AN ANALYSIS OF THE IMPACT OF PROBLEM-BASED LEARNING ON GRADE-6 STUDENTS' METACOGNITIVE SKILLS*

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Abstract

This study was designed to investigate the impact of problem-based learning on metacognitive skills of Grade-6 students. For this purpose, pretest-posttest design, without control group, was used in this study. The research group of the study was comprised of forty eight Grade-6 students who studied at the Practicing Middle School, Hlegu Education College, Yangon Region, in 2017-2018 Academic Year. Seven learning stages of problem-based learning process were carried out on the experimental group for a period of over 40 hours. Four problems developed from Chapter-5 (Earth and Space) from Grade-6 General Science Textbook were used as an intervention procedure. For quantitative data collection, Metacognitive Skills Inventory (MSI) which consists of 40 items and 2 factors was used. Before any intervention, participants of this study was completed Metacognitive Skills Inventory. Then, the participants worked through developed four problems within seven learning stages of problem-based learning process. After the intervention, students completed the same Metacognitive Skills Inventory for a second time. Two dependent sample t-test was used for pretest and post-test comparisons. Results showed that students performed better in post-test. It has been concluded that the learning stages of problem-based learning process had an impact on the metacognitive skills of Grade-6 students.

Keyword: Problem-Based Learning, Metacognitive Skills

Introduction

Good pedagogy today is about making students' thinking visible. The challenge of education is to design learning environments where students' ways of thinking and knowing are manifested in active, collaborative, self-regulated, and self-directed learning. Problem-Based Learning pedagogy can be a way to provide students with opportunities to develop deep understandings of knowledge and produce qualities such as imagination and creativity, ability to work in groups, communication and information finding

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skills, problem solving abilities, technological literacy, and a readiness to learn. In this respect, it is important for students to be prepared for the future by facing real or real-like problems in their learning environment and producing appropriate solutions to these problems.

If one aim of schooling is to prepare children to be lifelong learners, then it is important to help students become aware of themselves as learners and to take control of their own activities. According to Eggen and Kauchak (1996), metacognition is the awareness and control of cognitive processes. Simply put, metacognition means "thinking about one's own thinking." There are two aspects of metacognition: reflection: thinking about what we know; and self-regulation: managing how we go about learning. Developing metacognitive abilities is not simply about becoming reflective learners, but about acquiring specific learning strategies as well. Swanson (1992) described that the better the individuals control and monitor the strategies they use, the more their problem solving ability improves. Students often lack these skills or fail to recognize when to use them (Flavell & Wellman, 1977). So, the knowledge of individuals regarding their thinking process and strategies and their abilities to monitor and organize these processes has become important.

Research has also shown that one of the key traits good problem-solvers possess is highly developed metacognitive skills. They know how to recognize flaws or gaps in their own thinking, articulate their thought processes, and revise their efforts (Brown, Bransford, Ferrara, & Campione, 1983). Only developing metacognitive skills decide the strengths and weaknesses in learning. No other skills direct the own learning except metacognitive skills. So, as educators, it is important to help to foster the development of metacognitive skills in students which are the essential skills that will help students learn "how to learn." For these reasons above, the present study investigates problem-based learning on student's metacognitive skills. For this, this study attempts how impact of problem-based learning on Grade-6 students' metacognitive skills.

Literature Review

Overview Problem-Based Learning

Problem-based learning (PBL) is an instructional approach that has been used successfully for over 30 years and continues to gain acceptance in multiple disciplines. It is an instructional learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem. Savery (1996). Boud and Feletti (1997) stated PBL that it is generally known today evolved from innovative health sciences curricula introduced in North America over 30 years ago. Medical faculty at McMaster University in Canada introduced the tutorial process, not only as a specific instructional method (Barrows &Tamblyn, 1980) but also as central to their philosophy for structuring an entire curriculum promoting student-centered, multidisciplinary education, and lifelong learning in professional practice.

Hmelo-Silver (2004) described PBL as an instructional method in which students learn through facilitated problem solving that centers on a complex problem that does not have a single correct answer. She noted that students' work in collaborative groups to identify what they need to learn in order to solve a problem in self-directed learning, apply their new knowledge to the problem, and reflect on what they learned and the effectiveness of the strategies employed.

On the website for the PBL Initiative (http://www.pbli.org/pbl/generic _pbl.htm), Barrows (n.d.) described in detail a set of Generic PBL. Each of these essential characteristics has been briefly provided as additional information and resources.

- Students must have the responsibility for their own learning.
- The problem simulations used in problem-based learning must be ill-structured and allow for free inquiry.
- Learning should be integrated from a wide range of disciplines or subjects.
- Collaboration is essential.
- What students learn during their self-directed learning must be applied back to the problem with reanalysis and resolution

- A closing analysis of what has been learned from work with the problem and a discussion of what concepts and principles have been learned is essential.
- Self and peer assessment should be carried out at the completion of each problem and at the end of every curricular unit.
- Student examinations must measure student progress toward the goals of problem- based learning.
- Problem-based learning must be the pedagogical base in the curriculum and not part of a didactic curriculum.

These descriptions of the characteristics of PBL identify clearly the role of the tutor as a facilitator of learning, the responsibilities of the learners to be self-directed and self-regulated in their learning, the essential elements in the design of ill-structured instructional problems as the driving force for inquiry. If teaching with PBL were as simple as presenting the learners with a 'problem' and students could be relied upon to work consistently at a high level of cognitive self-monitoring and self-regulation then many teachers would be taking early retirement. The reality is that learners who are new to PBL require significant instructional scaffolding to support the development of problem-solving skills, self-directed learning skills, and teamwork/ collaboration skills to a level of self-sufficiency where the scaffolds can be removed. Teaching institutions that have adopted a PBL approach to curriculum and instruction have developed extensive tutor training programs in recognition of the critical importance of this role in facilitating the PBL learning experience.

The Role of Reflection in Problem-Based Learning

Shermis (1999) defines a problem as a situation where a student is 'curious, puzzled, confused or unable to resolve an issue'. The PBL teachers should stop at times during the process and allow students to reflect on how and what they have learned so far. The teacher should encourage his or her students to reflect on the processes involved in understanding the content as well as how they performed as team members and how they have contributed to the group's work (Engels, 1999). Reflection on solving problems can help

to develop the skills as well as the habits and disposition to use them. So, reflection is regarded as an integral part of problem-based learning where problems drive the learning.

Overview of Metacognition

According to Schraw & Moshman (1995), "metacognition includes two main sub components generally referred to as knowledge of cognition and regulation of cognition." Knowledge of cognition refers to what we know about our cognition, and may be considered to include three subcomponents. The first, declarative knowledge (knowing what factors influence human cognition), includes knowledge about ourselves as learners and what factors influence our performance. The second, procedural knowledge (knowing how certain skills work and how they should be applied), in contrast, refers to knowledge about strategies and other procedures. Finally, conditional knowledge (knowing when certain strategies are needed and why they influence cognition) includes knowledge of why and when to use a particular strategy. Individuals with a high degree of conditional knowledge are better able to assess the demands of a specific learning situation and, in turn, select strategies that are most appropriate for that activity.

On the other hand, regulation of cognition typically includes at least three components, planning, monitoring, and evaluation. Planning involves the selection of appropriate strategies and the allocation of resources. Monitoring includes the self-testing skills necessary to control learning. Evaluation refers to appraising the products and a regulatory process of one's learning. It makes children in the classroom evaluate their performance and compare task performance with people and use the final result in locating the error in the solution process (Lucangeli et al., 1998). Thus, metacognitive regulation includes planning, monitoring and evaluating the learning as well as learning process.

Metacognitive Skill

Brown (1980) referred to the component of metacognition as executive control processes, which included planning, monitoring, and evaluation of an individual's cognitive and affective functioning. With

planning strategies, a learner plans one's use of cognitive strategies, such as activating prior knowledge, organizing the material to be read, and so on, whereas metacognitive activities refer to the monitoring of comprehension when learners check their understanding against some self- or other-set goals. The monitoring process suggests the need for a regulation process. This suggests that a metacognitive skill includes knowledge of cognition and regulation of cognition.

When students use declarative, procedural and conditional knowledge and planning, monitoring and evaluating they are said to be consciously engaged in using metacognitive skills. On the other hand, metacognitive skills will also become automatic without much conscious awareness resulting from practice and habitual use (e.g., Schneider & Pressley, 1989), and it will become conscious mainly in new or difficult situations.

Methodology

Design of the Study

In the study, pre-test post-test design without control group was used. In this study, the effect of experimental procedure is tested on a single group and the measurements of the subjects regarding the dependent variable are acquired via pre-test before the intervention and post-test after the intervention by using the same subjects and the same assessment instrument. There is no randomness as well as matching and in this regard, the design can be described a pre-test measure followed by a treatment and then a posttest for a single group.

Sample of the Study

A total of 48 Grade-6 students, as participants of this study, were from Practising Middle School, Hlegu Education College, Yangon Region during 2017-2018 Academic Year. The sampling method chosen for the study was nonprobability sampling. Quantitative research data were collected by using purposeful sampling and convenience sampling methods, which are among the nonprobability methods.

Instrumentation

The researcher wanted to study the metacognition quantitatively. For this purpose, the metacognitive skills inventory was prepared by the researcher to measure the metacognitive knowledge and metacognitive regulation of Grade-6 students while solving problems through PBL approach.

Firstly, researcher collected (85) items from Junior Metacognitive Awareness Inventory (Sperling, Howard, Miller, &Murphy, 2002), Problem Solving Questionnaire (Fortunato, 1990) and Metacognitive Activities Inventory (Cooper, M.,and Sandi-Urena, S. (2009). Then, experts' reviews were conducted for face validity and content validity from educational psychology field to know whether the students had difficulties regarding the understanding of the statement, the confusion regarding the type of response to be given, any confusion regarding the instruction given , the time taken during the response and was appropriate and relevant to Grade-6 students. After that, during the second week of November, pilot study was done with a total of 92 students from No (4), Basic Education High School, Hlaing. After piloting, (45) items were removed and remaining (40) items were selected, which were arranged according to the component of metacognition based on test item analysis results. The reliability co-efficient of MSI obtained through KR-21 formula was 0.80 which shows that it was a reliable tool for the data collection.

Four Problem Situations

Four problem situations were developed by the researcher herself based on the topic "Eleven environmental problems caused by humans activities" described in Grade-6 General Science Textbook. For this purposes, the researcher read and learned such related books about environmental studies as Environment Science Essentials (Level 1 through 6) published in 2015 @ Macaw Books, Environmental Studies (Level - 4) published in 2016 @ viva online learning , Cambridge Primary Science (Learner's Book and Activity Book Stage 4 and 6) written by Fiona Baxter, Liz Dilley and Alen Cross in 2015. , Interactive Science (Stage 4 and 6) written by Jhara Ro And Fighting Global Warming in Everyday life. Moreover, the researcher also

read the books such as First Encyclopedia of Seas and Oceans, Natural Environment, Wishing Our Mother Earth Clean and Green, Journal and Articles about Let's Save Our Natural Environment and other related books. Then, problem situations about air pollution and global warming, increasing waste disposal, deforestation and extinction of wild animals were developed. And then, experts' reviews were conducted for content validity from educational methodology field to know whether the developed problems were relevant to Grade-6 students.

Procedure

The research was conducted with a total of 48 Grade-6 students from Practising Middle School, Hlegu Education College, Yangon Region for over two months (from first week of December till the last week of January). Since this programme was of over forty hours, permission for duration of 10 weeks was taken from the Headmaster to solve all four PBL problems. PBL was implemented for three days a week.

Firstly, pre-test was administered to the students before any intervention. After the pre-test, the researcher started the Problem-Based Learning intervention procedure with the help of six research assistants who are from Hlegu Education College. Before each period of PBL intervention procedure, the researcher and all these facilitators had meetings to discuss how to proceed PBL. It took about 10 hours to introduce and train PBL and made sure all the students were familiar with PBL process and can do all the activities they will be assigned to do. After that, Problem-Based Learning was implemented with Seven Learning Stages which are (1) Introduce the Problem (2) Problem Analysis (3) Self-study (4) Group Analysis (5) Select the Most Feasible Solution (6) Present Findings (7) Evaluating Performance.

Learning Stage 1: Introduce the Problem

The first learning stage began with the introduction of the students with the ill-structured PBL problem before any instruction was given to students. Then, the researcher made the students into a small group formation about six groups of eight to do group discussion. Then, the handouts that contained all the learning stages of PBL, respective problem situations, guiding questions were given for all the students. Moreover, the teacher made

an explanation about the handouts. At this time, all the students had to listen carefully, follow the teacher's instructions and read about the handouts. At that time, they were allowed to ask questions if they were unclear about what they had to do in their learning process of PBL.

Then, the teacher delivered **Metacognitive Prompts Worksheet** to all the students before solving the problem and told them to ask **four planning questions** on their own which are **"What is the nature of the problem? What is our goal? What kind of information and strategies do we need? How much time and resources do we need?"** to set the plans before analyzing the problem. This was an individual activity. Then, they had to write all their answers in **Metacognitive Prompts Worksheet**. Then, students had to consult and discussed their ideas, opinions and answers about problems with their group members until they agreed upon them to identify the problem more definitively and establish the goals for problem clearly. Then, all the groups had to identify facts about the problem.

Learning Stage 2: Problem Analysis

In the second learning stage, the teacher gave **"Need-to-Know" Worksheet** to the all the groups of students to analyze the problems more deeply to separate the known facts from the unknown facts by eliciting their prior knowledge to solve the problem, identify their knowledge gaps. All the students in each group had to receive "**Need-to-know Worksheet"** and they had to list facts about what they already knew based on their previous knowledge and put all these known facts into **"What we know?"** column, one of the first columns in **"Need-to-know Worksheet.** At such time, when their previous knowledge was insufficient to solve the problem, they were allowed to gather necessary information and learned new concepts by getting the help from the teacher while they engaged in their problem solving activity. This was a group activity. At that time, the teacher made an observation of metacognitive aspects that will be shown in filling in the worksheet during their group discussion.

Then, the students had to formulate hypotheses in **"Generating Hypothesis"** column which is one of the columns in "**Need-to-know Worksheet"** about the nature of the problem including possible mechanisms

to make the students delve deeper into it. It can be assumed that if the students understood the problem better, they would generate more hypotheses about possible solutions. So, at this time, all the students had to identify their ideas and explanations into tentative solutions.

On the part of the teacher, the teacher also prompt new lines of thoughts by asking the metacognitive questions; like **"What are you thinking about? Have you got a hunch about something?"** to monitor the student learning and to scaffold while they were solving the problem and observed them carefully while thinking of the problem and trying to formulate hypotheses.

Once known facts were listed, students were asked to identify **"learning issues" or "questions"** that they wanted to know more which were unresolved, questions arising from issues, or knowledge deficiencies or knowledge gaps. During this activity, the teacher instructed the students in all the groups to list all these learning issues and put all these learning issues or questions into **"What we need to know?"** column, one of the columns in **"Need-to Know" Worksheet.**

During this time, the teacher observed all the groups' metacognitive behaviors and assessed them properly. Surely, all these questions or learning issues will surely drive the next stage of the PBL process and served as guidelines for independent and self-directed learning. Self-directed learning is a distinguishing feature of PBL. During self-directed learning, the students were asked to find more information to answer or solve the problem.

Then, the students had to record the number of resources they needed and how they discovered these resources in order to solve the problem. And these resources were listed and put all these resources needed in **"How can we find out we need to know?"** column which is the last columns in **"Need-to Know" Worksheet.**

Learning Stage 3: Self-study

During this time, the students were asked to gather necessary information individually towards the identified learning issues and a division of labor within the group was done. So, the students were allowed to choose a

particular area in which to concentrate their efforts. Learning issues were divided among students, so no two students had the same or every student could find out every issue. The students were asked to define central and peripheral issues and every student was asked to research central issues and divided up peripheral issues among group members.

On the part of the teachers, all the resources that will be needed for the students in solving the problem were prepared. Again, the students were asked to find the necessary resources from the library or internet search, by getting the help from teachers or by reading learning resources already given by the teachers or by looking for other additional resources in many possible ways. Then, they had to prepare answers to the formulated learning issues.

During this time, teacher gave **Learning Log** to all the groups to document what they wanted to learn and how they learned. This was also group activity. Every group had to use Learning Log and discussed to make an entry of all the information in the first and second columns respectively which are **"What we wanted to learn?"** column**,** and **"How we learned?"** column in **Learning Log**. In this way, all the groups had to think what information and concepts they had to gather and how all these resources and information would be found out to solve the problem.

Moreover**,** while solving the problem and collecting the necessary data, the teacher requested all the students to answer four monitoring questions on their own which are: **"Do I have a clear understanding of what I am doing? Does the task make sense to me? Am I reaching my goals? Do I need to make changes?"** in Metacognitive Prompts Worksheet to monitor their learning and regulate the information they got enough or not or need to make some changes while solving the problem or while they are on the track of the problem solving activity and while they are trying to arrive at the solutions. This was an individual activity. At that time, the teacher observed the students' behavior and their performances attentively.

Learning Stage 4: Group Analysis

All the necessary information gathering was gathered, the results of each individual's research had to be communicated to the group members and all the groups had to discuss what they learned after every group discussion.

At that time, the teacher asked the students the monitoring questions likes: **Are we reaching our goals? Do we need to make changes?"** again to themselves in Metacognitive Prompts Worksheet to decide whether the research results do contribute to the understanding of the problem, or do not. If they didn't, the original learning issues had to refined or rewritten. Then, the students were asked to return to the research phase to gather more information on the altered issues. This two-step phase of independent study and collaboration was continued until every member of the group was satisfied that the problem has been sufficiently explored. The number of iterations needed depends on the complexity of the problem and/or the learning issues. This process is a chance for students to apply knowledge and skills recently acquired back to the problem. This approach helps to build a "community of learners" and engages the students in collaboration with group members- a real world activity.

Learning Stage 5: Select the Most Feasible Solutions

Once knowledge was accumulated, all the students came together in their groups and then had to share their results and generated the most feasible solutions to the group members. Moreover, each group had to make entry of the new information or concepts in the last column of **"What we learned?" in "Learning Log"** to evaluate their gained knowledge.

Learning Stage 6: Present Findings

In this learning stage, each group needed to review the new information or concepts in the last column of **"Learning Log"** which is **"information that had been learned"** to present the findings of each group and share their results among the groups members of others and the results are made to known and the reasoning behind the solution is made apparent in order to support the selection of this particular solution. The teacher had to check that learning objectives had been met and the effectiveness of their learning and their metacognitive aspects would be found out.

Learning Stage 7: Evaluating Performance

At that time, the teacher insisted all the groups to answer evaluating questions on their own **"Have I reached my goals? What worked? What didn't work? Would I do things differently the next time?"** in Metacognitive Prompts Worksheet to evaluate all about the information they had collected, and their performances by themselves after solving the problem. This was an individual activity. At that time, the teachers observed all about their actions and record them accordingly.

By using the above PBL learning procedures, the researcher implemented Problem-Based Learning Process for nearly forty hours during intervention which encourages the development of metacognitive skills in Grade-6 students to grapple with authentic problems they are assigned to solve.

Data Analysis and Results

The results were presented in this section.

Development of Declarative Knowledge

Table 1: Results of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Declarative Knowledge of Grade-6 Students

	Test	**Mean**	**Std.**	***t***	***df***	***p***
Declarative Knowledge	Pretest	2.88	1.024	- 6.155**	47	.000
	Posttest	3.69	1.055			

**p < 0.01; Mean Difference is significant at 0.01 level.

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **6.155**, p < 0.01). Thus, it can be interpreted that there was a significant increase in **Declarative Knowledge** of Grade-6 students.

Development of Procedural Knowledge

Table 2: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Procedural Knowledge of Grade-6 Students

	Test	Mean	Std.	t	*df*	p
Procedural Knowledge	Pretest	2.60	1.067	- 3.493**	47	.000
	Posttest	3.21	1.110			

**p < 0 .01; Mean Difference is significant at 0.01 level.

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **3.493**, p < 0.01). Thus, it can be said that there was a significant increase in **Procedural Knowledge** of Grade-6 students.

Development of Conditional Knowledge

Table 3: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Conditional Knowledge of Grade-6 Students

	Test	Mean	Std.	t	*df*	p
Conditional Knowledge	Pretest	2.81	1.179	- 3.865**	47	.000
	Posttest	3.46	1.051			

**p < 0 .01; Mean Difference is significant at 0.01 level.

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **3.865**, p < 0.01). Thus, it can be interpreted that there was a significant increase in **Conditional Knowledge** of Grade-6 students.

Development of Metacognitive Knowledge

Table 4: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Metacognitive Knowledge of Grade-6 Students

	Test	**Mean**	**Std.**	**t**	***df***	**p**
Metacognitive Knowledge	Pretest	8.50	2.183	- 7.076**	47	.000
	Posttest	10.19	2.120			

**p < 0 .01; Mean Difference is significant at 0.01 level.

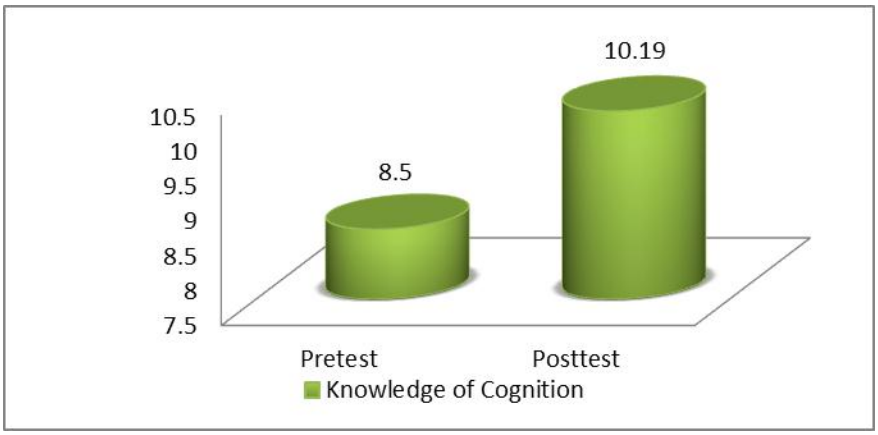

Figure 4: Mean Difference between Pretest and Posttest Measures in Metacognitive Knowledge

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **7.076**, p < 0.01). Thus, it can be interpreted that there was a significant increase in **Metacognitive Knowledge** of Grade-6 students and hence there was significant development of **Metacognitive Knowledge** of Grade-6 students while solving problems through Problem Based Learning approach.

Development of Planning Skills

Table 5: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Planning Skills of Grade-6 Students

	Test	Mean	Std.	t	*df*	p
Planning Skills	Pretest	4.48	1.726	- 4.122**	47	.000
	Posttest	5.44	1.515			

**p< 0.01; Mean Difference is significant at 0.01 level.

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **4.122**, p < 0.01). Thus, it can be interpreted that there was a significant increase in **Planning Skills** of Grade-6 students.

Development of Monitoring Skills

Table 6: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Monitoring Skills of Grade-6 Students

	Test	Mean	Std.	t	*df*	p
Monitoring Skills	Pretest	4.38	1.875	- 3.343**	47	.000
	Posttest	5.29	1.570			

**p< 0.01; Mean Difference is significant at 0.01 level.

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **3.343**, p < 0.01). Thus, it can be interpreted that there was a significant increase in **Monitoring Skills** of Grade-6 students.

Development of Evaluation Skills

Table 7: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Evaluation Skills of Grade-6 Students

	Test	Mean	Std.	t	*df*	p
Evaluation Skills	Pretest	4.83	1.404	- 9.227**	47	.000
	Posttest	6.31	1.274			

**p < 0 .01; Mean Difference is significant at 0.01 level.

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **9.227**, p < 0.01). Thus, it can be interpreted that there was a significant increase in **Evaluation Skills** of Grade-6 students.

Development of Metacognitive Regulation

Table 8: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Metacognitive Regulation of Grade-6 Students

	Test	Mean	Std.	t	*df*	p
Metacognitive Regulation	Pretest	13.71	4.589	- 6.530**	47	.000
	Posttest	16.58	3.891			

**p < 0 .01; Mean Difference is significant at 0.01 level.

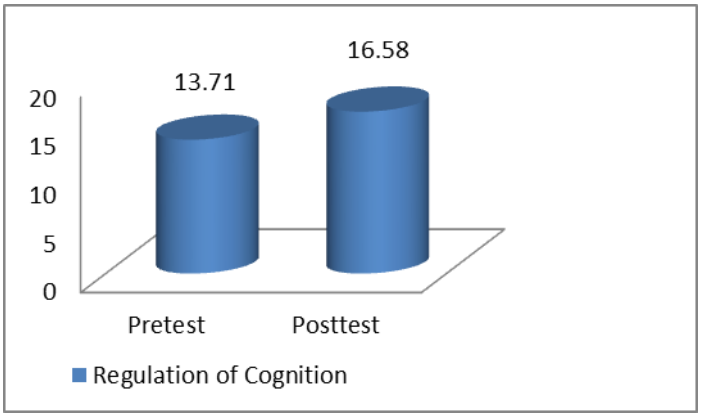

Figure 8 : Mean Difference between Pretest and Posttest Measures in Metacognitive Regulation

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **6.530**, p < 0.01). Thus, it can be interpreted that there was a significant increase in **Metacognitive Regulation** and hence there was significant development of **Metacognitive Regulation** of Grade-6 students while solving problems through Problem Based Learning approach.

Development of Metacognitive Skills

Table 9: Result of Paired Sample t-test for Comparing Mean Difference between Pretest and Posttest Measures in Metacognitive Skills of Grade-6 Students

	Test	Mean	Std.	t	*df*	p
Metacognitive Skills	Pretest	22.00	6.395	-9.082**	47	.000
	Posttest	26.94	5.715			

**p < 0.01; Mean Difference is significant at 0.01 level.

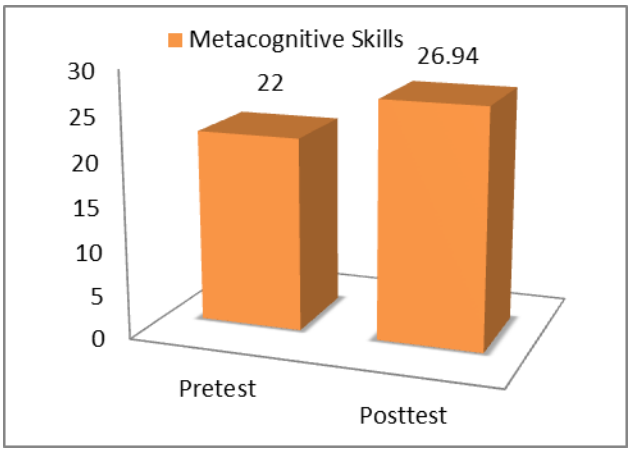

Figure 9: Mean Difference between Pretest and Posttest Measures in Metacognitive Skills

According to t-test result, the mean difference between pretest and posttest was significantly different (t= **-9.082**, p < 0.01). Thus, it can be interpreted that there was a significant increase in score on **Metacognitive**

Skills in pretest from posttest and hence there was significant development of **Metacognitive Skills** of Grade-6 students while solving problems through Problem Based Learning approach.

Conclusion

This is a study of investigating the impact of problem-based learning approach on Grade-6 students' metacognitive skills**.** The present study took place in Practising Middle School, Hlegu Education College, Yangon Region during 2017-2018 Academic Year. A total of 48 Grade-6 students were learned through PBL approach. According to quantitative results, the present study has proved that problem-based learning has positive impact on the development of Metacognitive Skills of Grade-6 students. From the above findings it could be concluded that learning stages of PBL approach definitely provides greater opportunity for the development of metacognitive skills. Therefore, the use of PBL approach facilitates the development of metacognitive and problem solving skills which has become an important goal among educators.

Moreover, this study highlights that metacognitive skills of planning, monitoring and evaluating are also important for the learner as they encourage self-reflection. Metacognitive skills are tools that empower the learner. Students very often fail to see learning as cycle that involves revisiting previous work to see where it can improve, acknowledging the value of mistakes, and planning improvements. By showing a learner that they can be in control of how they study, how they organize their work, and how they reflect upon it, we encourage them to take responsibility for learning. So, educators must implement problem-based learning in the classroom to accurately self-monitor and evaluate the problem solving abilities of children by sufficiently using metacognitive skills.

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