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An Exploration into Key Roles in Making Project-based Learning Happen: Insights from a Case Study of a University

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Abstract

Given the challenges encountered in adopting project-based learning in higher education, it is important to understand how project-based learning pedagogy can be effectively delivered, hence, resulting in quality student learning from project experience. Recent work suggests that the instantiation of specific roles of the teacher and the student may be central in a project-based learning course. Using a case study of UNI-X with a focus group approach, we examined the roles played by the teacher and the student in project-based learning courses. Results suggest that the teacher plays the roles of a *designer*, *champion*, *facilitator* and *manager* in a project-based learning course. To ensure learning is effective, the student has to play the roles of a *self-directed learner* and a *warrior* when completing his or her project. Our study also identifies the existence of role ambiguity and role conflict in project-based learning courses and we discuss how role conflict could impact the effectiveness of student learning. Implications for research and practice are highlighted.

Introduction

With the fast-changing work environment, universities today are embracing teaching pedagogy that inculcates learning of twenty-first century competencies so as to prepare their students to be future-ready (Rotherham and Willingham, 2010). A major theme in developing twenty-first century competencies centres on the learning philosophy of taking what was learned in one situation and applying it to new situations (Lee, et al., 2014). To embrace this learning philosophy, teaching pedagogy may have to evolve from content teaching, to engaging students in active learning, hence focusing on applying and reflecting knowledge (Pan et al., 2019). This results in a shift of teacher's role from transmitter of information to facilitator of learning. The role of a student also transitions to become that of a self-directed learner (Yamashita, 2016). Teaching is no longer just about knowledge transfer. It is also about creating learning environment and process that motivate and inspire students to stay actively engaged (Pan et al., 2017).

An approach that embodies such active learning philosophy is the pedagogy of 'learning through doing' or project-based learning (PBL), which allows students to learn theory in the classroom, then apply what they have learned in the field, solving a wide array of business or societal challenges facing organizations, while at the same time solidifying their own knowledge (Markham et al., 2003). Students are challenged to manage projects in unfamiliar environments, and develop implementable solutions. In this way, students can better understand the theories and frameworks taught in class and supplement them with hands-on learning through real-world application and solution development (Seow et al., 2019).

While PBL offers students valuable hands-on learning experience that engages in real-world tasks (Bell, 2010), implementing PBL pedagogy is no easy task for any education institution. To date, PBL is far from being integrated in education institutions in a systematic way (Shpeizer, 2019). In fact, its integration is completely absent from many education institutions, while in others, it is used on an irregular scale (Harmer and Stokes, 2014). The limited adoption

of PBL in academia goes against the expectations of advocates of the method, particularly in light of the advantages it offers (Lee et al., 2014).

One of the main obstacles facing PBL adoption relates to a lack of understanding by teachers and students in the roles they are required to play in the learning process (Shpeizer, 2019), and as a consequence, it generates confusion in teaching and limitation in learning (Bradley-Levine et al., 2010). While many would agree with the importance of demystifying role ambiguity and conflict in PBL process, there are however, few empirical studies that have examined the exact roles played by the teacher and the student in achieving the learning outcomes of a PBL course (Shpeizer, 2019). Accordingly, our study aims to address this knowledge gap in the PBL literature, so as to better promote regular adoption of PBL pedagogy in educational institutions.

The following section provides a background of PBL literature, which is followed by a description of our research approach and a description of a University, UNI-X's (a pseudonym) experience of adopting PBL pedagogy in its undergraduate curriculum. In our case study, undergraduate students from various disciplines formed project teams and applied their interdisciplinary knowledge in developing implementable solutions to address real-world issues and challenges in organizations. Following the case description, we analyse and discuss the case in two steps: identification of key roles and identification of role ambiguity and conflict in PBL courses. The paper ends with conclusion, and implications for research and practice.

Literature Review

Project-Based Learning

PBL is a form of situated learning based on constructivist finding that students develop a deeper understanding of content material when they actively construct meaning by working with and using ideas (Tal et al., 2006). Markham et al. (2003) alternatively describe PBL as “a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured among complex, authentic questions and carefully designed projects and task” (p. 4). Typically, PBL involves assignment that requires students to apply previously acquired knowledge to produce some forms of output, such as a process or product design, a computer code or simulation, or the design of an experiment and the analysis and interpretation of data. The final product, which is the central focus of the assignment, would normally be a written or oral report summarizing what was done and what the outcome was (Prince and Felder, 2007).

Bell (2010) aptly describes PBL as “the basis of the curriculum” and not just a “supplementary activity to support learning” (p.39). According to Tal et al (2006), a PBL environment would usually possess five key features: (1) It begins with a driving question or a problem to be solved; (2) Students initiate and participate in authentic situated inquiry in order to explore the driving question, learn and apply important ideas in relevant disciplines; (3) Students, teachers and members of the community engage in collaborative activities to derive solutions for the driving question; (4) Scaffolding takes place with the help of learning technologies that engage students in the process of inquiry; and finally, (5) Students create tangible outputs that address the driving question.

Prior research shows that PBL provides a number of positive learning outcomes for students. Gultekin (2005) suggests students are turned into better researchers, problem solvers and high-order thinkers through PBL. Studies that have compared PBL to conventional teaching

approach by Thomas (2000), Mergendoller et al. (2006), as well as Parker et al. (2011), show that the former yielded significant positive effects on problem solving skills, conceptual understanding, attitudes to learning, and “comparable or better student performance on tests of content knowledge” (Prince and Felder, 2007, p.16). Similarly, Williams and Linn (2003) have also demonstrated that students engaged in PBL achieved higher scores than their counterparts at the receiving end of traditional classroom instruction.

The Role Perspective in Project-based Learning

PBL is somewhat different from traditional methods of teaching in that the teacher takes on the role of a facilitator and learning is enacted in a more collaborative, hands-on process driven by real-world connection. It uses authentic projects as a vehicle to encourage deeper learning through collaboration and extended inquiry, and culminate in a final product or event (Pan et al., 2019). For PBL to be successful, there must be a shift in the definition and expectations of the teacher, and acceptance of breaking from the traditional “teacher and student” model. The role of the teacher involves collating sources, facilitating thinking, & inspiring students to impact the world with their learning, and spending class time probing students about their own sense-making and acquisition of skills (Prince and Felder, 2007). Also, a PBL teacher may seek to understand her students, and craft driving questions or projects aimed at igniting wonder, passion & action (Olzan, 2016).

Unlike traditional methods of teaching where teachers are considered the main source of information and dominate most of the talk time in class (Aldabbus, 2018), teachers who are seen as facilitators and advisers, provide students with adequate guidance and feedback. They give students more room to choose the way they approach the tasks which in this way, motivates students to be more independent. This is consistent with research on constructivist and student-centered learning environments, where learners are expected to experience ambiguity and cognitive disequilibrium (Savery, 2006).

In PBL, students tend to work together in teams, distributing roles, helping and supporting one another, searching for information, sharing experience, designing activities, and reflecting on the knowledge and social skills which are essential for lifelong learning (Aldabbus, 2018). Bell (2010) observed that PBL encourages students to collaborate with one another in solving problems; it promotes self-learning as students become more responsible in their learning (Grant, 2011). According to Gubacs (2004), learners self-assess their own end products, evaluate their classmates’ projects and give constructive feedbacks to one another. This may help learners to become more aware of their own strengths to be enhanced and weaknesses to be eradicated.

While PBL contributes several benefits to learning, it may also present some challenges in the learning process. For instance, Mills and Treagust (2003) noted that some of the students taught with PBL pedagogy ended up unhappy over the amount of time and effort required by the project work as well as the interpersonal conflicts they experienced in project teams. Another challenge of PBL is related to defining projects with a suitable scope and balancing with an appropriate level of difficulty for the class (Prince and Felder, 2007). Among the several challenges of PBL, Shpeizer (2019) argues that the key obstacle of effective PBL adoption is attributed to a lack of understanding by teachers and students in the roles they are required to play in the learning process (Shpeizer, 2019). In addition, role conflict may potentially exist too. This change in roles and responsibilities – both for students and for teachers – may lead to uncertainty and confusion in a PBL setting (Bradley-Levine et al., 2010). Despite the lack of

understanding, it does not help to know that so far there is a limited number of empirical studies that have attempted to address this challenge in PBL courses (Hugerat, 2016). It is therefore our aim to address this knowledge gap in the PBL literature.

Research Methodology

Our strategy was to undertake an in-depth case study of PBL courses taught in UNI-X's undergraduate curriculum. UNI-X is a Singapore based University. The case study approach is particularly appropriate for our exploratory study since it allows us to capture the organizational dynamics of the phenomenon better and also its ability to explain the phenomenon based on interpretation of data (Miles, 2015).

Focus group discussions (FGD) were conducted with undergraduate students who took a UNI-X course either in August-December 2016 or January-May 2017¹. Emails were sent to these students to solicit their willingness to participate in the FGD. In total, 26 students were recruited, out of which 13 were female students and another 13 were male students. Among them, 4 students were in Year 2, 14 students were in Year 3 while 8 students were in their graduating year during the period when the FGD was conducted. This reflects a high proportion of senior year students in UNI-X courses. Altogether there were 4 students who were enrolled in the Bachelor of Accountancy, 6 students were enrolled in the Bachelor of Business Management, 7 students were enrolled in the Bachelor of Science (Information Systems), 2 students were enrolled in the Bachelor of Social Sciences, 1 student was enrolled in the Bachelor of Science (Economics) and 6 students were enrolled in Bachelor of Law.

These 26 students were split across 3 different Focus Groups with 2 groups of 9 students and 1 group of 8 students. Each FGD lasted between one-hour and one-and-a-half hour, and was tape recorded and then transcribed. Participants of the FGD were asked to discuss their experiences in the UNI-X courses, mainly on what they took away from the course experience in terms of the learning outcomes and skills, their personal evaluations of the effectiveness of UNI-X courses and the roles played by the teacher and the students. Besides students, we also conducted FGD with 6 faculty who taught in UNI-X courses, asking specifically their perceptions of PBL's course design, delivery and its impact on overall student experience, and their role in the course.

These focus group interviews were taped-recorded with interviewees' permission and transcribed immediately after the meetings. Focus group interviews were the main source of our data because the researcher could grasp the interviewees' interpretations of their own project experience, as well as their beliefs in the projects (Gilflores and Alonso, 1995). Secondary data such as student reports were also gathered to supplement the information collected through these interviews. Overall, the data collection process drew upon interviewees' perceptions of their roles and PBL's impact on student learning experience.

Data analysis was carried out by recursively iterating between the empirical data, the theoretical lens, and the relevant PBL literature. The iterative process continued until the state

¹ Prior approval for the focus group discussions was obtained from our university's Institutional Review Board. Informed consent were obtained from the participants who participated voluntarily in this study. Participants were assured of data privacy and understood clearly that their responses will not be reported in such a manner that their identity can be identified. Participants were also assured of data confidentiality. The research data was kept securely and can be accessed only by the research team.

of theoretical saturation was reached, that is, when it was possible to comprehensively explain the findings of the case study and no additional data needed to be collected or added to improve the findings (Eisenhardt, 1989). We began our analysis by reading all transcripts and documents and highlighting the descriptions that were related to roles in PBL. We used analytic induction (Taylor and Bogdan, 1998) to uncover new constructs and relationships that could enrich our understanding of the phenomenon and assist our theory building process. Analytical induction involved the following steps (Goetz and LeCompte, 1981): (1) A phenomenon is defined in a tentative manner, (2) scanning data to identify categories, (3) developing categories, (4) determining the relationships that exist among categories, and (5) continually refining categories until all are accounted for.

We then developed a list of common themes related to roles in PBL. Coding categories reflect our interpretations of the roles in PBL. An initial pilot run was conducted for coder training and pilot testing of reliability. During the pilot run, coding instrument and procedures were also refined. To establish the reliability of the coding, each coder was asked to quote a particular segment of the relevant texts. Coding was conducted independently and without consultation and guidance. We examined the portions of the codings where both coders agreed and measured the inter-coder reliability using Cohen's Kappa coefficient. Our coefficient score of 0.77 suggests substantial agreement between the two coders and the result also demonstrates that the categories were clearly defined, and could be located in the text with little ambiguity. As the reliability coefficient was high, each coder was subsequently asked to code separate portions of the texts. Relevant interview comments and secondary reports were sorted according to the various categories and a list of themes within each category was developed. The list contained the location of each comment on the transcript, the transcript number, the interview date, any links to other comments, reports and sources of news coverage. In order to reduce researcher bias, a senior colleague was asked to take part in early analysis of some of the data. The colleague was uninvolved in the fieldwork and was therefore unfamiliar with all four cases. The role of this colleague was to bring a different and possibly more objective eye to the evidence and detect any bias in data analysis.

Project-based Learning Pedagogy at UNI-X

Recognizing the need to prepare its students with twenty-first century competencies so as to tackle increasingly complex real-world problems, UNI-X launched undergraduate courses that adopt PBL pedagogy.

The PBL pedagogy at UNI-X comprises four principles: 1) project-based learning tackling real world problems and issues; 2) inter-disciplinary learning; 3) active mentoring and; 4) a deeper relationship between faculty, student and industry partner. By applying the 4 principles in a project, students are expected to learn competencies such as critical and inventive thinking, communication, collaboration and adaptability. By weaving these four principles together in a closely knitted manner, PBL offers a fundamental platform for students to learn and share knowledge.

As each PBL course involves partners from corporate, non-profit or government-sector organisations in project design, it is built into the course that the partners and faculty actively mentor so that students benefit most out of the deep relationship. A key benefit of close engagement with external partners is to provide authentic feedback on student projects. In addition, students could better see the applicability of the course to their future careers with client-based projects. Essentially, a PBL course establishes a learning loop for the tripartite:

students obtain a deeper understanding of what it means to apply theory learnt outside the classroom, faculty learns how real world adapts theory and external partners deepen their own learning methodology.

As at December 2017, there were 38 PBL courses at UNI-X. The enrolment for these PBL courses reached 4466 places between 2015 and 2017. To date, 3385 undergraduate students have studied at least 1 PBL course with 811 students studied 2 or more PBL courses. These PBL courses had collaborated with more than 259 organizations that sponsored projects, and students taking such PBL courses had delivered more than 700 implementable solutions to these organizations.

Types of PBL projects at UNI-X include accounting, branding, business improvement, data analytics, design thinking, innovation, policy implementation, smart technologies, strategic management and web/mobile application development. Out of the 259 partners, 70% were private companies, 14% were public companies and 16% were NGO. Among the private companies, 32% were multi-national companies, 7% were large local companies and 61% were SMEs. Top 3 industries were Information and Communication, Health and Social Sciences, and Wholesale and Retail Trade.

Results and Discussion

In this section, we used content analysis to identify the underlying roles associated with actions in a PBL setting. The analysis resulted in the identification of distinct roles involved in PBL by the teacher and the student (refer to Tables 1 and 2). Each of these roles is discussed below and relevant literature is enfolded in the discussion where applicable. In the next analysis step (reported in the following section), we analyzed role conflict and its impact on PBL process. We found that role conflict may arise when the teacher does not have a clear idea of the boundaries of her role, or which tasks and responsibilities formed part of it during PBL. This could lead to dissatisfaction with the role, decreased satisfaction, anxiety, lower commitment and lower performance (Biddle and Anderson, 1986).

Role of Teacher

Designer

Create, support and model a safe learning environment where students feel valued, trusted and respected during the learning process. According to Clapper (2010), the role of a facilitator in PBL requires a teacher to move away from passive means of instruction to more active strategies that energize the learning environment to maximize learning. The key is to establish a safe learning environment upfront so that students would be fully engaged with learning activities. An important aspect of establishing a safe learning environment is the need to assess and support one another with respectful communication. For instance, the teacher could provide examples of good respectful communication, model these examples in class and recognize respectful feedback or inquiry throughout the lesson provided by students. One of the faculty interviewees agreed that setting up a safe learning environment at the start of the lesson is important to enhancing effective learning:

“I started my class by encouraging students to ask questions that include ‘stupid’ ones; think out of the box; try new ways or new ideas. I always remind my students no to be afraid to make mistakes in class.

This is the best environment to fail. Throughout the semester, whenever a student was afraid to give a verbal presentation or participate actively in a group discussion with an industry project sponsor, I would remind the student to simply give a try. His or her classmates would also encourage him or her to open up". – A Faculty Interviewee

Involve industry partners at the start of the course, to collaborate, align course objectives, project scope with industry expectations and ensure PBL meets their needs. Pollard (2012) suggests teacher should require the student project team to acquire a sufficiently detailed description of what the project entails from its industry project sponsor and secure an adequate understanding of how deliverables ought to be completed. Besides understanding the project expectation, the teacher ought to keep the student team working and interested in the project, and hold the team members accountable for the tasks assigned to them.

"A major takeaway for us was being able to understand the problems of the industry partner, their specific requirements, and manage to craft a solution to address their needs. In addition, being able to manage expectations as well as communicate with the industry sponsor consistently was key as well". – Year 4 Bachelor of Science (Information Systems) student

"Most of the industry partners did not have much spare time. Therefore, it was important at the start of the course, for faculty to negotiate and work out a mutually agreeable level of time commitment from the industry partners in mentoring the projects during the course". – Year 3 Bachelor of Law student

Well-balanced teams are formed according to the nature of the project and student needs, with appropriate student voice and choice. Sedaghat (2018) highlights a challenge for PBL teachers, is in teaming up students with multidisciplinary projects. According to him, the ideal number of students in each project team is four with two students from each discipline. Moreover, students believe that they can perform better if they are allowed to select their teammates rather than be grouped randomly by teacher. In addition, social/cultural issues are main challenges when forming project teams. For example, some students may refuse to work with others for reasons such as gender bias, lacking in industry experience and varied level of friendship.

"By combining experiential learning with classroom learning, we were able to better appreciate the content and theories we learnt in class. In addition, with the focus on real world project and the setup of interdisciplinary teams, we were able to experience a real-life scenario and worked with a team consisting a wide range of skills and knowledge". – Year 4 Bachelor of Science (Information Systems) student

Champion

Expectation for the performance and Accountability of all students are clearly established and shared with students. Bell (2010) stresses that when students worked collaboratively, there is an expectation from teacher that each student should contribute to the project equally. The group dynamic creates an interdependent team in which students ought to do their part. Hence, peer pressure contributes to the accomplishment of ongoing group tasks throughout the PBL

process and the culmination of a successful final product. Teachers inculcate student accountability through goal setting in PBL, as well as meeting expectations of their peers. As a self-directed learner, students also evaluate their own contributions, efforts, motivations, interests, and productivity levels in the project (Faridah, 2011).

"I have always believed defined learning outcomes and structured activities must be established to support the learning outcomes in collaboration with industry partners. Student learning will be greatly enhanced if a curriculum integrates 'solving a real world problem with guidance from practitioners' with 'concepts and theories in classroom'". – A Faculty Interviewee

Student, industry partners and teacher roles are clarified, with potential challenges highlighted so that students know what they are getting into and they can then make responsible choices. According to Lee et al. (2014), successful PBL adoption requires the teacher, the student and the administrator to reframe their thinking on how learning occurs and what learning and teaching entail. This new thinking may challenge traditional understanding of learning processes with the teacher continues to be content expert, who structures the classroom environment to support student learning, but does not lead didactically (Pecore, 2015). The teacher's belief, view, and preference about the role of content teaching, play a significant role in shaping her instructional behavior (Asghar et al., 2012). Research shows that transitioning from a traditional instructional model to a PBL model is difficult for both the teacher and the student. Bradley-Levine et al. (2010) found that while teachers (and students) understood that the teacher's role was to facilitate the learning process, they still struggled to redefine their roles in the classroom; they wavered between being an expert and authority figure to being a facilitator and guide.

"My key learning objective is the experience of being able to work on a real life problem, gaining insights and advice from a very experience mentor from the external project sponsor and being able to present our ideas to an external client". - Year 3 Bachelor of Economics student

"Our job is to make students understand working with a real-life company has a lot of challenges, as it is difficult to understand a company's process and be familiarised with it over a semester. Also, to learn to discuss, think and analyse situations properly, and find ways to implement metrics that can be useful for a company". – A Faculty Interviewee

"I always know I want to learn how to work with external companies and managing expectations, and understanding how complex business processes can get". – Year 4 Bachelor of Accountancy student

"We had the opportunity to apply our knowledge directly in the real life project with the industry partner. The project experience we obtained was very relevant and it offered a glimpse of what we could expect when we enter the workforce – exactly how real world projects are done, and what approach we may take when handling these

projects". – Year 3 Bachelor of Science (Information Systems) student

Inspire, encourage and stimulate. Haruna et al. (2012) highlight the importance of getting students engaged so as to ensure the richness of PBL is achieved. Stimulating students' motivation is a crucial issue that should be tackled by the PBL facilitator to ensure that students are able to successfully attain the intended learning outcomes. In addition, having a well-designed course and a set of effective learning activities for the whole semester using the collaborative learning approach is essential in maintaining student's motivation to persist at the tasks given (Pan et al., 2019). In PBL, students are trained to be self-directed learners, function effectively in their respective project teams to solve real world problems. The two motivational elements include contextualisation and self-directed learning, which are significant to promote student's motivation (Haruna et al., 2012).

Biggs and Tang (2007) had declared that the importance of task and students' expectation of success are the two primary factors that can make students learn. Students immerse in tasks that seem worthwhile for them and achieving the possibility of success. Students may not want to take a risk if they believe they will fail. It is a norm if students resist when they feel insecure with the PBL approach as they do not possess any prior experiences about PBL. So, facilitator has to steer students' motivation, whether design a course or tasks that students value or structure the promising learning environment to succeed.

"We realized that delivering a real prototype was very different from just conceptualizing an idea. Our professor constantly encouraged us to explore new ideas, conduct more research and most importantly do not be discouraged during the project. We believe we learnt the most by working something out, through getting our hands on that thing or even a simple act of talking to someone who does not have the idea beforehand might give us a new perspective and let us know what is actually required on top of what we might already think of". – Year 3 Bachelor of Business Management student

Facilitator

Encourage students to ask questions and where appropriate, question students' assumptions and approach. Chin and Osborne's (2008) study found that student learning was driven by students' questions. The questions could be classified under four main categories: (1) information-gathering questions which pertained to mainly seeking basic factual information; (2) bridging questions that attempted to find connections between two or more concepts; (3) extension questions which led students to explore beyond the scope of the problem resulting in creative invention or application of the newly acquired knowledge; and (4) reflective questions that were evaluative and critical, and sometimes contributed to decision-making or change of mind-sets. Therefore, the ability to ask the 'right' questions, as well as the extent to which these could be answered, are important in sustaining students' interest in the project.

For improving learner autonomy, the teacher has to motivate and facilitate students to carry out the task willingly and completely. It is worth noting that both the teacher and the students ought to be committed to carry out learner autonomy. The success of promoting learner autonomy depends on having an institutional policy that facilitates learning process and how well learning facilitation is carried out.

“There were more than one way of solving the industry partner’s problems and we had to sieve through all available solutions and considered what data representation could be most useful to the industry partner. Some of these information we found on the internet could be outdated and might not work for them. Through this project, I have learnt what to ask and how to ask the right question. I have also learnt how to research the best possible solution and plan contingency plans in case my initial solution is not what the industry partner wants”. – Year 3 Bachelor of Science (Information Systems) student

“My major takeaway in the project was going to the field to talk to actual business users. This has allowed me to question things that I would typically see on a daily basis but do not really think much about. Talking to people exposes you to different perspectives”. – Year 2 Bachelor of Business Management student

Highlight relevant knowledge and critical thinking gaps. According to Heaviside et al. (2018), it is important for the teacher to offer students an opportunity for thinking creatively and flexibly during PBL session. For example, allowing other students who have different opinions to share their views, may encourage debate and discussion among students.

The aim is to enhance students’ ability to think creatively and flexibly, recognising the need to adapt thinking and knowledge to novel situations. It reflects students’ awareness that learning is continual and solutions in professional practice often require nuanced application of knowledge. PBL lessons may help to establish a learning environment where innovation and creativity was typically observed in students’ behaviour.

“Critical thinking skillset was the most important skillset I learnt through my UNI-X course. We were not given a direction to approach the problem, so we had to think what best worked for the set of data we had on hand. We went through a couple of iterations and only managed to come up with a solution after redoing it a few times”. – Year 3 Bachelor of Science (Information Systems) student.

“We shared with students the values of critique and revision, persistence, rigorous thinking, and pride when doing high-quality work”. – A Faculty Interviewee

“We were given different pain points from our industry partner and supposed to make use of the data and came up with a solution. I felt that throughout the entire process, I had developed problem solving skills which is an important skill set to master”. – Year 3 Bachelor of Science (Information Systems) student

Manager

Ensure the project progresses as per schedule. The teacher plays the role of a project manager who is engaged in the project process and tasks, dealing with project team members as well as coping with a variety of stakeholders within and outside the organisation (Turner and Muller, 2003). According to Pollard (2012), the focus of a project manager is on team building, group dynamics, planning, scheduling, creating a work breakdown structure, allocating resources, managing project changes and generally, managing the team throughout the project process.

“Checkpoints can present difficult choices. Every checkpoint analysis requires an objective examination of the project to date. This can be a difficult task for the project manager and the team who have so much invested in every project. In the end, checkpoints can provide a much needed safety net to prevent wasted time and resources”. – A Faculty Interviewee

Help resolve conflict and reach an agreement. According to Oakley et al. (2004), the most common causes of group conflicts are that team members refuse to do their share of the work, a domineering team member tries to coerce the others into doing everything in a specific way or a team member refuses to participate or even tries to sabotage the work. Chan and Chen (2010) studied reasons behind conflict in teamwork in an undergraduate college program in foreign language teaching in Taiwan. They identified the following causes of conflicts: poor communication, poor task management, unfair work allocation, unequal treatment, being egocentric, having different values and finally, lack of sense of responsibility and initiative. Other interesting work from the field of business education includes a pedagogical framework developed by Keyton and Beck (2008), which allows students to self-evaluate their group interactions and processes such as leadership, decision making and conflict management.

Hitchcock and Anderson (1997) studied how tutors can intervene when medical student groups become dysfunctional. They presented an intervention model with four levels. First, after recognizing problems in a group, the tutor should try to correct the problem by asking questions and trying to involve all students. If the problem persists, the group should be interrupted to acknowledge the problem as well as brainstorm potential solutions. If this fails, the tutor should impose non-negotiable rules for work in the group. This could include attendance, punctuality, thinking aloud and using the white board. Finally, outside assistance is sought, for example a mediator or counselor.

“Having a willingness to trust and openly listen to alternative ideas and views is essential for collaboration to be successful. Being close-minded can create and prolong conflict in a project”. – A Faculty Interviewee

Assessment rubrics are used to guide both formative and summative assessment. Unlike other forms of learning, PBL treats the output of project work as a major learning outcome. Assessment procedures are embedded in the learning process, focusing on authentic tasks and taking into account the learners’ individual orientations and fostering their meta-cognitive skills (Hansen et al., 2003). In so doing, it takes students’ various learning styles into account to increase learning effectiveness. As students enter the workforce, they will be judged not only on their performance outcomes, but also on their ability to collaborate, negotiate, plan and organize. PBL effectively equips students with this toolbox of skills and prepares them to be successful in the workplace.

“Formative assessment, both formal and informal, is used to monitor students’ progress. Summative assessments provide information at the student, classroom, and school levels. When closely tied to curriculum and instruction, summative assessment provides information about a student’s achievement of specific learning outcomes. Summative assessments can provide critical information about students’ learning at the end of an interval of instruction, as well as an indication of the quality of classroom instruction,

especially when they are accompanied by other sources of information”. – A Faculty Interviewee

Table 1: Key Teacher Roles in a PBL Course

Role	Description of Role
Designer	<ul style="list-style-type: none"> • Create, support and model a safe learning environment where students feel valued, trusted and respected during the learning process. • Involve industry partner at the start of the course, to collaborate, align course objectives with industry expectations and ensure the pedagogical approach (knowledge, skills & behavior) meets their needs. • Well-balanced teams are formed according to the nature of the project and student needs, with appropriate student voice and choice.
Champion	<ul style="list-style-type: none"> • Expectation for the performance and accountability of all students are clearly established and shared with students. • Student, industry partners and teacher roles are clarified, with potential challenges highlighted so that students know what they are getting into and they can then make responsible choices. • Inspire, encourage and stimulate.
Facilitator	<ul style="list-style-type: none"> • Encourage students to ask questions and where appropriate, questioning students’ assumptions and approach. • Highlight relevant knowledge and critical thinking gaps.
Manager	<ul style="list-style-type: none"> • Ensure the project progresses as per schedule. • Help resolve conflict and reach an agreement. • Assessment rubrics are used to guide both formative and summative assessment.

Role of Student

Self-directed Learner

Students regularly self-assess their progress in project. According to Liuliene and Metiuniene (2014), self-assessment is the key element of the learning process in a project team, as it implies reflection on one’s role in team activities and, through those activities, on one’s progress in a number of learning skills. Self-assessment may also lead to critical thinking and (positive or negative) positioning of the individual against a task and a team (Lanthon et al., 2018). PBL creates multiple opportunities for students and teachers, to reflect upon various stages of project progress and to employ the spirit of the team for the best results.

“We were given the project issue and we had to work on it. Initially, we did not know how to apply our knowledge to the project scenario. After that, we had a few talks with our industry partner, conducted online research and look at various ways of how other people were doing such kinds of project before. We took a lot of initiative to learn things apart from what was taught in class and curriculum, and we applied that to a project and draw solution to the client”. – Year 3 Bachelor of Science (Information Systems) student

Students are directed by the teacher only to the extent necessary when working in project teams. According to Yulianil and Lengkanawati (2017), both the teacher and the student have to be mindful of the importance of being autonomous in learning. The teacher has to facilitate the learners to be responsible in determining the learning activity, the material resources, the assessment technique and reflection. In other words, the teacher ought to encourage learners to be actively involved in the learning process so that learners can promote their learner autonomy. This may mean student groups involving in activities that include doing the project based on the schedule, searching for material from various sources without much direct control of the teacher. Ramirez (2014) proposes that PBL has a positive influence on the increase of learner autonomy to discuss and exercise more choices and control over their learning process. As a result, learners interact and learn from their own mistakes whenever they are given meaningful choices and control of their learning.

“As we had to work in groups, it became essential for me to take initiative to move the job, to clarify doubts for the project requirements and to be more self-directed. It also helped us to coordinate properly as our group did not meet often so we needed to coordinate very well in order to come up with a solution”. – Year 4 Bachelor of Accountancy student

Be committed and motivated to complete project. According to Blumenfeld et al. (1991), the components of student interest may consist of one or several of the following: (1) Variety and novelty of tasks; (2) Authenticity of problem; (3) Complexity of problem; (4) Ending of project; (5) Freedom to choose on how to perform the project; and (6) Opportunities of collaborative work. Tasks that have clear closure are authentic and complex, and tasks that enable freedom to choose how to work, have higher probability to raise and sustain student motivation for a long time.

Bell (2010) notes students enjoyed PBL as it encourages greater understanding of a topic and it increases students' motivation to learn. As students define problems and generate questions, they developed a sense of ownership of the learning process. According to Ryan and Deci (2000), the experience of “agency, belonging and competence”, which are pre-requisites of intrinsic motivation, are at the core of project-based pedagogies.

Hilvonen and Ovaska (2010) also concur that students are more motivated to bring out and test their ideas and increase their level of understanding when they are confronted with authentic projects in PBL. In addition, students may feel “ownership” towards the project when they have the chance to raise questions to solve the project on their own (Blumenfeld et al., 1991).

According to Pan et al. (2017), the complexity of the project relates to the novelty of the problem domain and to the concreteness of the problem which is included in the project. The problem should not be too abstract or novel to the students, since excessive complexity might kill the motivation of the students.

Seow et al. (2019) also suggest the environment of the PBL course relates to the time and place where the PBL course was implemented. If the time of the PBL course is very busy for students, it can decrease the motivation towards the project. Additionally, if the physical environment (classrooms, meeting rooms etc.) is not suitable for teamwork, it might decrease the quality of the teamwork and thus, decrease the motivation level of the students.

In addition, the teacher plays an important role in improving students' motivation in PBL (Pan et al., 2019). If the teacher can give responsibility and support to students for conducting the project, it can develop a sense of agency for them and increase student motivation. If the teacher gives all the control to students and offer little support in the project, students might feel too much pressure, which might decrease the motivation. The support from the teacher can be as simple as being around in project meetings or giving a couple of supportive utterances to them.

“Learning in classroom would not be as engaging and ‘hands-on’ as we would not be able to interact with industry partners. Without the interaction, it would not have given us the taste of a real-life scenario and would instead be much theory driven. Often we were motivated by real-life users of our solution to validate our solutions to determine their feasibility. Also, project scenarios that we would have used if it was a conventional module would have had several controlled conditions and we would need to make various assumptions when crafting our solutions. This is different from situations when we get to work with a real client, the problem is more detailed and more challenging as they have several external factors and conditions that make the issue more complex. This would normally push us to propose a thorough and tailored solution”. – Year 4 Bachelor of Science (Information Systems) student

“Participants also felt that through the project experiences with industry partners, they have learnt to better delivering a real world project. This is because in their UNI-X course projects, they had to show a lot of initiative and self-direction and were not spoon fed with what to do, and therefore, became more confident in handling projects on their own.” – A Faculty Interviewee

Reflect what is learnt in project. Valli (1997) proposes “five levels of reflection”: (1) Technical Reflection: Students write specifically about course content matter and conceptual ideas and problems; (2) Reflection in and on action: Students reflect on their performance in the class, both in teams and individually; (3) Personal Reflection: Students discuss and chronicle personal growth, changes in attitude and epistemologies, and evolving relationships with other students; (4) Deliberative Reflection: Students look beyond the course content and make connections with other disciplines and other areas; and (5) Critical Reflection: Students reflect on the construction, operation, and power structures of the course and classroom and provide constructive criticism to improve the learning environment.

PBL pedagogy may lead to changing traditional power structures within the classroom and blurring the lines between the teacher and the student, re-envisioning these roles. Hence in a PBL setting, reflection may involve students examining the construction of the course, teaching methods used to deliver the content, their own empowerment, and the extent to which they are actively engaged in and driving their own learning and education.

“When I reflected on my learning journey in this course, what I found very useful was that the UNI-X course has provided me an environment to apply theory to practice. Through the project experience, I had the opportunity to see how internal audit in companies were conducted from concept to completion. Besides, I also had the chance to review and recommend processes for better

governance and accountability. I truly appreciate this complete understanding of the whole audit flow which I firmly believe will be useful for my future work”. – Year 4 Bachelor of Accountancy Student

Warrior

Endure projects that are naturally ambiguous and have no obvious plan and certain answer. According to Seow et al. (2019), students in PBL need to be capable of coping with the ambiguity of the not-yet-known; recognizing that how a situation emerges crucially shapes its meaning and interpretation. Students should strive to possess sufficient adaptive capacity and resilience to handle the level of environmental complexity and change found in many projects. The PBL pedagogy supports and fosters continuous change, creativity, self-organized networks and critical reflection. It also helps to cultivate the emotional skill to create buy-in and provide orientation even in complex, unknown and uncertain environments. Thus, students need to learn and practise how to lead the changes into an unknown future. Furthermore, they need a learning environment that fosters critical reflection on theory while they engage in practice on an ongoing basis and within self-organizing networks of self-managing teams that continuously empowering each other (Zancul et al., 2017).

“After doing rounds of prototyping, there were still changes. I realized that what we initially thought was correct might not be right in the first place. Throughout the several rounds of iterative changes, I found that I had improved my adaptability skills and I have become more resilient and better prepared to face any failure”. – Year 3 Bachelor of Business Management Student

“The project requirements were not always clearly set right from the start, which is understandable given that it was a real-life scenario. Hence, we needed to be adaptable to the additional information provided along the way. When faced with concepts that we were unfamiliar, we needed to discuss within our team to improve our understanding as well as to do additional research so as to bridge gaps before we proceeded with the project”. – Year 4 Bachelor of Science (Information Systems) Student

“With projects in UNI-X courses, we had to work with real problems and we realized that along the way, project directions might change. My initial project scope was to look at cost savings. However, as we progressed, we found that there were more important issues to address rather than just cost savings, so we took a different direction. We learnt to accept that changes are inevitable”. – Year 3 Bachelor of Business Management Student

Students understand there is no single “right answer” or preferred way to do the project, and that it is fine to make mistakes and learn from them. Some students in a PBL course may be reluctant to take risks in their projects as long as there is no single and obvious answer to be found. A way to reduce students’ risk-aversion in PBL is to adopt a rubric that values problem-solving, planning, and resilience during most project activities (Clapper, 2010). Essentially creating a learning environment where failure is just another opportunity to try again and improve.

“Sometimes, what I prepared was thrown out of the window after presented to the project sponsor. In such cases, I have learnt ways to adapt my answers based on my research and consider how to better answer project sponsor’s question using what I have previously prepared. I feel that this is not something I could learn in classroom or exam setting. This is real life and in real life, you cannot be prepared for everything. You just have to learn how to adapt along the way”. – Year 3 Bachelor of Law student

Table 2: Key Student Roles in a PBL Course

Role	Description of Role
Self-directed Learner	<ul style="list-style-type: none"> • Students regularly self-assess their progress in project. • Students are directed by the teacher only to the extent necessary when working in project teams. • Be committed and motivated to complete project. • Reflect what is learnt in project.
Warrior	<ul style="list-style-type: none"> • Endure projects that are naturally ambiguous and have no obvious plan and certain answer. • Students understand there is no single “right answer” or preferred way to do the project, and that it is fine to make mistakes and learn from them.

Role Conflict

Several teachers we interviewed mentioned that they had experienced role ambiguity and conflict especially when delivering PBL courses. According to them, it was common for teachers to play both facilitator and manager roles in projects. This meant that besides facilitating student learning in their projects, teachers also had to play the role of an assessor, grading students’ performance in projects. Role conflict occurs when teachers often face the dilemma of deciding, to what extent of guidance they should render to assist students in completion of their projects. After all, students should complete the projects independently with minimum assistance from their teachers. According to one of the faculty interviewees:

“We were not supposed to give students direct answers in their projects. We ought to encourage them to experiment with a few options and come up with their own solutions. I felt as an teacher, our role was to facilitate and guide them in achieving the project progress and completion but often I was also guilty of offering too much assistance I thought I ought to be giving”.

Although in certain projects the boundaries of the teacher’s and the student’s roles were relatively clear from the start, in others the students needed to figure it out along the way. This is illustrated by the following quote from a student interviewee:

“Some teachers were very involved in students’ projects. Other teachers said: “just figure it out”. They would tell the student team: “you know this is independent learning, so you have to figure out yourselves on how to complete your projects”.

Role conflict might also be reflected in the teacher's uncertainty about his or her authority during the project. For instance in the case of UNI-X, even though the teacher had to facilitate student learning and assess students' performance in the project, he could not deviate too far from the project sponsor's request. In another scenario, students also mentioned that they were confronted with conflicting demands by the teacher and the project sponsor on a few occasions. This occurred when the teacher insisted the student team to adopt her advice in the project, when her advice went against the project sponsor's instruction. This has put the student team in a difficult situation because on the one hand, the student team had to satisfy the project sponsor's requirements in the project. On the other hand, students had to follow the instruction of the teacher in completing the project. As students were accountable to both the teacher and the project sponsor, they found it hard to satisfy both parties and manage their relationships. Such role conflict, resulting from having dual reporting lines, might negatively affect students' project performance and learning experience. According to one of the student interviewees:

“When the unpleasant situation arose in which there was a clash between the demands of the teacher and the project sponsor, it was often up to us (the students) to come up with a solution to meet the differing demands of both parties. This might lead to adding requirements in the project, which often caused more pressure on the student team”.

Conclusion and Implications

This paper presents an empirical study on the role perspective of PBL in a collaborative project environment. By drawing upon a case study of UNI-X, we argue that the teacher plays the roles of a *designer*, *champion*, *facilitator* and *manager* in a PBL course. To ensure learning is effective, students should play the roles of a *self-directed learner* and a *warrior* when completing their projects. It is clear that role ambiguity and role conflict could occur in PBL courses and might even impact the effectiveness of student learning.

For researchers, this paper contributes to the PBL literature by introducing a role perspective of PBL. Our study identifies a list of roles the teacher and the student could potentially play in a PBL setting. Such understanding could serve as a reminder for the teacher and the student for the roles they need to play in achieving learning outcomes of a PBL course.

While our study has shown that role ambiguity and role conflict could give space for teachers and students to define their role expansively, which could in turn benefit the performance of student teams in a PBL course, we also highlighted that role conflict and role ambiguity may lead to negative effects such as stress, lower commitment and lower performance in student teams. In addition, with a dual-leadership PBL structure, it is possible that the teacher and the project sponsor may act separately. This may increase the risks of conflict, including interpersonal conflict within the student project team, which in turn, makes it more difficult for the students in the team to act coherently. This is a major contribution to PBL literature, especially when there is almost no empirical study that has examined role ambiguity and role conflicts in a PBL course.

For educators, this study offers useful insights to understanding the roles ought to be played by the teacher and the students so as to ensure an effective PBL course. In anticipation of the role ambiguity and conflicts in a PBL course, educators can devise useful actions to overcome role conflicts during project design and facilitation phases. For example, the teacher, students and

project sponsor could highlight and discuss potential role conflicts at the start of the course and devise a set of agreed upon behaviours and actions to overcome the risk of role conflicts during PBL course.

A limitation of this study concerns the generalizability of a single case study. While a multiple case-study design over a single case-study design for obtaining more compelling and robust data is generally preferred, it is not easy to obtain the opportunity for a multiple case-study design. Therefore, we posit that “one must follow a more opportunistic approach even if that means settling for a single case study” (Keil, 1995, p. 447).

Another limitation of this study is related to Asian cultural reticence that may generate cultural barriers to effective student leaning in PBL (Gwee, 2008). This cultural phenomenon might have some influence over our results and findings. Asian cultures have strict rules of behaviour and a single definition of truth. There is very little tolerance for uncertainty and ambiguity in teaching materials (Hofstede, 1986). Students see knowledge as something to be transmitted by the teachers. They expected the teachers to tell them exactly what to read and assign clearly defined tasks. Thus, the active learning process and the new role of teachers as facilitators often produce anxiety and disengagement amongst them (Wang and Farmer, 2008). While we acknowledge cultural influence could be present, we believe mitigating mechanism present in our case such as having a conducive and supportive learning environment for students, might have minimized the impact.

Finally, while this study represents an important step toward understanding the role perspective in PBL setting, longitudinal field studies that involve multiple case studies are clearly called for, to reflect the diversity of learning dynamics. In particular, future studies may validate the list of roles and actions taken by the teacher and the student in PBL courses in other education institutions. Future research should also explore possible interventions against the role ambiguity and role conflicts in a PBL course.

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