META COGNITION AS A MEANS FOR DIALOGUE, SELF REGULATION AND LEARNING

- A CASE STUDY FROM AN IMPLEMENTATION OF PROBLEM-BASED LEARNING -

By

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ABSTRACT

One of the key arguments for problem-based learning as a holistic, learner centred pedagogical method rests on the premise it addresses multiple facets of learner development rather than decontextualised, content related learning outcomes. Fostering meta-cognitive ability in an attempt to develop self regulatory, autonomous learning habits is an important goal of PBL learning environments. Using a small pool of data from students' Learning Journal entries from an institution which implements PBL as the sole methodological framework, this article explores the nature, type and possible conclusions from a range of student responses within a specific context. The purpose of this seminal work is to demonstrate the faint but discernible patterns one can observe through such students' work which mark their respective positions in the spectrum of ability for self regulated, self directed learning.

INTRODUCTION

Around the world, major changes in the design of curricula and the methodologies for teaching learning have been driven by the need to adopt 'learner centred' approaches to education with the view that learners would emerge empowered, capable of autonomous, life long learning skills. Such initiatives have also attempted to bridge the gap between 'knowing what' and 'knowing how' a dichotomy which was seen to be a fundamental weakness of teacher centred approaches to education. In short, the preference for learner-centred pedagogical approaches stems from one aim: it is to make student learning possible. (Rams den 1992) In recent years, higher education has begun to accommodate this aim as evidenced by the focus on the use of constructivist learning environments (Jonassen 1999), open-ended learning environments (Land and Hannafin1996), microworlds and anchored instruction (Cognition and Technology Group1992), problem-based learning (Savery and Duffy 1995) and goal-based scenarios (Schank and Cleary 1995). Among these, the epistemic assumptions and pragmatic, design issues in problem-based learning are of interest to this discussion.

Problem-based learning is said to encourage and support deep learning strategies because students 'learn' through the activation of their prior knowledge. In order to achieve this end, PBL problems offer a learning space comprising the knowledge structures of a discipline and the strategies for inquiry. This is easier said than done because it is difficult to know what goes on while a student is learning. Epistemological traditions in psychology have used meta level monitoring of student work retrospective interviews and think aloud protocols in particular being the most widely used. The typical pattern in think aloud protocols, though, produces plenty of talk while the students are figuring out how to go about the task but the point at which they discover an opening (something like 'Aha') is followed by total silence until the plan of action is completed or they get stuck again. (Laurillard 2002)

It is imperative then to establish a means and mode for an ongoing dialogue which allows the teacher/expert to get a glimpse of the problem solving processes when the students/novices attempt to solve it. (Venkatachary 2004) This article explores the value of students' meta cognitive output (in the form of Learning Journal entries) as an index to the learning experience in problem-based learning.

Conceptual Framework

Educational research contends that there is a significant link between students' use of self regulatory strategies and subsequent academic achievement. (Pintrich 2000) Work of Pintrich and his colleagues classifies such strategies into four major types namely

- Rehearsal strategies (used to memorize material)
- Elaboration strategies (used for deep learning; such as paraphrasing or summarizing material)
- Organizational strategies (such as concept mapping, diagrams etc)
- Meta cognitive strategies (used to monitor and control cognition such as checking, questioning, task monitoring and adaptation)

(Pintrich and DeGroot 1990; Pintrich, Garcia and McKeachie 1993; Garcia and Pintrich 1994; Pintrich, Wolters and Baxter 2000)

Students are better able to engage in meta cognitive and self regulatory behaviour when they are engaged in authentic tasks and work with relative autonomy in co-operative learning environments. Butler (1998) reported on three different studies investigating a model of self regulation under the label of 'Strategic Content Learning' approach. This initiative addresses three goals: firstly to support students' self regulation when they are engaged in tasks: secondly to enable them to construct their own knowledge and range of beliefs that are conducive to self regulation: thirdly to establish that increased meta cognitive knowledge about chosen tasks and strategies result in increased performance over a range of tasks and better adaptive attributes. (Pintrich and Schunk, 2002)

A key component of students' ability to develop meta cognitive and self regulatory attributes is appropriate feedback and reward structure. In Vygotskyian terms, it is important to scaffold the 'learning space' in all types of self directed learning, particularly so in problem-based learning environments where the students 'define the tasks, work on them and present the solutions' on their own and are assessed on both the process and the product of learning.

The questions which are explored in this discussion are:

- What trends are apparent if students are encouraged to maintain a regular, reflective journal about their learning experience?
- Can students be positioned along a continuum of growth as budding autonomous learners in an environment which fosters a co-operative learning environment?

This article attempts to illustrate the role and impact of activities promoting meta-cognition in relation to the learning efficacy and growing autonomy among relatively young students at post secondary level of education. The authors draw from their experience from a post secondary level institution in Singapore which implements problem-based learning as the sole methodological framework for teaching-learning and use the analysis of data from their students' learning journal entries in support of their observations.

Overview of problem-based learning implementation: 'One day one problem' approach

The implementation of problem-based learning at a post secondary institution in Singapore is characterised by division of a given curriculum semester module into 16 PBL problems. In effect, students work in teams on a given PBL problem from a module (of a specific discipline) for the span of a whole day (about 8 hours). Each PBL problem carries a set of learning outcomes, a context for learning activities and exploration (articulated in the problem statement) and scope of assessment. Each class consists

of 25 students and a tutor/facilitator. The 25 students are divided into teams of 5; in effect each class has 5 working teams. The interaction of the facilitator can be directed at a lone student, a team of 5 or a larger set of 2 or more teams at any point in time. Each day is structured into three meetings with the facilitator and two segments of time when learning is self-directed: individual study, pair work or team work. In the first meeting, the students are presented with the problem of the day and make an attempt to identify the learning issues for the day. Usually they use a template with three questions: 'What they know', 'What they don't know' and 'What do they need to find out' in order to solve the problem. In the second meeting, more discussion takes place, with the facilitator's role on listening and diagnostics. The students present and defend their solution in the third meeting. The presentations are made by teams.At the end of the day's work, a number of activities are carried out a quiz, a Reflection Journal (Learning Journal) entry, self and peer evaluation. All of these are done by individual students. Students receive a grade and diagnostic feedback on performance from the facilitator, aimed at both individual and team performance. This structure aims to embody a conversational framework with an action-feedback cycle embedded within it. It is often grounded on the discourse structure of a given problem (Venkatachary 2004). In addition, there is a 'mini project' that the students are required to do in the three years of study for the Diploma programme. They 'profile' an organisation or an eminent individual in the form of a case study and write a report linking it to their current interests. As a result of this, students learn basic skills in independent learning; management of time and resources, communication as well as interpersonal skills.A further aspect of tutor-student interaction is that the teaching-learning transactions are carried out in an e-platform. The materials, student portfolios for their daily work and assessment are all done online with the supportive framework of a digital learning management system. This procedural framework is implemented at the institutional level for all modules and for all disciplines in this institution which is at a post secondary level (Polytechnic) in the educational landscape of Singapore.

Scaffolding for meta-cognition in the above implementation is provided through prompting the students to maintain a daily Learning Journal (internally known in the institution as Reflection Journal) to keep a log of their views/observations on their learning experience. Towards the end of study time on every day, the facilitator of a given class offers a prompt (often in the form of a question) to that set of students allowing them scope to stand back and reflect on their 'personal learning experience' of that day. Students submit their written entries as part of the e portfolio and get feedback from the facilitator. Each student writes a personal account in response to the prompt it is to be noted that the prompt (or question) is set to the whole class but individuals respond to it from their private, personal point of view.

Methodology of data analysis

Adopting a predominantly qualitative method of analysis for this study, we did content analysis through identification of emergent themes within the mass of data content. This was a process that was inductive and evolving in nature. Students' views/opinions/observations in the Learning Journal were the prime source of data that was extensively examined. Employing an approach of descriptive analysis allowed us as researchers to gain an in-depth conceptual understanding of the findings to the research questions that we set out to study.

Learning Journal inputs were first parsed iteratively and different themes were then identified and recorded on paper according to the various strands of ideas expressed by students. The entire body of textual data from the

Learning Journal entries were then broken down and organized according to these thematic categories and the names of contributing students noted in the side margins. This helped us to count the number of students who articulated similar ideas within each thematic category. The following sections which are a discussion of our findings have been presented according to the order of the above described categories. Largely we have paraphrased the comments raised by student participants for better clarity and also to make visible linkages between similar ideas and patterns of logical reasoning communicated by students. A few sample direct, representative quotations taken from students' reflections have also been included for each of the categories for better contextual understanding. Interspersed throughout these discussions are our own interpretations and explanations from an emic perspective as active participants within the student community of learners.

The authors analysed data from 37 entries made by students distributed across two classes. The entries taken up for analysis were written by students on two separate days dealing with the same lesson a PBL problem that was from the General module for first year students. The prompt for reflection set for these students was: "Do you think certain characteristics in a module and/or a facilitator help you learn better? If yes, what do you think an 'ideal' module and facilitator might have? If not, what do you attribute your learning to? (for example, is it your own thinking or other factors?)" The prompt was significant as the students had a difficult time grappling with that particular lesson and some immediate reflection on what personal mindset and approach to factors intrinsic and extrinsic to their self in relation to their learning achievement (both in specific and general terms) was considered a valid and valuable exercise by the facilitator. As the analysis of data and our discussion demonstrate, this spot of reflection uncovered valuable seminal trends linking the perceptions of students and their levels of autonomy as learners.

Analysis of data and discussion

The range of student responses shows that there was a continuum in terms of relative autonomy and self regulatory capabilities in the sample. At one end of the spectrum is the fully empowered, self-sufficient student who is focused on mastery learning and achievement and seems aware of the ways towards achieving his/her goals. Goal setting and sub task monitoring are the two important facets of self directed and autonomous learning and collaboration are the strengths of this student type. An excerpt below illustrates this position:

"I do not think it is right to say that certain characteristics in a module or certain likable personality traits of a facilitator help me learn better. I think we are old enough to realize that the onus is on us to want to learn. Therefore we should attribute our learning to ourselves. I feel strongly about this because I see examples of people around me blaming others for whatever happens to them academically. Modules and facilitators become a source of excuses for them. If they do not understand a day's lesson, they blame it on the boring facilitator. If they cannot achieve good daily grades, they say that the module is just too tough and complex, I am not trying to be sanctimonious here because I too have made excuses for myself. *But I think if we can be aware of this, then we can work towards changing our attitude. We must see this flaw; that is the first step.* (Emphasis from authors). My bottom line is this; I attribute my learning to myself, my way of thinking, my way of doing things. I learn because I want to. I get good grades because I work hard for them, because I bother to stop and spend time to think and try to understand and to ask questions. As for facilitators, they can only guide you or hold your hand so far."

As evident from the excerpt the student shows a high degree of achievement orientation and also awareness

of her own position as against the contrasting positions of her peers. She is able to be sure of her position primarily because of her rather diagnostic understanding of the contrast seen in her peers' attitude. Her motivation stems from her strategic goals of good performance and good grades. This type of responses is of course a numerical minority in the sample used in this discussion and represents one end of the spectrum.

At the opposite end of the spectrum are responses which show low self reliance and awareness and a high dependence on curricula and teachers as factors affecting his/her learning. These students have very few, if any, skills in managing self directed, autonomous learning and tend to blame external factors for their failure. Illustrative excerpts below:

- "The facilitator must get the attention from the student, if the students are not participating very well that means that the lesson bore."
- "…my 'ideal' module is definitely a module that I can understand ultimately and completing the project at ease… My 'ideal' facilitator will be one facilitator that never fails to assist his/her students who are in need, bringing them to the right track and hinting out mistakes to his/her students and most importantly, ensuring his/her students learn the main objectives for the day.…
- "… an ideal module is supposed to have clear understandable problems and … the facilitator should provide guidelines to understand the question better…"
- "… an ideal module will have problems that are interesting… an ideal facilitator will make the class fun…"

We found that this type of responses was found in larger numbers in the sample. Between these two positions are those occupying the middle of the spectrum; demonstrating varying degrees of self-sufficiency, meta-cognitive awareness, and budding autonomy in learning. Factors which characterise these responses are

- Concern about 'grades' rather than mastery learning
- Emphasis on the psycho social attributes of the classroom dynamics and/or one's own attitude to the module content
- Tendency towards stereotypes and quick judgements about 'relevance' and 'interest'

Excerpts from the data to illustrate these characteristics:

- "….For me, my ideal module would comprise interesting and intriguing questions related to us, it would further cheer me on to research that topic. If the questions are all "dry" like it requires only calculations or answers we see little relevance to our life, it would not be easy to keep our attention focus on solving the problems… My ideal facilitator would definitely be one who allows us to express ourselves, our answers in the way we see its best…"
- "…an ideal module is actually the module that interests you the most…"
- "When there is no bond formed, students do not feel like listening to the facilitator"
- "An 'ideal' module is one which is interesting, meaningful and also challenging… a facilitator needs to be engaging, motivating, knowledgeable and easy-going…"
- "…. I always think that if one likes a specific subject or module, then he or she will do extremely well in it and vice versa. I think that the theory is true. I am a living example of it. I hate Science so much that it makes me lose all interest in it. And because I hate Science so much, I always don't do well for it. I think that certain characteristics in a module or facilitator can help me learn better. The module or facilitator must appeal to the masses. As in, the module must be interesting and the facilitator must be fun and not boring or dull…"
- "…I feel that the facilitator has to be young. Not that older people are lousy facilitators but younger facilitators can communicate with us better. They are closer to us in terms of age and are more likely to share the same interest as us and are able to understand our plights and attitudes. A good facilitator should also to be able to motivate and communicate with us…"

Other observations on the responses from the sample are summarised as follows:

Students' tendency to be purely anecdotal (referring to specific instances) indicates low ability for meta-cognition and self regulation. In other words, they seem to be able to observe events or people but are unable to draw conclusions from it. They see the detail but do not see the patterns behind it yet.

The fact that almost the entire sample of entries shows a high tendency among the students to be frank in sharing their views and opinions with the facilitator (one of the authors of the article) is an indication of trust and budding autonomy necessary for successful self regulation in learning. The fact that they are able to voice their views for the facilitator to respond seems to indicate that they are open for further development and growth in self directed learning.

Level	Descriptors	Percentage of students from the sample
3 (well developed)	Shows ability to observe changes/progress in one 's own view: is capable of analytical thinking, goal setting and achievement orientation	5 %
2 (developing)	Focused on rewards for achievement (such as 'grades') rather than mastery learning: Emphasise the psycho social attributes of the classroom, self, peers and teacher as the reasons for learning and achievement	50%
3 (under developed)		45%

Table 1: Distribution of students' meta-cognitive ability on a developmental scale

What is the viability to extending these observations on the sample to the whole population of students from this institution? The question is difficult to answer categorically without further study of data and observations. However the authors attempt to consolidate the findings from this small seminal study in order that a more large scale research may be taken up as the next step.

Available research emphasises that meta-cognitive ability is both a pre requisite for and an offshoot of problem-based learning environments. (Wilkerson and Gijselaers 1996) In problem-based learning approaches,

- understanding is derived from interaction with the problem scenario and learning environment
- engagement with the problem scenario and inquiry may create cognitive dissonance to stimulate learning
- knowledge evolves through collaborative processes of social negotiation and evaluation of one's standpoint (Tan and Ee 2004)

The primary purpose of this qualitative analysis of Learning Journal entries in this article was to illustrate how meta-cognition and as a result self-regulation can be fostered systematically through a procedural framework in PBL. Students are encouraged to become reflective both in how they manage their information processing skills and collaborative environment with their peers as well as in managing their attitudes, expressing them in the form of an ongoing dialogue with their own selves and the facilitator who mediates their learning. The first step in this tableau is to encourage a climate of trust and openness in order that the students might be truly 'reflective' and not 'merely politically correct' in their responses. When this is achieved, both the students and facilitators gain a great deal of scope to share views and opinions on a variety of issues through a relatively private channel of communication namely the e portfolio. As a result, what may not be apparent in a classroom setting can be expressed and responded to at an individual level. In addition, since the documentation is maintained in the form of e portfolio, each student can re visit material for further reflection, learning or even observation on the path towards personal growth and learning. The focus on meta cognitive awareness thus seems to make a strong case for problem-based learning as the holistic, learner centred approach which encompasses both the 'process' and 'product' of teaching-learning.

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