



# Impact of Problem Based Learning among IBMYP Mathematics Learners

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## ABSTRACT

Problem Based Learning approach has been one of the recommended instructional strategies for teachers in Mathematics. Mathematics Project work is provided to give an opportunity for students to experience the Problem Based Learning model in the classroom for Grade 10 and 11 students. Therefore, this study explores the impact of Problem Based Learning on students in developing their Approaches to Learning skills using qualitative methods. Data were collected based on students' perceptions from a focus group conducted in school. Information was gathered on students' motivation level in learning Mathematics and on the development of their Approaches To Learning skills namely collaborative, communication, information literacy, and organization, transfer, reflection and thinking skills. The results indicated a positive impact on students' learning process in the Middle Years Programme Mathematics curriculum. Overall, the Problem Based Learning approach had favourable implications on enhancing students' Approaches to Learning skills development.

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## Introduction

The Problem Based Learning approach has recently received much support from educators and is being applied in many levels and disciplines. Selcuk (2009) has asserted his findings based on his study on implementing PBL in physics course. From this research, the impact of PBL approach towards children's academic and learning attitude has been discussed positively. The purpose of my research is to gain students' perception on Problem- Based Learning (PBL) in learning Mathematics. A study by Wlodkowski cited by Franz (2010) (p.1) asserted PBL that "as the use of real-life problems as a mean for people to learn critical thinking, collaboration, and the essential concepts and professional skills of a particular discipline". Research on a PBL approach demonstrates that it enhances students' learning. For instance Klegeris and Hurren (2011) stated that "....the students satisfaction and motivation proven in this study will make further researcher easier, knowing that the students are enjoying the process and seeing the benefits in terms of their own development." In the Middle Year Program (MYP) there is an emphasis on supporting students to develop their Approaches to Learning (ATL) skills to enable them to take responsibility for their own learning. Thus, these skills are essential for students to develop the awareness on how they learn best, of the thought processes and of learning strategies. The ATL skills in the MYP are communication, social, self-management, research and thinking skills. These ATL skills are developed through the subject disciplines and students are expected to be critical, independent and life-long learners upon graduating from the MYP. As such, this research intends to gather findings on students' perception about the impact of PBL in their learning process.

## Background

The PBL teaching and learning strategy seems to support the purpose and objectives of the MYP Mathematics. This inquiry-based strategy is reflected in Pre-Published Maths guide .

*"MYP mathematics promotes both that inquiry and application, helping students to develop problem-solving techniques that transcend the discipline and that are useful in the world outside school" (2014, p.5)*

It is believed that integrating the PBL model in the instructional strategies would enable students to become inquirers in searching new information from various resources and applying the mathematical knowledge in real-life contexts in meaningful ways. Through the PBL strategy students will be able to develop not only inquiry learning but "interdisciplinary" learning beyond the classroom context. Interdisciplinary learning is seen as important in MYP mathematics curriculum. For example in the Pre-Published Maths Guide

*"Interdisciplinary teaching and learning is grounded in individual subject groups and disciplines, but extends disciplinary understanding....." (2014, p.13)*

Interdisciplinary teaching basically means connecting various subjects or disciplines concepts and knowledge in broader perspective. The MYP programme emphasis on interdisciplinary teaching and learning as it prepares students for further studies as they could apply the knowledge and concepts from various subjects in our interconnected and interrelated world. The implementation of PBL in the classroom could be the "head start" for meaningful integration and transfer of knowledge across various subject disciplines. Hence, this research study seems to be an approach for using PBL in developing Approaches to Learning skills in the IBMYP Mathematics Curriculum.

## Problem Statement

Previous research on PBL basically focuses on the students' academic performance and studies show that PBL has positive impacts on students' performance and learning and this is supported in a study by Tarmizi et al (2010), Cindy (2007). However, in this study, the focus is on PBL's effectiveness towards the ATL skill. In the Middle Year Program (MYP) there is an emphasis on supporting students

to develop their Approaches to Learning (ATL) skills to enable them to take responsibility for their own learning. Thus, these skills are essential for students to develop the awareness on how they learn best, of the thought processes and of learning strategies. The ATL skills in the MYP are communication, social, self-management, research and thinking skills. These ATL skills are developed through the subject disciplines and students are expected to be critical, independent and life-long learners upon graduating from the MYP. Thus there seems to be a high need to explore in the areas of ATL and how it gets influenced by the application of Problem Based Learning in the IBMYP Mathematics Curriculum.

### Research Questions

- 1) How does PBL motivate students in learning IBMYP mathematics?
- 2) What are the ways PBL enhance students to develop their self-management, communication, research, social and thinking skills?

### Literature Review

Problem solving skills are always emphasized in the field of Mathematics. As problems are usually placed in central of Mathematics learning, hence developing the problem solving skills is very essential (Zanzali n.d). Focusing on the Malaysian Education system, Mathematics is one of the core subjects in the Integrated Secondary School Curriculum (KBSM) in Malaysia and compulsory for all students. One of its focuses is on problem solving and teachers are urged to give emphasis to problem solving in planning their teaching, (Malaysian Curriculum Development Center 2004). Similarly, problem solving was a key focus in the US Mathematics Education research (Schoenfeld, 2007). The absence of a national curriculum in US was a major concern and the educational research and development (R&D) took the initiative to incorporate and emphasize the “problem solving skills” in the education system as the focus on this skill had deteriorated by the mid-1990s. After a decade of skills-based instruction in US, students were extremely poor at concepts and problem solving. According to the US research results (Schoenfeld, 2007), there is evidenced that general heuristic strategies influences students’ metacognition and self-regulation not only in Mathematics but also in non-routine performance behaviour.

Several research studies were conducted recently on the implication of PBL on students’ mathematics performance. Abdullah et. al (2010) has explored the effects of PBL as an alternative instructional strategy in the teaching and learning of Mathematics in Malaysian secondary schools. The researchers identified that students were more efficient in solving problems heuristically; they were motivated to explore the problem by investigating through various resources, gathering information to strategize and plan for possible solutions. Moreover, a study by Tarmizi (2010) focusing on the implementation of PBL in Calculus stated that PBL is an instructional strategy that specifically enhances learners thinking and communication skills.

Looking at many studies on the implementation of PBL, it is believed that PBL increases students’ motivation into self-directed learning. This is aligned with the purpose of Mathematics studies in the MYP. Hence, incorporating the PBL approach in students learning enables them to develop teamwork among their group members (collaborative skills). Students are required to work in groups to investigate the problem and discuss the possible strategies to solve the problem.

Besides that, PBL also fostered problem solving skills in students, enhances acquisition, retention and use of knowledge, Cazzola (2008).

### Source of Data

Focus group interviews were conducted and the discussions were tape recorded, transcribed and then analysed going back to the aim of the study which is to discover students’ perception of their experiences in the PBL learning environment. The content of the discussion was analysed to identify recurring, key thematic patterns in the students’ responses to the important questions, as well as throughout the focus group discussion. The main themes were described and taken into considerations on factors such as the “strength” or “intensity” of participant comments, consistency, frequency, depth, and specificity of the comments.

### Methodology

An action research approach was selected in this project as to collect rich details of experiences of students’ engaging in the PBL approach. As the purpose of the study is to gather data about how students learn and their experiences in the PBL approach. When the participants are engaged, voices would give meaning insights on specific key themes that need to be examined. The PBL model was introduced and administered in Semester 2 during 2013/2014 academic year for Grade 10 and 11 students who are taking Extended Mathematics. There are 19 students altogether who took part in this study. The students were separated in two main groups. PBL approach was conducted over 8 weeks in (Quarter 4). Before students were given the problems to solve using the PBL model, mathematical concepts were taught in the classroom with sufficient practice for the first 5 weeks. All these activities are very structured and guided to scaffold their learning. In week 6 students are then introduced with the PBL model and are required to solve the problems in groups. Students were expected to complete the “Mathematics Project” in groups in 2 weeks. Upon completion of the Mathematics Project, focus group interviews were conducted.

### Findings & Discussions

The data are organised from the responses of the focus groups and outlined the main themes that emerged from two focus groups with 14 students in total. Selected comments are included to illustrate certain themes. Furthermore, the summary is organised by the sequence of questions asked in the focus group. The questions in the focus group were designed to answer the key issues in the project.

Most of the students agree that Mathematics Project work enables them to become a better researcher, active learners, and risk takers, open-minded and independent.

They also explained that they were really engaged throughout the completion of the project work in class. They also emphasised the importance of working in group and contributing ideas in discussions. They seem to learn to listen to others’ perspective and be open to criticisms. Moreover, students also explained that they were able to conduct many researches and gather their findings in groups. As such, most students agreed that they played their roles as a researcher, active listeners and independent learners. Students also emphasized that they have learned to participate actively in group discussions, become better listeners and open-minded to different views and perspectives. Several students also mentioned that, they have learned to share ideas and communicate or express their thoughts effectively during group interactions. They also explained that during the accomplishment of the Project Work they have learned to

give and take especially to trust their team members in completing the assigned tasks and also to respect their opinions.

On the other hand, a number of students stated that the Project Work gives them better understanding on how the knowledge is applied in real-life situations. Furthermore, students mentioned that the Project Work is a platform for them to extend their learning beyond the classroom. Students believe that the Project has helped them overall to not only increase their understanding of the learning but to improve their skills, attitude and self-confidence.

Some students described some major benefits of the Project Work such as in depth understanding of the content-knowledge. Students expressed that through the Mathematics Project Work they are able to construct better learning as they were actively involved in group discussions and exposed to various resources such as books, internet and through interview sessions. Besides that, they also felt that by frequently asking questions and exchanging opinions and ideas they are able to gain more constructive knowledge about the content. In addition, as they share their understanding and explain things with each other they subsequently obtain new insights and exposed to diverse ideas. In addition, as they work in groups; teaching each other they have improved their understanding level.

The following statement from student highlights and provides evidences to support the above findings.

*"I was very active throughout the investigation phase. As I love to talk, I was basically communicating my ideas with my team members. And I think I have become a better communicator"* [S5F1Q2]

*"Yes, I too agree that we become more independent in our learning as we want to give our best to complete the project successfully."* [S3F1Q2]

*"Adding to this, I'm glad that I could improve many skills which are important such as researching, citing using MLA format, and leading discussions."* [S2F1Q2]

*"Ok.....I'm basically the researcher in my group. I job was basically finding information because I'm a technology savvy."* [S4F2Q2]

*"Oh..... In my case I'm very independent. I basically was very independent doing my work. I strongly feel being independent is very important as we will have the sense of belongings towards our learning."* [S1F2Q1]

*"I'm sure that I become very knowledgeable in the subject after the completion of the Project and this has given better understanding of the topic"* [S9F2Q2].

#### **What is your opinion about working in groups? (Collaboration skills)**

*"I guess working in groups enables to understand the model that teacher introduced better because ..... when we use the model we could work as group completing part by part."* [S1F2Q2].

*"Student F: In my group we don't specifically assign specific roles but rather the roles develop as we work on the Project and we are collaborative enough to work together in group."* [S6F1Q2]

#### **To what extent has the Mathematics Project Work helped you to explore learning besides content? (Application of Knowledge)**

*"Hmmmm.....besides having better understanding of the topic, I think I have developed my IB Learner Profiles. I am now more knowledgeable, I'm a thinker, reflective and also open-minded."* [S1F1Q1]

*"Yes I totally agree to this point. I myself felt the same. I could see the link between the topic and how it is applied in real life. Teacher always mentions that whatever we learnt there is a purpose and through the Project I could see it."* [S2F1Q1]

*"I believe that the Project does not only increase my understanding but overall it has improved my skills, attitude and.....self-confidence."*

*All students: Yes....yes.....all the while I didn't know that I could use calculus in baking cakes and it is fun to know how calculus can be used to design cakes."* [S3F2Q1].

#### **What is the main benefit of the Mathematics Project Work? (Benefits)**

*"Oh ok.....that's a lot to mention actually. Where shall I start first????? Hmm..... I think I had better understanding of the topic after completing the Project given by teacher."* [S1F1Q1]

*"Yes..... Me too I have deeper understanding of the concept taught by teacher in the class. I gained vast information various resources especially from internet."* [S3F1Q1]

*"We also enjoyed the entire Project as the format was something different"* [S3F2Q1]

*"Working with this problem makes me a better problem solver."* [S5F2Q1]

*"In my opinion, the Project Work has given in depth understanding of the learning in the classroom. Besides that, as I'm actively involved in group discussions and exposed to many kinds of resources such as books, internet and many more and this has increased better learning."* [S5F1Q1]

*"The group discussion actually gives us the authority to build our knowledge based on our capability."* [S9F2Q1]

In light of the results of this study, it can be contended that PBL motivates students' learning in MYP Mathematics and develops students ATL skills such as collaboration, researching, thinking, transfer, communication and problem solving skills. Another finding that is concluded in this study was PBL helps students enhance their IB Learner Profile throughout their learning process. This finding is emerged from the focus group discussions when students shared their opinion about their roles.

#### **References**

- ABDULLAH et al (2010). The Effects of Problem Based Learning on Mathematics Performance and Affective in Learning Statistics at Form Four Secondary Level. *Procedia Social and Behavioral Sciences* 8, 370 – 376.
- CAZZOLA,M.(2008).ProblemBasedLearningandMathematics:PossibleSynergicalActions.IATED(InternationalAssociation of Technology, Education and Development, Valencia, Spain.
- CINDY E. et al (2007). Scaffolding and Achievement in Problem- Based and Inquiry Learning: A Response to Krischner, Sweller, and Clark (2006).*Educational Psychologist* Vol 42. No. 2 pp 99 - 107
- HURREN,H.Klegeris,A(2011).Impactofproblembasedlearning in a large classroom setting; student perception & problem-solving skills. *Advances in Physiology Education* Published. Vol.35.No.4pp 408 – 415.
- KLEGERIS, A et al (2011). Impact of Problem-based Learninginalargeclassroomsetting:studentperceptionandproblem-solving skills. *The American Physiological Society*. Vol.35 pp 408 – 415.
- SELCUK.G and SERAP.C (2010). A small scale study comparing the impacts of problem based learning and traditional methods on student satisfaction in the introductory

physics course. *Procedia Social and Behavioral Sciences* 2,809-813.

SCHOENFELD, A. (2007). Problem solving in the United State, 1970 -2008; research & theory, practice & politics. *ZDM Mathematics Education* 39, pp 537 – 551.

TARMIZI et al (2010). Problem-based learning: engaging students in acquisition of mathematical competency. *Procedia Social and Behavioral Sciences* 2, 4683 – 4688.

ZANZALI (n.d). Designing the mathematics curriculum in Malaysia; Making mathematics more meaningful.