vehicle to demonstrate a better understanding of their own learning. It captured the student's frustrations of trying to cope with a different way of learning. (The students are facing their first semester in a PBL delivered curriculum) It also demonstrates how they tried to rationalize their situations and to look for strategies to cope with the change.

> 'The method of coping with academic difficulties is by giving lecture by the facilitator. The facilitator will be able to give a clear explanation of the problem and I will be able to understand the problem better. Honestly, I do not like peer teaching, because it does not serve any anything. What happen if the members in the group don't understand the problem then all of us will have to suffer.'
>
> [Student C]

It was interesting to note though, that when there was a change in the pedagogical approach of lessons, the PBL way was preferred, and there was also an awareness of which provided a better way to learn and which brought about 'deep learning' and an ability to apply (Ramsden, 1992)

> 'After we have complained the PBL method of teaching in Math, today I have a taste of the old method of learning. It is quite boring and inefficient, because I feel that what I learn might not be able to apply in any application.' [Student G]

Students showed an awareness of the gaps in their understanding, and the need to deal with the cognitive dissonance they faced when encountering the problem. This is critical for learning as the ability to identify gaps in one's own learning is a beginning of taking the steps to remedy it. This leads to the student making an attempt to examine his strategies to better understand himself.

> 'Well, what I have learnt, is not very clear. I will have to go back to do some more research as my team had the concept of explaining completely. I guess me got confused over the technical terms. But what team 5 explained, I found it quite interesting and easy to understand. But I still am unsure of today's topic, so I will

have to do a bit more research as earlier stated. But there are a few things which I found logically like for e.g. potential and kinetic energy.' [Student A]

Student B, as seen in the reflection journal trail below, showed a progression of increasing awareness over the semester in his own learning. He begins the semester with superficial repetition of the learning outcomes of the day. Around weeks 5 to 6 and in week 9, he alludes to being 'tired' of the whole process of problem solving, wonders where he is going. From week 10 onwards, his journal entries are more affirmative of his learning, and what he understand of the day's problem. He moves beyond mere repetition of learning objectives, and articulates what he thinks of the concepts and relates how he can apply them.

Week 1:

'Today I learnt about the refraction. From the problem of spear fishing, I learnt that if I going to spear fish next time, I need to aim more perpendicular to the water, the amount of refraction decreases. It's the same thing that archer fish doing. Searching the information we want by using internet is very popular today. It can provide us a lot of information, but we still need to verify whether it's correct. So we need to visit more websites to verify. It is also the way we collect the real information.'

Week5

'I already don't know I have learnt, or I have learnt something but I don't know what I have learnt. When I saw the problem statement, I'm thinking that how to solve the problem. I think it is same as others people also. Then we all focus in how to solve the problem, finding answer. But at the end, I found that it is not just a problem solving. The learning point inside the problem statement is what we need to learn, we need to find out ourselves. It is good that someone can point it out first, than we can more focus to it instead of just finding answer.

Week 6

'I think mostly should be how to find the resources are useful for the presentation. There are a lot of resources available on internet. If I search those related to engineering, science or math are easy to find. But for example in this module, some time I can't find to much related information. I need to spend a lot of time to go through the website and read. I also found that the keyword we search is very important, if not a lot of false information will come out. And some time the given resources are general, we need to find some special one by our self.'

Week 9

'After two month study in RP, I slowly practice into this learning process. But I feel that this working process everyday is repeating the same thing. It makes I feel like the time I was working, everyday do the same thing, repeat and repeat, although I'm doing R&D job, but me still feel very tired for this kind of life. I think I can't adapt into this type of learning process in this moment. I also thinking that

this kind of learning process can really apply to engineering subjects and math or not? Because it is very difficult to learn ourselves in those subjects, we need a teacher really to teach just like others poly. I'm asking myself how I can graduate with a good result in this poly by this kind of learning. I think I only can get a pass result if this situation still continues.'

Week 12

'From today problem statement we learn statistic, probability and related to gambling. Probability can use for calculation in many others things but not in gambling, just like why we have said. Sometime we make the decision base on bias or what we observant. If we really go do some study before making a decision, it can help us make a more correct selection. I think most of the people making decision when they are in bad situation are base on their emotion, bias, prediction. And most of the people make the wrong decision when that time. If we can put all the facts together and consider it carefully, maybe we can find a best solution. I hope what I have learnt today will use in future.'

Student E, shown in the journal trail below, began the semester being dependent on the teacher for his learning. His reflection showed increasing independence in his abilities to look for answers.

Week 6

'I felt that my ideas have given enough information and resource for my team members. How well my ideas work got to depend on my teacher!'

Week 10

'Hopefully, those that I have learnt will help me in solving problems that I will meet. How will I be able to use it depends on the type of problem that I face.'

Week 11

'Understand the problem, use the correct method and ways to solve it.'

Week12

'By handling ambiguity, we must first understand the problem statement. From there, we will look for resources to get a clear view of it.'

2. An enhanced ability to handle and process information

As the students progressed through the semester, the reflection demonstrated increased complexity of the students' cognitive skills. The reflections moves from mere statements about what he learned to how he processed information. There was an articulation of strategies to solve problems and to work through gaps in understanding. This is evident through the use of words like 'analyzed', and being able to be critical about information received, and making a conscious effort to use critical thinking to reason out a solution. There were even signs in the later weeks of attempts to evaluate

ideas presented by their peers. Student I's journal trail exhibits this increased awareness of cognitive strategies.

Week1

> 'I learn that there is a game called the Australian football, which I have never heard before. Also the game rules and how it is being played.'

Week 2

> '…by analyzing the questions, and also teamwork. My team and I analyze the questions together and then we further discuss and explain to each other what we know. By analyzing the questions, I found out certain things that I have not learn before,…..'

Week 4

> 'I faced the difficulty of trying to figure out the differences between 'inductive' and 'deductive'. Both of the words are alike in meaning which made me confused at the beginning. But actually, after the reading and presentations done, I am able to differentiate the differences between the 2 words and how they are being used…'

Week 7

> 'From what I have learned for the past few weeks, I learned that we have to make reasons out of everything, regardless of assumptions and logic, in order to convince people in believing our theories and reasoning.'

Week 10

> 'I suggest that we use critical thinking to explain how we derive to the strategy. I chose to use critical thinking to explain, as it is stated in the resource given, which may be related to the question, so I choose to make a try. Other than the reason that it is in our resource, it is also because that critical thinking actually applies to our daily lives, as it helps us to better many things that we do everyday….'

Week 13

> 'I have learnt to differentiate between scientific theories that can be believed and scientific theories that cannot be believed. As in the past, we used to sit in the class and keep listening to what my teacher said during classes, and also keep absorbing. In the past while listening and absorbing in lessons, we will never think that lesson will ever be misleading as we are too dependent on our teachers on answers and difficulties. I learnt that I am able to give some answers to whether the presentation done is related, even when it has a little bit of relation, as my group knows that we will always be asked that kind of questions.'

Meta-cognitive strategies and self regulation are integral aspects of the PBL processes. Meta-cognition can improve with practice. The PBL process provides many opportunities

to develop and practice meta-cognition. As students reflect, they open their minds, learn new skills, and become confident about the application of their reasoning skills.
(Weissinger, 2004:50).

Student G demonstrates the meta-cognitive process in the following journal trail. The entries showed that he constantly monitored his actions, his own time management, and even calling for himself to confront the difficult processes and issues that he faced in his learning.

Week 2

> 'For the next topic/problem next week, I will search the information I need the most/important, and make a strong backup on it. Rather than running away from the question (example: side tracks)…'

Week 6

> 'I believe most of us (classmates) have difficulty understanding the statistic, firstly because we are trying to get a statistic without understanding it and to prove that we have an accurate data from a well-known web-site. Secondly we are rushing our work without good time management hence this cause some teams to misunderstand.'

Week 9

> 'Although we meet some confusion along the way, we manage to refer back our problem statement and double check whether we need this information. During 2nd meeting, we tried to reason our hypothesis, to check whether it sound or unsound. Although the resources, teaching us some knowledge, I don't think it help me to find the solution for Johnny. I must use my peers and my prior knowledge to construct a conclusion/suggestion for it…'

Week 10

> 'So whatever we do think, speak, react we must give a second thoughts and think broader rather than narrow and reflect what we have speaks.'

Week 13

> 'If I believe my own set of beliefs, I will have to trust it. Whether it make sense, it up to what beliefs I use. One's got to ask themselves? What make them trust their belief? What evidence or assumption they use? Can the assumption make out of point or illogical?'

Week 16

> 'Just like recent problem my friend has, I have helped her to make the problem simpler and have a various solution to it. When she told me the problem, I quickly analyze it, than later I ask myself some question such as why it happen this way, etc and view the problem different angle.'

3. Social dimension of learning.

There is an awareness among the students that collaborative action is critical in their learning . This brings to bear the PBL set up in that students are expected to co–construct their knowledge together. Hence it is not surprising that they have indicated the importance of the role of the peer in their learning. It also demonstrates their understanding that learning happens when they are able to make meaning of the concepts and to be able to re-present it to their friends.

> 'I have learnt that being a leader is not easy. It is very difficult to get the team going at the start. I felt sad that I could not get the team started. However, after awhile, I got the team started and we discussed on how we were going to solve the problem. I also arranged different roles to the team. However, they found some resources and felt that it was adequate to solve the problem. However, I sort of convinced them that it was not enough and they went to look for more. I also learned that we must often share our ideas and not keep it to ourselves.'
>
> [Student F]

> 'I basically do not have the basic A maths so I approach my friend to teach me. And I am glad he able to explain to me clearly until I understand. And I teach my friend back in order to be more sure'.' [Student D]

Discussion

From this study, it appears that reflection journals are a vehicle for students to articulate their thoughts. The process of writing is to get learners to filter, to reconstruct and organize the knowledge they encounter. The reflection journals showed students coming to terms with their own learning. This is evident through an increased awareness of their ability to learn and also through the increased meta-cognition displayed over a period of time. The reflection journals also enabled students to articulate the importance of learning as a social process.

A large proportion of the entries focused at trying to internalize the content that was introduced in the day's problems. Some students managed to merely regurgitate the learning objectives or to simply state concepts in a piecemeal fashion. Others on the other hand used the reflection journal to pose questions to probe at the concepts, to question their understanding, or just simply to even state their inability to grasp the ideas. This is all well, as identifying gaps in their learning can help to push the learner to pursue the matter and their understanding further.

The reflection journal is an integral part of the PBL environment. Students can get caught up in the process of finding a resolution to the problem posed and they can be overwhelmed by the multitude of information and processes that they employ. Reflection as a culmination of the problem solving cycle enables the learner to sort out the

processes that work and also the information that can help to make meaning out of the context.

Conclusion

Reflection and learning are closely related. The reflection journal poses great possibilities for a learner to articulate his thinking and hence construct meaning from the concepts and information that he faces. In doing so, it can be a vehicle for the learner to bridge the gap between the different knowledge in various contexts and to make it meaningful to himself. This is especially so in the problem solving framework. There lies a potential for the reflection journal to further help the learner on this process of making linkages between old and new knowledge, both content and procedural.

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