A "BIG" PBL Problem: What Supports or Hinders Student Motivation?

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Abstract
This study examines student perceptions and motivations toward solving a "Big" Problem over multiple lessons in problem-based learning (PBL) environment, both from student and staff perspective. It was conducted as a mixed methods research, involving quantitative student surveys and qualitative in-depth interviews. A big problem was introduced as an intervention in 'Qualitative Research Methods' module where Year 2 polytechnic students were given 4 weeks to solve it. The online survey measured student (N=71) motivations using three subscales- Intrinsic goal orientation, Extrinsic goal orientation and Self-Efficacy for Learning and Performance, adapted from Motivated Strategies for Learning Questionnaire (Duncan & McKeachie, 2005). It also included some open-ended questions to explore the reasons behind the responses. Lecturers' perceptions of student engagement with a big problem, gathered through class observations and review of reflection journals, were explored using in-depth interviews (N=2). Triangulating the findings, it can be inferred that both students and staff see value in including big problems in the curriculum, despite facing some problem solving/ facilitation challenges respectively. Further statistical analysis reveals, there is no correlation between mean motivation scores and assessment grades for this problem. Spearman's Rank correlation analysis was done as the grades data was not normal. The study gives educators the conviction to design big problems of higher difficulty, where relevant. It also provides impetus to conduct research to help staff and students adapt to big problems, where students get a combined grade across multiple lessons. Follow-up research may be done to study student motivation towards large problems using other subscales such as task value, and/ across multiple disciplines.

Keywords: Problem-Based Learning, Big/Large Problem, Student Motivation

Introduction

Problems are the starting point of students' learning process in problem-based learning (PBL) (Sockalingam, 2011). Problems typically describe a set of situations or phenomena set in real-life context and require the students to explain or resolve them (Hmelo-Silver, 2004). Educators employing problem-based learning are constantly rethinking of how to craft interesting and challenging problems to trigger students' learning. Authentic PBL education requires the student to go through the same activities during learning that are valued in the real world. The intent is to challenge the students with a problem that he/she will be facing in practice both as a stimulus for learning and a focus for organizing what has been learned for later recall and application to future work (Barrows, 2000). Since not all future work problems may come in bite sizes, in PBL context as well, "all problems are not equal" (Jonassen & Hung, 2008). This naturally creates space for big problems in the curriculum to enable authentic learning.

A big or large problem is designed to be of higher difficulty allowing students to solve it across multiple lessons without the pressure of daily grading. Problem crafters increase the difficulty level by varying complexity and structuredness. Problem complexity refers to the breadth, attainment level, intricacy, and interrelatedness of problem space while problem structuredness represents the intransparency, heterogeneity of interpretations, interdisciplinary, and dynamicity of problems (Jonassen & Hung, 2008).

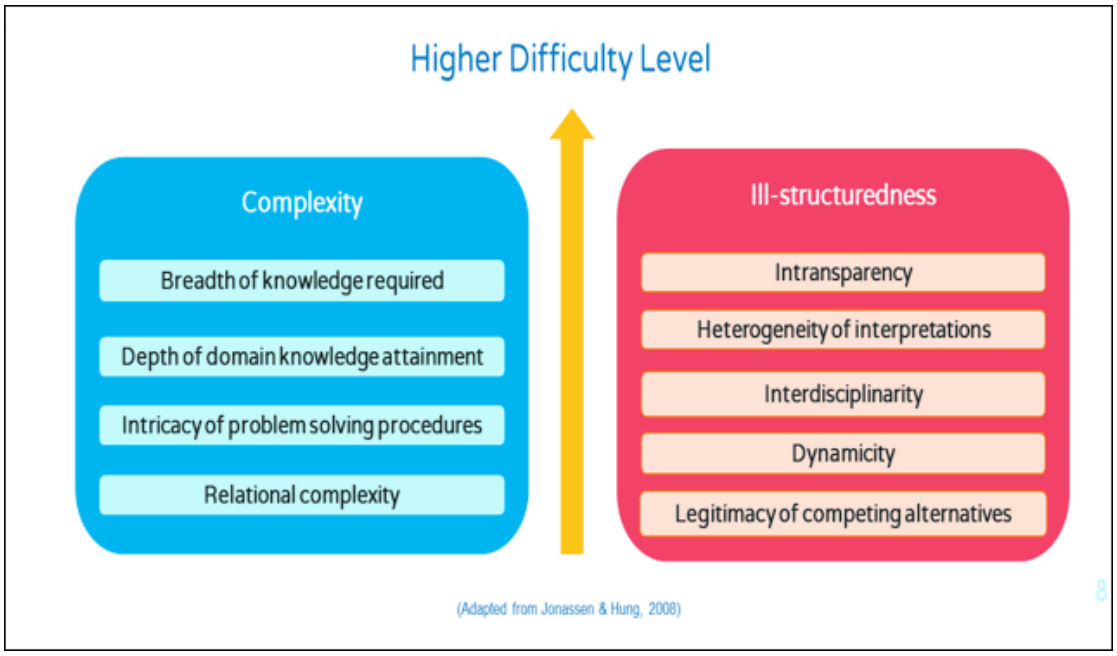

Figure 1: Factors affecting Problem Difficulty

If learning can be considered as a cycle where students constantly visit and revisit ideas (Kolb, 1984), big problems should enable learning by allowing students to revisit them over a few days. The underlying premise is that this extended interaction with the problem would allow them to internalise the concepts to propose better solutions. This paper attempts to study student response to a big problem that mirrors a demanding industry context.

Objectives of the Study

The aim of this study was to examine student perceptions a “Big” PBL problem to be solved over multiple lessons and motivations for answering it. It took into consideration the viewpoint of students and lecturers both. The study addressed the following research questions:

1. What is the extent of students’ motivations, in terms of intrinsic goal orientation, extrinsic goal orientation and self-efficacy for learning and performance, towards solving a big PBL problem?
2. Based on staff and student perspective, what are the factors that motivate and hinder students in engaging with a big PBL problem?

Methods

This study was designed to be a mixed methods research, involving a quantitative student survey and qualitative in-depth interviews to study student repsonse to a big problem. The curriculum for Year 2 polytechnic students taking ‘Qualitative Research Methods’ module included a big problem and they were given 4 weeks to solve it. The online survey measured students' (N=71) motivation through statements on Intrinsic goal orientation, Extrinsic goal orientation and Self-Efficacy for Learning and Performance, adapted from Motivated Strategies for Learning Questionnaire (Duncan & McKeachie, 2005). The survey included some open-ended questions to explore the reasons behind the responses. In-depth interviews were conducted with lecturers (N=2) to gather their perceptions of student engagement with a big problem. Lecturers shared their perceptions based on the class observations and review of student reflection journals.

The intervention used in the study was a big problem, which required students to prepare a market research proposal to meet the company's needs and design relevant research materials over four weeks. Students had to break it down into smaller tasks such as defining research objective, recommending an appropriate research method, designing a screener questionnaire, developing a focus group discussion guide and preparing a fieldwork plan. The intricacy of problem solving procedures for preparing the proposal and materials added complexity to it. Relational complexity was also high as they had to process several stakeholder relations in parallel including agency, company and respondents. It was highly ill-structured due to the legitimacy of competing alternatives at each step of the research process- research approaches/ methods/ materials/ projective techniques. To add to the challenge, in the last week, the students were asked to extend the fieldwork plan to multiple countries, making it dynamic. The students were assessed using reduced continuous assessment grade (CAG) awarded at the end of 4 weeks.

Statistial techniques employed to analyse the survey data include descriptive measures such as mean ratings for each subscale, reliability testing of subscales by computing Cronbach's alpha to measure how closely related the statements were on each subscale and correlation analysis to study if there was any relationship between mean motivation scores and assessment grades of students. To analyse the open-ended responses to the survey and interviews, in-depth content analysis was done using thematic coding.

Quantitative Findings

As illustrated in the graphs below, overall mean scores for the *motivational orientation* subscales (Intrinsic goal orientation, extrinsic goal orientation and self-efficacy for learning and performance) are from 4.55 - 5.12, with a standard deviation from 1.03 - 1.11. Since the overall mean scores are above mid-point on a 7-point scale, we can infer that most students have a favourable response to the big problem.

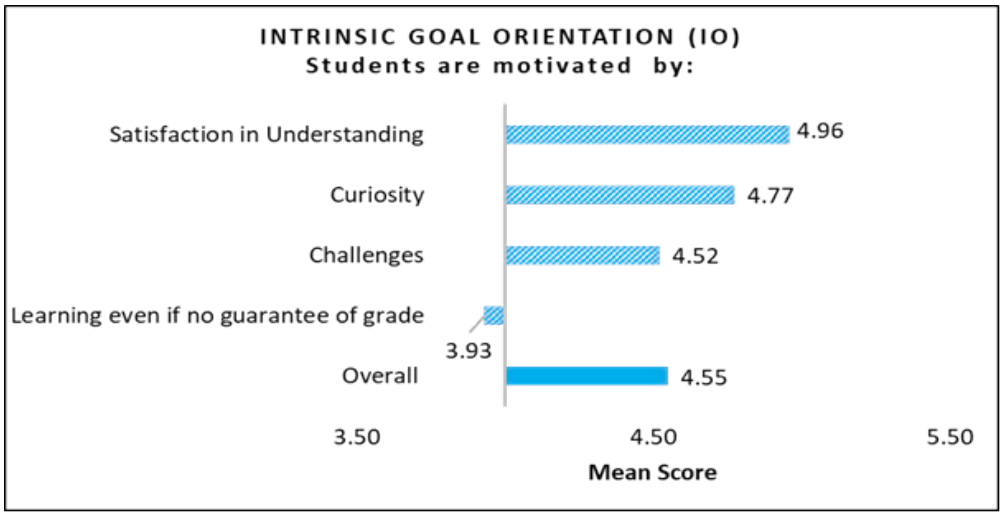

Figure 2: Student Motivation in terms of Intrinsic Goal Orientation

Students are intrinsically motivated most by satisfaction they obtain in understanding the content as thoroughly as possible, followed by arousal of curiosity, challenges to learn new things and lastly opportunity to learn more even if it does not guarantee a good grade. This shows grade are quite important for them.

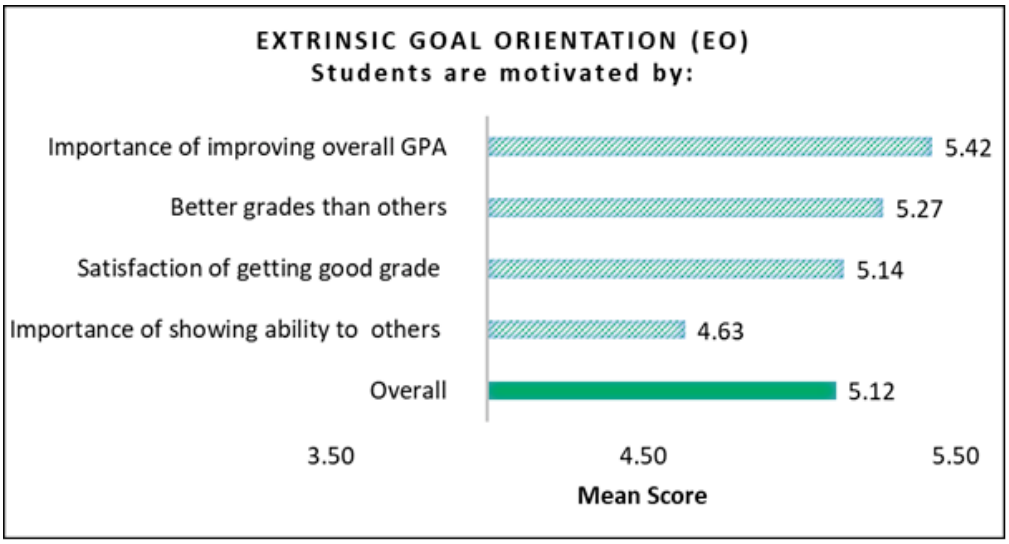

Figure 3: Student Motivation in terms of Extrinsic Goal Orientation

Students are extrinsically motivated most to improve GPA, followed by better grades than others, satisfaction of good grade and lastly importance of showing their ability to lecturer. This reiterates the value they place on GPA and grades.

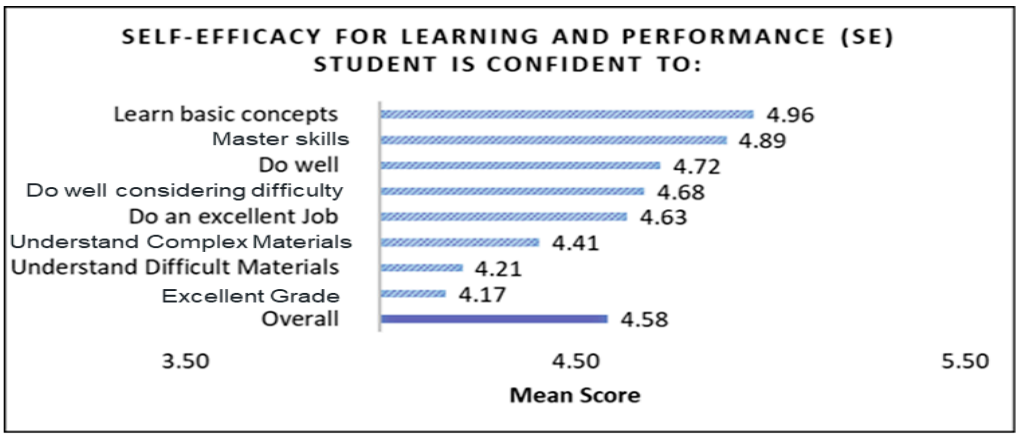

Figure 4: Student Motivation in terms of Self-efficacy for Learning and Performance

It seems natural that students are most confident of understanding basics, followed by more complex things such as mastering skills, doing well considering difficulty and lastly getting an excellent grade.

The subscales have been subjected to reliability testing using Cronbach's alpha (α), which measures internal consistency to show how closely related the items are in the subscale. Intrinsic goal orientation subscale consists of 4 items (α = 0.72), extrinsic goal orientation subscale consists of 4 items (α = 0.73), and the self-efficacy for learning and performance subscale consists of 8 items (α = 0.93). A reliability coefficient of 0.73–0.95 is considered high. Hence, we can infer that the item statements within each subscale are closely related and measure it. Further statistical analysis shows there is no correlation between mean motivation scores and grades of students.

Qualitative Findings

Thematic analysis of the open-ended responses to survey questions reveal student perceptions in terms of key motivators such as good grades and more time. It also brings forward some key concerns such as ill-structuredness and complexity. The key motivators and concerns have been summarised in Figure 5, in the order of mentions made by the students.

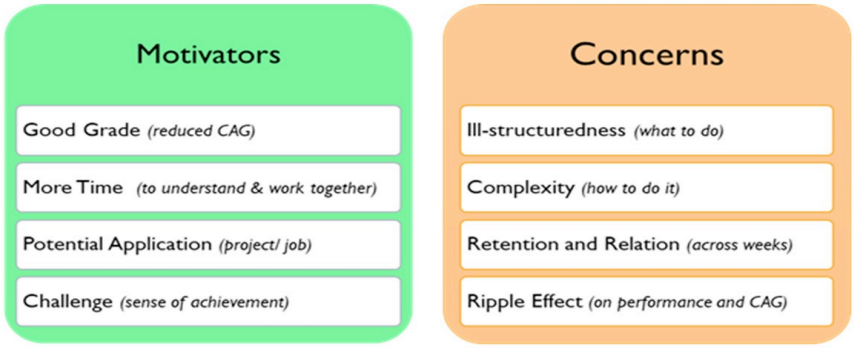

Figure 5: Student Motivators and Concerns for a Big Problem

Reduced grade was a motivator for some and a concern for the others. A student mentioned *"thinking of the possible final grade I could get, I wanted to solve the big problem as effectively and as efficiently as I can…."* On the other hand, another

student had a concern *"If I am unable to make it for one lesson, I will not be able to get an A grade… if concepts applied in the previous lesson are wrong, it would be hard to continue to the other concepts for the next lesson."*

Having more time to solve the problem helped students revisit and build on to their learning as some of them mention, *"…helped me understand & focus on concept better…no need to re-understand the problem every week; …able to follow up and link the different topics together for a finalised understanding; able to work with teammates over 4 weeks, feels like we are doing a group project..."*

The authentic problem mirroring real life gave students a drive to solve it as they were, *"able to replicate what market researchers do in their everyday life/ apply to other things/ mid-semester assignment (MSA)."*

The big problem challenged some to push themselves to achieve higher potential as one student said *"... It satisfies me, the bigger the problem, the bigger the tasks but the bigger the satisfaction."*

Students also expressed some concerns regarding the big problem. It was purposely designed to be of higher ill-structuredness and complexity, so students obviously struggled to decide what to do and how to do it. Some of them mentioned, *"I'm a lost child in* ***Neverland; …****when presenting solution… confused about how to go about it … do I use every concept…; …hard to grasp concepts to solve the big problem…took me some time to break (it) down into smaller issues to better understand it."*

The students also reported issues in retaining and relating concepts across weeks. *"I am used to having one problem a day, I often forget that the four weeks are connected; …sometimes I have difficulty linking the previous theories to the next week's lesson…"*

Similar sentiments were also reflected in staff perceptions of student responses to the big problem, categorised below as positive and not-so-positive.

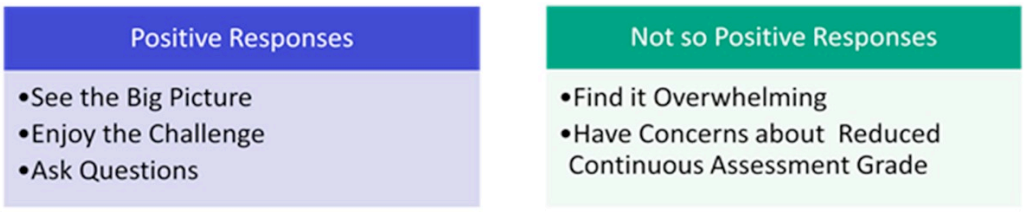

Figure 6: Staff Perceptions of Student Responses towards a Big Problem

Lecturers shared some positive observations such as *"some students enjoyed when they see it in totality; the stronger students enjoyed it as it challenged them; …the ill-structuredness caused them to ask more questions...allows them to think through..."*

They also shared some not so positive observations such as *"…some students found it unnerving…there was a lot of uncertainty; …. concerned about how they were going to be graded...how much to do each week..."*

These inputs provided deeper insights into student perceptions and motivations which can help strengthen big problems in future.

Discussion and Recommendations

It is encouraging that the big problem enables some students to see the big picture and they make effort to cope with it by asking more questions. It is also a reality check that some students are unnerved by the difficulty. Since high difficulty and ill-structuredness are purposely planted in the problem design, it is natural for students to struggle with it for the first time. However, problem crafters need to assess if the difficulty level is suitable or not. If not, either scope it to be of appropriate difficulty or develop measures to prepare students to handle higher difficulty. Characteristics of good problems include suitable difficulty and relevance (Sockalingam & Schmidt, 2011). Problem difficulty plays a role in the effectiveness of students' learning outcomes in all types of instructional methods that use problems. A problem with an appropriate difficulty level is within learners' cognitive readiness and therefore solvable, while an inappropriate difficulty level of problem may exceed the learners' readiness and result in failure (Jonassen & Hung, 2008). Building in and reiterating the problem relevance would be useful in helping students see the rationale behind the big problem.

Based on the above discussion, following recommendations have been made to enable educators to include large problems in curriculum:

1. To acclimatise students to the difficulty and overcome the issue of retention and relation of concepts over a long period, scope big problems across 2-3 weeks to begin with.
2. To balance the challenge of ill-structuredness, provide appropriate scaffolding and revisit the problem analysis regularly so that the students can become increasingly confident about their progress towards the challenging goal.
3. To allay the concerns about reduced CAG, explain the rationale behind it and provide regular feedback which would give them a reassurance they look for in a grade.

Conclusion

Triangulating the findings, it we infer that both staff and students see value in including big problems in the curriculum, despite facing some facilitation and problem-solving challenges. For this problem, there is no correlation between mean motivation scores and grades of students. The study gives educators the conviction to design big problems of higher difficulty, where relevant. It also provides researchers the impetus to conduct research to help staff and students adapt to big problems with a combined grade across multiple lessons. Follow-up research may be done to study student motivation to large problems using other subscales such as task value, across multiple disciplines.

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