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**Inquiry into the Structure and Mechanism
of Problem-Based Learning**

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Chapter 1 Introduction

1. Background of the Study

(1) Overview of Recent Trends in Higher Education

Critical thinking and problem solving abilities are imperative for professionals who ought to thrive in the 21st century. An increasingly changing globalised economy demands capable university graduates with a solid knowledge base and skills that are broadly applicable in real-world settings. Society, therefore, needs people who can not only respond quickly to questions that have only one correct answer fixed in advance, but also can identify a set of best possible solutions among multiple choices that seem intricately entwined.

Higher education institutions around the globe are exposed to the constant pressure of meeting such transnational demands by fostering capable human resources. This situation is even more harsh in Japan, where the population is ageing and shrinking more rapidly than in any other country. Japanese universities cannot survive without attracting and accommodating students from secondary schools as well as from the public at large. In other words, the *raison d'etre* of universities is being severely tested in Japan.

The lecture is still the dominant style of teaching throughout the world (McKeachie and Svinicki 2006), and Japan is no exception (Kino 2009). Teaching has been traditionally viewed as being less important than research by faculty members in Japan (Kitamura 1988; Akahori 1997; Yamauchi 2002). However, given the internal and external threats mentioned above, Japanese educators became aware of the seriousness of the problem. In the past decade or so, some Japanese universities have established affiliated centres on campus that specialise in research on lesson improvement in college education (Takahashi and Ishii 2013). Among a

variety of pedagogical styles, problem-based learning (PBL) has been highlighted as an effective alternative approach to enhance the quality of teaching and learning. For example, Mie University, a national university located in a western part of Japan, has adopted PBL as a university-wide endeavour since the late 2000s to help students become self-directed and lifelong learners.

With an even keener sense of crisis, the Ministry of Education, Culture, Sports and Technology (2013) recently stipulated in its policy papers that what is urgently needed for university education in Japan is to train and enable students to acquire specialised knowledge and skills necessary to identify problems with no right answers but come up with optimal countermeasures. The Ministry continued claiming that teaching in university should shift to being more practical, interactive, problem-based, and thought-provoking so as to stimulate and encourage students' intellectual growth.

(2) History and Definition of Problem-Based Learning

PBL is not a new approach. It has historical roots in university education in North America. It was developed in the 1960s as a solid alternative to the traditional form of lecture-oriented teaching in Canadian medical schools (Birch 1986; Maxwell et al. 2004; Loyens et al. 2008). PBL was aimed at addressing the problem that learners could not gain practical knowledge through conventional instruction. It adopts a learner-centred approach in which learners are guided to take the initiative to solve problems by interacting with their peers in group settings. To date, PBL has gained increased attention and acceptance in a wide range of educational institutions and disciplines across borders (Savery 2006; Annerstedt et al. 2010).

Birch (2000) mentioned that PBL seems even better able to conform to social sciences that have no definitive solutions but need to be tackled nonetheless. Takeda and Hayashi (2006) insisted that such ambiguity and difficulty that do not exist in learning in natural sciences

would rather develop thinking and reasoning skills of learners.

Originally, Barrows and Tamblyn (1980) defined PBL as ‘the learning that results from the process of working toward the understanding or resolution of a problem’ with two pedagogical objectives: ‘the acquisition of an integrated body of knowledge related to the problem, and the development or application of problem-solving skills’ (pp. 1, 12). Rhem (1998) described PBL as a pedagogical strategy wherein learners confront contextualised, ill-structured problems and strive for feasible solutions through group work. Van Berkel and Schmidt (2000) defined it as an approach to professional education that stresses the use of real-life problems, encourages learners to discuss them, and makes the learning opportunity constructive and meaningful. Recently, Ramsay and Sorrell (2007) defined PBL as a learner-centred instructional method that enhances one’s ability to analyse, synthesise, and evaluate problems.

This study initially follows the definitions of PBL put forth by these researchers, and by Barrows (2002) who also claimed that it is ‘an engaging and motivating way to learn as the learner works with problems that are challenging and perceived as relevant’. However, a new definition of PBL, from a viewpoint different from that of previous research, will be added as this research unfolds in subsequent chapters. Distinctive characteristics of PBL will also be mentioned.

2. Objective of the Study

The aim of the research is to unravel the structure and mechanism of PBL from a holistic perspective. To this end, the author will elucidate the process and meaning of PBL that university students may experience, and will finally build a hypothesised comprehensive model of learning generated through PBL.

While this paper was primarily based on the case studies implemented in university

settings in Japan, the author firmly believes that its original findings will go beyond borders, will be of interest and use to a broader readership, and will contribute to enhancing the global understanding about the yet-untouched domain of PBL.

3. Method of the Study

This study was carried out using both qualitative and quantitative methods.

In Chapter 2, a literature review was conducted in line with the steps of open coding stipulated by Strauss and Corbin (1990). This approach, also known as grounded theory, serves to guide the research process and offer a heuristic for data analysis and interpretation (Miller and Fredericks 1999).

Chapter 3 was written as a qualitative case analysis (Creswell 1998; Cohen et al. 2000). This method provided a rich, in-depth description and an insightful interpretation of the case examined.

Chapter 4 includes a quantitative case analysis to complement and support the findings of the third chapter. The author performed a statistical analysis based on quantitative data collected in the form of Likert scale questionnaires.

Chapter 5 is a general discussion; theoretical analysis was conducted for deeper deliberation and development of a conceptual framework of learning engendered through PBL.

4. Organisation of the Study

This study consists of six chapters and is organised as follows:

Chapter 1 is an introduction that presents the background, objective, method, and organisation of the study.

In Chapter 2, a literature review provides an overview of PBL research, including an

extensive knowledge base upon which the study was built. Chapter 2 identifies, critiques, and synthesises past research and suggests some topics for future research.

Chapter 3 presents two quantitative case studies implemented in two different universities. The author demystifies the process and meaning of PBL experienced by students from the perspectives of cognitive, social, and internal aspects.

Chapter 4 illustrates mainly through an analysis of variance that a learner's internal inspiration evoked through peer discussion seems to be a key enabler that guides him or her to the threshold of personal transformation. A comparative analysis is also made between individual PBL and group PBL.

In Chapter 5, the author proceeds to an overall discussion based on discoveries made in the previous chapters and finally develops a hypothesised but elaborative model of learning generated through PBL from a comprehensive viewpoint.

Chapter 6 briefly summarises and concludes what this study identified, clarified, and developed throughout the preceding chapters. It also suggests the direction of future research on PBL.

Chapter 2 Literature Review

1. Introduction

Over the past few decades, PBL has gained increased attention and acceptance in a broad range of educational institutions and disciplines (Savery 2006; Annerstedt et al. 2010). Numerous research has been accordingly conducted so far. It is then opportune and necessary to conduct a literature review on what is known and needs to be known in PBL to advance future research. More specifically, this paper attempts to answer the two research questions below.

- (1) What aspects have been researched in PBL?
- (2) What aspects need to be researched in PBL?

Fenwick (2002) and Hung (2011) stressed that most existing literature on PBL has dealt with the cognitive aspect of learning, such as student outcomes and achievement. Consequently, meta-analyses on PBL have focused mainly on the cognitive aspect as well (Goodnough 2006). However, learning is not only composed of the cognitive aspect, but also other aspects, such as social and internal aspects (Cazden 2001). Therefore, there is a strong need to investigate the findings of past literature from multiple other perspectives.

To this end, the authors utilised the online database of the EBSCOhost to retrieve a list of articles from reliable journals of major publishers, based on a key word search for ‘problem-based learning’. Abstracts of the articles presented in the search results were read by the author, and papers were selected according to the following criteria:

- The article addressed PBL implemented in higher education;

- The study addressed face-to-face instruction, not an online mode of PBL;
- The paper was peer-reviewed.

As a result, 99 papers were selected, and from their references, other relevant literature was also extracted. Additionally, six books and one report with ‘problem-based learning’ in their titles were included in the review. The author then read them, highlighted the results, discussions, and conclusions, and classified each paper in line with the steps of open coding stipulated by Strauss and Corbin (1990). Through this analytic process, six major themes emerged within the large context of the data, namely, 1) motivation and engagement, 2) understanding and achievement, 3) generally applicable skills, 4) interaction and collaboration, 5) design and implementation, and 6) self-discovery and transformation. The next section describes each theme.

2. Themes

(1) Motivation and Engagement

Barrows (1986) originally claimed the four most important educational objectives attainable with PBL in a medical curriculum as follows: (1) structuring knowledge for use in practical contexts, (2) developing an effective reasoning process, (3) developing self-directed skills, and (4) increasing motivation for learning. Many studies have acknowledged that PBL promotes students’ motivation and engagement for learning (Kolmos 1996; Colliver 2000; Segers et al. 2003; Hallinger et al. 2010; Klegeris 2011). Thus, argument for the effect of PBL on students’ motivation seems highly conclusive (Norman and Schmidt 1992).

Concerning the mechanism leading to increased motivation, researchers explained that real-life problems serve as the stimulus for the contextual interest and curiosity of learners whose prior knowledge is further activated in small-group discussions. Then, with proper

scaffolding provided by a facilitator, each individual student constructs and reconstructs new knowledge through the cycle of self-study and group work (Hung 2011; Schmidt et al. 2011). This type of participatory learning is reported to be fun, enjoyable, exciting meaningful, and comfortable (Hussain et al. 2007). Students who experienced PBL were found to be more satisfied with their learning style compared to those who received traditional instruction (Gurpinar et al. 2010). This is because students can learn from peers, monitor their own thought process, and have a greater sense of ownership and control over their learning (Savery and Duffy 1995; Downing et al. 2009). Cognitive and social satisfaction enhanced in such a way may develop into higher motivation to continue learning the same subject and beyond (Sobral 1995). Consequently, PBL students tend to express more appreciation toward faculty and have more positive attitudes toward their learning in comparison with those enrolled in a conventional curriculum (Kaufman and Mann 1996).

PBL has much in common with cooperative learning. Johnson, Johnson, and Smith (1998) claimed that cooperative learning is the heart of PBL. Slavin (1996) developed a conceptual framework of cooperative learning leading to enhanced learning with four major theoretical perspectives: motivational, social cohesion, cognitive, and developmental. In the motivational perspective, a group needs to work together to attain each member's personal goal for higher achievement as a reward. While Slavin did not elaborate on the various aspects of motivation, Biggs (1999) categorised it into four types: extrinsic, social, achievement, and intrinsic. Among them, he insisted that intrinsic motivation promotes deep learning and sound academic outcomes, irrespective of any rewards. Such a deep approach associated with intrinsically raised interest and inquiry can drive learners to seek more personal meaning in their current tasks in relation to their future profession (Prosser and Trigwell 1999). Vernon and Blake's (1993) meta-analysis of 35 studies comparing PBL with traditional teaching methods reported that PBL students place more value on meaning than on memorisation

compared to others in conventional programs. Thus, PBL may appeal to students' intrinsic motivation, enhance deep and meaningful learning through self-directed and collaborative study, and eventually produce substantial achievement.

Jones et al. (2013) extracted from a qualitative data analysis three elements affecting students' motivation in PBL, namely, problem design, group experience, and an advisor. Dolmans et al. (2005) similarly referred to three components of PBL influencing educational practice, that is, the problem, tutorial group, and tutor. While these studies were not intended to detect which element or component affects learners' motivation the most, Van Berkel and Schmidt (2000) ascertained, using a structural equations modelling approach, that the quality of problems has the largest impact on intrinsic motivation, concluding that strong engagement in PBL seems to be a potent determinant of student achievement.

In sum, PBL contributes to increasing learner motivation, especially intrinsic motivation, and bringing about deeper learning. This mechanism possessing some variables has been elucidated to some extent. Still, there seem to be always a certain number of students in a classroom who struggle to fit into the group despite their willingness to participate; yet, little attention has been given to how faculty or tutors can encourage such students in group work. Kaufman and Mann (2001) depicted their experiences of motivating a student who was academically positive but negative toward teamwork. In their study, that student started to actively participate in group work once he understood the rationale for collaboration. Be that as it may, it is critical to study how teachers can support a student who sincerely wishes to participate but lacks the social skills to do so. How can they guide a student with such inclination during the group session? What kind of prior training should be provided for both faculty and students? As not all students are easily motivated, further research needs to be conducted to answer these questions.

PBL enhances the enthusiasm and engagement of not only students but also teachers

(Bernstein et al. 1995; Kaufman and Mann 1996). Faculty who adopt PBL approaches generally enjoy being close to students (Albanese and Mitchell 1993; Mennin 2003). Increased student contact is thus a contributor to faculty satisfaction, and such satisfied faculty are likely to be more motivated to learn from student discussions (Quinlan 2003). However, are faculty stimulated to learn only from interactions with students? Do they also learn before or after class, that is, outside of the classroom? How do they view and enjoy each stage of preparation, implementation, and reflection? What do they learn? These are questions to be answered to improve the whole process and outcome of PBL. In other words, while most existing research focuses primarily on students' motivation, engagement, and learning, little attention has been paid to the same areas for teachers, who are crucial agents of PBL. As teaching, in essence, is the learning profession (Sykes 1999; Sato 2009), the concept of faculty as 'learners' emerges as a subject of future research in the area of PBL.

(2) Understanding and Achievement

Understanding and achievement relate to the cognitive aspect of teaching and learning. Concerning this aspect, research on the outcomes of PBL in comparison with traditional instruction is inconclusive (Colliver 2000; Macdonald and Isaacs 2001; Newman 2003; Mennin 2003; Gijbels et al. 2005; Savery 2006; Hmelo-Silver et al. 2007; Hung et al. 2008). Or rather, PBL has been said to be even weaker than traditional methods in terms of the quantity and depth of the knowledge students acquire (Bernstein et al. 1995; Lee and Kwan 1997). Many researchers referred to the conclusions derived from two seminal meta-analyses conducted in the early 1990s by Albanese and Mitchell (1993) and Vernon and Blake (1993). Even relatively recent case studies showed no statistically significant difference in test scores on academic achievement between PBL students and traditional curriculum students (Segers et al. 2003; Gurpinar et al. 2010). On the other hand, a cross-disciplinary meta-analysis

showed that PBL students tend to perform as well as or better than lecture-based students when subject matter is outside the field of medical education (Walker and Leary 2009).

Thus, while PBL effects on knowledge acquisition are mixed, those on knowledge application and retention are quite clear. Norman and Schmidt (1992) averred that PBL enhances self-directed learning skills and knowledge retention. Vernon and Blake (1993) found that the practical performance of PBL students is better than that of conventional students. Albanese and Mitchell (1993) also insisted that PBL graduates perform as well as or better than their traditional counterparts. Dochy et al. (2003), who conducted a meta-analysis on the effects of PBL, summarised that PBL is instrumental in knowledge application (i.e. skills) rather than knowledge acquisition. They also pointed out that PBL students tend to gain slightly less knowledge but keep more of the knowledge they acquire. Capon and Kuhn (2004) somewhat corroborated these findings through a case study comparing PBL with lecture/discussion settings. They found that PBL is not remarkable in acquisition or instant recall of new information, but it is superior in the integration of new concepts with existing knowledge structures. Furthermore, Strobel and Van Barneveld (2009) carried out a meta-synthesis of meta-analyses, concluding that PBL outperforms traditional curricula with regard to students' skill development, performance improvement, and long-term knowledge retention.

Gijbels et al. (2005) offered another meta-analysis on the effects of PBL from the viewpoint of assessment. This analysis revealed that PBL has the largest effects when the assessment targets the understanding of principles that link concepts. PBL seems particularly effective in developing students' understanding of underlying principles (Askell-Williams et al. 2007). These assertions are basically consistent with the concept of deep, rather than surface, learning that is an active search for understanding and meaning (Spencer and Jordan 1999; Prosser 2004). More concretely, students in PBL tend to understand content by relating

it to their own experiential frameworks so that the content becomes more relevant and meaningful to them (Fyrenius et al. 2005). PBL indeed promotes students' 'sense making' (Capon and Kuhn 2004), and such deep cognitive processing may even result in conceptual changes for learners (De Grave et al. 1996).

In addition to the studies looking into the effects of PBL, research on the process of PBL has been conducted as well. For example, Schmidt (1983) clarified seven steps in PBL: clarifying terms and concepts, defining the problem, analysing the problem, preparing explanations, formulating learning objectives, collecting additional information, and synthesising and testing newly acquired knowledge. Likewise, Birch (1986) identified six steps: problem recognition, initial formulation of the problem, description of the problem situation, identification of key relationships, identification of solutions, and evaluation of solutions. In recent research, Ramsay and Sorrell (2007) enumerated seven steps: case or problem statement, questions, action plan, investigation, tentative evaluation, final product, and final evaluation and feedback. Massa (2008) narrowed the steps down to four: problems analysis, self-directed learning, brainstorming, and solution testing. Yew and Schmidt (2009) simplified it even further by identifying three phases: problem analysis, self-directed learning, and reporting. Thus, while the categorisation of PBL steps varies from researcher to researcher, learning in PBL is a cumulative process in which the learning in each step or phase is based on knowledge constructed in a previous one (Yew et al. 2011).

Considering the process of PBL as a cognitive endeavour, Schmidt et al. (2011) conducted a literature review focusing selectively on what happens to learners in PBL and concluded that individual study and group collaboration contribute equally to student achievement. In the course of reaching this conclusion, they elucidated how students learn in PBL, referring to the path model developed by Yew et al. (2011) that includes prior knowledge as an independent variable, concepts recalled in three different phases as intermediate variables, and

achievement as a dependent variable. Van Berkel and Schmidt (2000) proposed another path model of PBL which includes the amount of prior knowledge, quality of problems, and tutor performance as input variables, tutorial group functioning, group attendance, and time spent on individual study as intervening variables, and achievement and interest in subject matter as output variables.

These two are the statistical models that demonstrate the comparative strength of direct and indirect relationships among variables (Lleras 2005). The findings detail the relative contributions of various factors in PBL (Norman and Schmidt 2000). However, the path analysis itself cannot prove causation or even determine whether a specific model is correct; it can only offer support for whether the data fit the hypothesised model (Streiner 2005). Therefore, the model may not precisely mirror what is happening to learners in reality (Norman and Streiner 2003).

In this regard, previous research has yet to reach theory construction in the cognitive aspect of PBL. That is, there is still plenty of room for more detailed research concerning the mechanism of learning in PBL. For instance, students' situational interest serves as a driving force but declines over the course of PBL (Schmidt et al. 2011). Then, what can act as a continuous propulsive power for student learning when their interest begins to decrease? How is new knowledge created among students who initially possess little prior knowledge? What are the characteristics of knowledge created in PBL? These questions should be answered based on more theory-based studies. Dolmans et al. (2005) verified that modern learning principles of constructive, self-directed, collaborative, and contextual learning also apply to PBL. Yet, as they stressed in their article, more research needs to be undertaken to illustrate the theoretical claims and constructs behind PBL practices. Additionally, researchers can revisit the recognised weakness of PBL regarding students' acquisition of systematic knowledge. They need to pursue the question of how PBL can best be implemented in

combination with lecture-based instruction within a single course or a whole curriculum to help students obtain basic subject matter knowledge in a more orchestrated fashion.

(3) Generally Applicable Skills

PBL enables students to acquire a wide variety of skills as well as domain knowledge (Nel et al. 2008). Practical and flexible skills are necessary for professionals to thrive in a knowledge-based society as lifelong learners (Hmelo-Silver et al. 2007). It has been extensively recognised that PBL can help students develop (1) critical thinking and reasoning skills (Bradbeer 1996; Lieux 2001; Hmelo-Silver and Barrows 2006; Parton 2008; Lin et al. 2010; Kek and Huijser 2011), (2) metacognitive skills (Savery and Duffy 1995; Gijsselaers 1996; Kumar and Natarajan 2007; Downing et al. 2009; Downing et al. 2011), (3) self-directed learning skills (Barrows et al. 1986; Norman and Schmidt 1992; Dahlgren et al. 1998; Spencer and Jordan 1999; Hmelo-Silver and Barrows 2006; Koh et al. 2008), (4) interpersonal or communication skills (Bernstein et al. 1995; Fenwick 2002, Prince et al. 2005; Murray-Harvey et al. 2005; Koh et al. 2008; Schmidt et al. 2009), and (5) problem-solving skills (Morales-Mann and Kaitell 2001; Schmidt and Van der Molen 2001; Hmelo-Silver 2004; Gijbels et al. 2005; De Simon 2008; Hallinger et al. 2010).

These skills are collectively called ‘soft skills’ (Hmelo-Silver et al. 2007) or ‘process skills’ (Nel et al. 2008). Engel (2008) used the term ‘generalisable competencies’ as a synonym for them. Among the various soft skills, Schmidt et al.’s (2006) case analysis found that the effect of PBL was the largest in interpersonal skills. They considered that it was partly attributed to the nature of PBL in which learners work collaboratively and intensely in small groups. Koh et al. (2008) also identified that PBL has positive effects on physician competencies, especially in the social and cognitive dimensions.

Murray-Harvey et al. (2005) named those overarching skills ‘generic skills’, maintaining

that such skills nurtured by PBL are basically the same as desirable qualities of graduates of higher education. This assertion can be corroborated by Palfreyman (2008), who claimed that the aim of higher education, in any subject, is the development of the individual's facilities in communication, critical thinking, and knowledge updating. It can also be supported by Biggs (1999), who ascertained that the objective of undergraduate education is to develop students' functional knowledge that will enable them to utilise what they know under a given professional context to address certain tasks. Furthermore, it can be corroborated by Dearden (1980), who insisted that the purpose and value of general education lie in students' development of general potency of mind in relation to problem solving.

However, it has been pointed out that these skills are difficult to measure simply by standardised or multiple-choice tests (Hmelo-Silver et al. 2007; Hung et al. 2008; Belland et al. 2009; Neville 2009). Boud (1988) long before argued that, not only academic achievement but also skills acquired through PBL need to be duly assessed. Duch and Groh (2001) pointed out that both content and process should be linked and evaluated together for assessment. Still, this issue seems to remain unsolved or as a continuing challenge.

Little research has explored the applicability of each one of these skills. In other words, it has been uncertain how equally or differently critical thinking skills, metacognitive skills, self-directed learning skills, interpersonal skills, and problem-solving skills are applicable beyond concrete disciplines and contexts. The first four skills seem to be transferable, but problem-solving skills need to be carefully examined. In fact, the relationship between PBL and problem solving is vague (Maudsley 1999). Hmelo and Evensen (2000) claimed that PBL does not necessarily emphasise having students solve the problem but rather enabling them to analyse and explain the cause and effect of the problem. The preceding four skills rather appear to be things like attitudes, dispositions, or habits of mind that go beyond the classroom to many other contexts over the course of one's lifetime (Hung et al. 2008; Kek and Huijser

2011). However, problem-solving skills seem quite domain-specific. Dolmans et al. (2005) claimed that PBL curricula do not ensure the acquisition of general, content-free problem-solving skills. Additionally, Schmidt et al. (2011) averred that there are no problem-solving skills independent of subject matter knowledge. Then, Regehr and Norman (1996) insisted that problem-solving skills need to be acquired in highly specific contexts. For example, a person without medical knowledge cannot cure a patient even though he or she may have excellent skills or abilities in reasoning, metacognition, self-regulation, and communication. In this respect, if versatile problem-solving skills do exist, they are considered to be a complex or mixture of the other four or more skills.

As Walker and Leary (2009) noted, much research has focused on PBL in medical or health-related education, whereas little has addressed other discipline areas. For instance, Bernstein et al. (1995) clarified that in the field of medicine PBL methods are better than lecture-based instruction for improving doctor-patient relationships. Problem-based medical school alumni assessed themselves better in applying interpersonal skills (Schmidt and Van der Molen 2001; Koh et al. 2008). Given this finding, one might assume the same can be true for lawyer-client relationships via problem-based legal education, teacher-student relationships via problem-based teacher education, etc. This is, however, a mere conjecture because little or no research with evidence has been conducted, except in medical education. According to Dochy et al.'s (2003) meta-analysis, PBL's effects on student skills appear to be immediate and lasting. Yet, their analysis was based on articles almost exclusively on medical education. In this sense, the instant and sustainable effects of each of the generally applicable skills need to be minutely examined in non-medical disciplines as well.

(4) Interaction and Collaboration

From a constructivist perspective, interaction plays a critical role in the development of

cognition, and learning occurs in a social context through cooperation, discussion, and reflection among learners (Donnelly 2006). Learning is indeed a product of social and cognitive interactions (Greeno et al. 1996). This principle is particularly true for PBL because collaborative small-group activities are embedded in its design and implementation. Yew and Schmidt's (2009) data-intensive case analysis of students' verbal interactions revealed that the collaborative nature of learning activities accounts for more than half (53.3%) of the entire PBL cycle, followed by self-directed and constructive activities with 27.2 % and 15.7%, respectively. Thus, working collaboratively in small groups is one of the most characteristic features of PBL (Dahlgren et al. 1998).

Through collaboration or social negotiation, students can learn subject matter deeper and create new knowledge. Group members are indispensable because they can challenge each individual's understanding and expand his or her outlook by asking questions and adding new insights that would be unnoticed if everyone studied in isolation. They are the greatest source of puzzlement for further inquiry and the best provider of alternative ideas (Savery and Duffy 1995).

However, group work does not always function smoothly from the beginning because group members may be strangers and may feel hesitant to speak up. Therefore, the facilitator needs to provide an ice-breaking time for self-introduction within the group in order to promote group rapport and trust (Goodnough 2006). Then, as time elapses, students become gradually familiar with each other. As they become more actively involved in group work, their discussions may become more controversial and tangled. They may counter or refute ideas. Barrett (2010) described this chaotic process unique to PBL as a transient messiness that is nonetheless necessary for students to shift into deeper learning. By experiencing such complex group processing, students can acquire communication and teamwork skills. Talking with and listening to their peers who hold different views are an invaluable but painstaking

endeavour. For all that, this process gives students ample opportunities to revise their ideas and realise the deficiencies in their thoughts, which fosters their metacognitive abilities as well (Sungur and Tekkaya 2006).

The problem and the facilitator are two major factors that influence student learning in PBL (Gijsselaers 1996; Hmelo-Silver 2004; Budé et al. 2009). They are critical to the success of this innovative educational approach (Savery 2006). Goodnough (2006) admitted from the teacher's point of view that her two hardest challenges in implementing PBL relate to problem design and facilitation. Van Berkel and Schmidt (2000) quantitatively identified that both problem quality and tutor performance have strong impacts on group functioning, with the former being slightly stronger than the latter. Research on these two variables is to be reviewed in detail in the next section.

One theme that deserves more attention is the role of the student as a group member. There still remains the question of how an individual student's behaviours, attitudes, qualities, traits, or characteristics contribute to enhancing or undermining overall group functioning. The level of group performance is highly dependent on the quality of interaction and collaboration among students (Dolmans et al. 2001). However, the factors that determine its quality have not been fully identified. Also, while mutual respect and trust of members are vital to functionalise collaborative work (Kumar and Natarajan 2007), little or no research has been undertaken on how these components are nurtured and consolidated in the process of PBL.

Many studies have focused on interaction and collaboration among students. Yet, little attention has been paid to the relationships between students and the teacher. As PBL changes pedagogical environments, a teacher is no longer a sage on the stage but a guide on the side who coaches students through questioning and ushers them into more in-depth understanding of the curriculum (Maxwell et al. 2004). Hmelo-Silver (2004) reported her own successful

implementation of PBL by devising a wandering facilitation model in which she rotated from group to group providing proper scaffolding and advice.

From the students' standpoint, in PBL, they can interact with the teacher in a more accessible, intimate, and comfortable manner than is possible with traditional instruction (Ramsay and Sorrell 2007). This physical and psychological proximity may enable the teacher to learn from students on the spot. That is, the teacher can continually monitor students' learning and act flexibly according to the effects of instruction (Ramsden 1992). In short, PBL environments allow the teacher to gain insight into the structure and progress of students' understanding (Donham et al. 2001). However, while PBL is a joint educational undertaking of both students and the teacher, this theme has been less investigated. Especially, how teacher-student interactions affect the teacher's practice, not just the students' learning, has been largely less studied in the area of PBL.

(5) Design and Implementation

Deliberate design and thoughtful implementation are touchstones of any educational innovation (Boud and Feletti 1997). To make PBL more time-efficient and fruitful, Vardi and Ciccarelli (2008) delineated seven instructional strategies: directing students to identify issues in advance, providing online resources, posing conceptual questions, checking student preparation, stimulating group functioning, assessing students individually, and grading their reports. They reported that these strategies resulted in high rates of student preparation and participation in group discussion. Hmelo-Silver and Barrows (2006), on the other hand, devised ten general strategies that an expert facilitator may adopt to attain the goals of PBL: asking open-ended metacognitive questions, prompting for explanation, revoicing, summarising, generating hypotheses, mapping causality on the board, checking the content on the board, cleaning up the board, addressing learning issues, and encouraging construction of

visual representations. Likewise, Zhang et al. (2011) extracted eight facilitation strategies, identifying that questioning and revoicing are the most important ones of them all. These strategies are the ones enumerated methodologically from a teacher's viewpoint. So, while these researchers used the term 'strategies', it is essentially consistent with the term 'steps' in the PBL process from the students' viewpoint, explicated in the 'Achievement and understanding' section. Two different types of analyses, therefore, focused on two sides of the coin in PBL. One analysis viewed it from a teaching perspective, while the other saw it from a learning perspective.

As mentioned in the previous section, the problem and the facilitator are two critical components in designing and implementing PBL. Hung (2006) stated that the problem lies centrally in PBL. Savery and Duffy (1995) claimed that learning in PBL occurs in the context of the problem from the very beginning. They added that the problem used in the course must be authentic and deal with the primary concepts or principles relevant to subject matter. Hmelo-Silver (2004) insisted that the problem should be realistic, complex, ill-structured, open-ended, and resonant with the students' experiences. Barrows (2002) averred that the problem should be one apt to be confronted by the students in their lives or careers. Then, Van Berkel and Schmidt (2000) clarified that good-quality problems have positive influences on intrinsic interest, group functioning, and learning outcomes. Furthermore, Sockalingam et al. (2011) identified eleven key attributes of effective problems, of which presenting appropriate learning goals and promoting self-directed learning were rated as the highest and the second highest, respectively, by students and tutors. On the other hand, problems that lack such elements or features could undermine the effectiveness of PBL (Hung 2011).

Dolmans et al. (1997) outlined seven principles for effective problem design, suggesting taking into account students' prior knowledge, interest in subject matter, inclusion of cues as stimuli, context relevance, knowledge integration, self-directed learning, and faculty

objectives. Hung (2006) developed the PBL problem design model as a conceptual framework to guide instructional designers and educators, that includes content, context, and connection as static core components, and researching, reasoning, and reflecting as dynamic processing components of PBL. Duch (2001) suggested more down-to-earth steps to write about PBL problems: choosing a central theme, thinking of a real-world context for the concept, presenting the problem to lead students to research, writing a teacher guide, and finding resources for students.

The facilitator or tutor is another important actor in PBL. Tutor selection and development surely affect group functioning and learning (Maudsley et al. 2008). Moust et al. (1989) revealed that interventions of staff tutors are more effective in vitalising students' higher order learning process in small groups than those of student tutors due to the fact that the former have more accurate expert knowledge. By contrast, Searight and Searight (2009) advocated that the tutor's process skills are seen as more important than their domain knowledge, adding that basic knowledge base in the field is of course helpful for better facilitation. Thus, tutors seem to be required to have much of both content knowledge and human skills to interact with students on a personal level (Schmidt and Moust 1995). In greater detail, Chng et al. (2011) demystified that tutors' social congruence or interpersonal qualities have the greatest impact on students' learning process while their social congruence, cognitive congruence, and subject expertise all have considerable effects on student achievement.

Dahlgren et al. (1998) maintained that there are two different perspectives on the teacher's role as a tutor in PBL, discerned as supportive and directive. They described that a supportive tutor primarily focuses on promoting the group process, while a directive tutor places value on giving instructions to students and answering their questions, with no special attention to the group process. Donaldson and Caplow (1996) identified that a supportive tutor serves as a facilitator of group work, a guide for knowledge construction, and a coach for critical

reasoning, while a directive tutor works as a commander, knowledge dispenser, and trainer for each respective functional dimension. On the other hand, in abstract subjects that require high-order thinking such as statistics, mathematics, and computer programming, directive tutor guidance seems to have more positive effects than non-directive guidance does on students' achievement and their subjective perceptions with regard to the course, tutor, and discussions in tutorial meetings (Budé et al. 2009).

Thus, while numerous studies have investigated the design and implementation of PBL, there still remain areas for future research. For example, Jonassen (2011) classified the types of PBL into seven categories: story, rule-using/induction, decision making, troubleshooting, policy analysis, design, and dilemmas. Yet, less clear is what type of problem has what kinds of impacts on the process and outcome of any problem-based subject or curriculum. The way of learning seems to change according to the type of problem. Still, this relationship remains a black box.

Additionally, little research to date has examined the case in which only one teacher as a tutor implements PBL with a large number of students. Usually, in PBL, several small groups are formed, with each group having five to eight students (Hung et al. 2008) or six to nine students (Silén 2006) attended by a tutor. However, as PBL has spread widely beyond disciplines and borders, not all PBL classes can be designed and implemented by a teacher plus several tutors, perhaps mainly due to financial constraints. Therefore, new PBL facilitation strategies for many students in a large classroom need to be developed to meet the emerging demands of higher education around the globe. Strangely enough, no or little research has been done on the collaborative activities taken by teachers who try to learn from each other. As noted by Harland (2003), PBL changes the traditional teacher's role drastically, and those who choose to practice it despite the resistance or reluctance of their colleagues need a great deal of fortitude and endurance. Still, the process and effects of such reciprocal

study meetings among academics on PBL implementation have not been fully discussed.

(6) Self-Discovery and Transformation

In PBL, knowledge is constructed in the social and emotional contexts in which learning takes place (Williams 2001). Through interaction and collaboration, students are likely to have rich and varied feelings such as anxiety, discomfort, conflict, excitement, enjoyment, accomplishment, satisfaction, confidence, and gratitude. PBL may therefore promote emotional development as well as intellectual and interpersonal development (Keville et al. 2009).

Working together in that way may allow them to gain new perspectives of thinking about themselves and their learning (Harland 2002). Macdonald and Isaacs (2001) ascertained that PBL learners can build their identities while engaging avidly in collaborative work. Barrett (2012) averred that participants in PBL not only tackle the problem in terms of knowledge but also in terms of their identities or their sense of being. Savin-Baden (2000) further mentioned that PBL offers students the opportunity to discover and rediscover their identities by learning to make sense for themselves. As such, it seems to enhance self-reflection and self-discovery.

PBL may also help students become more ethical by placing the patient at the centre of the learning circle and keeping fresh their original intentions to be doctors to serve and help people (Palmer 1998). Lin et al. (2010) reported that PBL worked in nursing ethics education as well. Burch (2001) claimed that PBL nurtured learners' ethical and political sensibilities through its participatory democratic nature of learning. Koh et al. (2008) also identified that PBL during medical school contributed to enhancing physicians' appreciation of ethical and legal aspects of health care.

Fenwick (2002) affirmed through a case analysis of a graduate course for adult learners with diverse professional backgrounds that PBL could enhance their self-knowledge and lead

to their personal transformation through an intense period of confrontation with and connection of different ideas. Jungert and Rosander (2010) even claimed that students' self-efficacy beliefs increased by PBL can go far beyond the personal level and influence the institutional atmosphere and the communication of educational goals between and among students, teachers, and administrators.

Self-discovery and transformation relate to the internal or affective aspect of learners. However, compared to the first five themes mentioned above, this one seems predominantly less researched despite its great importance. As students discuss ideas with others out loud, they simultaneously discuss the same issues with themselves in silence. It is known that talking to oneself or generating self-explanations significantly enhances learning (Chi et al. 1994; Michael 2001). Simon (1980) figured out that good students can learn both by being taught and by explaining ideas to themselves. In this regard, learners' inner dialogues could be further investigated.

Besides, the following questions need to be examined. What does PBL mean to teachers? How does PBL change a teacher as a person, a teaching being, and a lifelong learning being? What is happening affectively in the mind of teachers throughout the PBL process? Additionally, what does PBL mean to higher education institutions? How does PBL change a university as a teaching and research entity? What are the benefits and constraints of PBL for teachers and universities? To date, what are the lessons learnt from PBL practices for faculty and institutions in the broader context of rapidly progressive globalisation? Such reflective and reflexive questions should be posed deep inside of individuals and organisations on the teaching end.

Lastly, like other themes, further research is necessary to develop a conceptual framework or theoretical model that explains how PBL can stimulate learners' emotionality, enhance their ethics and self-awareness, and bring about personal transformation. Savin-Baden (2000)

suggested that PBL can prompt the shaping and reconstructing of people's lives as learners and teachers. Given that this is true, this area seems worth pursuing in detail.

3. Synthesis

(1) Deficiencies and Challenges Ahead

What the author enumerated, explained, and critiqued in the previous section led him to think further about the challenges and potentials of PBL. The following are key issues that may indicate the future direction of research on PBL.

First, it can be said that there is a deficiency in PBL research in non-medical disciplines. As noted earlier, most existing research has focused on medical education. This is not surprising, considering that the roots of PBL date back to the problem-based curriculum introduced by the McMaster University School of Medicine in the late 1960s. This curriculum was developed for the purpose of equipping medical students with a body of knowledge usable in the future and problem-solving skills in real settings (Barrows and Tamblyn 1980), and other medical schools followed suit across national boundaries. However, this philosophical concept applies equally to the aim of higher education in general, as discussed earlier. Birch (1986) also maintained that PBL is central to the purpose and value of higher education.

Hmelo-Silver and Barrows (2006) mentioned that the problems used in PBL do not necessarily have a single right answer but require students to explore every possible solution that they generate. Birch (1986) stressed that many of the problems that need to be addressed in social sciences and professional fields of study are essentially soft or open; they are too complex to be solved easily but still need to be challenged by way of seeking alternative solutions. According to these studies, PBL seems to fit in best with the disciplines in which there is no definitively correct answer, that is, the disciplines that often encounter dilemmas

with multiple avenues for a solution (Maxwell et al. 2004). In a broad sense, Horii (2004) claimed that the problem is nothing but a gap between the actual and the ideal, and if the ideal can be called a goal, goal attainment is no different from problem solving. He then insisted that our daily life is an incessant process of problem solving and goal attainment. In this respect, PBL can be more widely practiced in higher education and researched in all academic fields in order to identify potentials that may contribute much more to society.

Second, there seems to be a deficiency in PBL research on the internal aspect of learners. A vast majority of studies have hitherto focused on learning outcomes or achievement of PBL instruction (Fenwick 2002; Goodnough 2006; Hung 2011), comparing in particular the effectiveness or test results of PBL with those of conventional lecture-based instruction. Ravits (2009) critiqued that such dichotomy in research is less meaningful because there are no 'pure' forms of PBL or those of traditional teaching. Norman and Schmidt (2000) more harshly remarked that the comparison of curriculum-level interventions is a waste of time and energy for similar reasons. This propensity seems to reflect faculty's strong interests in student cognition. However, from the perspective of learning, PBL is not limited to the cognitive aspect. In other words, as identified by Cazden (2001), there are social and internal aspects as well in learning that occurs in PBL instruction. In fact, the social or interpersonal dimension has been much studied in terms of student interaction and collaboration. In contrast, the internal or affective aspect of learners seems to be dominantly less investigated, as pointed out in the previous section. Given that education essentially takes place in the minds of learners (Maitland and Cowdroy 2001), more in-depth research needs to be conducted to unravel the process and meaning of students' experiences in PBL, for example, by shedding light on their emotional transitions, meaning making, self-reflection and self-discovery, acceptance of and respect for different values, and personal transformation as learners and human beings.

Third, there is a deficiency in PBL research on the teacher. PBL is a shared effort of both students and the teacher, but little is known about the teacher's conceptual change or professional growth promoted through student contact. Previous studies appear to focus heavily on the student rather than the teacher because their interests centre around learning. Even so, teaching is also a dauntingly complex task, and this is particularly true when it comes to a student-centred pedagogical approach such as PBL (Hmelo-Silver and Barrows 2006). Good interactions often unfold in unexpected ways that force teachers to change their original instruction plan (Christensen 1991). Thus, teaching in PBL is so situational that a teacher is required to interchangeably play a variety of roles that include being a provider of scaffolding, a challenger of opinions, and a sounding board (Goodnough 2006). As such, good teaching is only made possible by learning about students' learning and being open to constant change (Ramsden 1992). PBL provides a prime opportunity for teachers to fundamentally rethink and reconceptualise the nature of learning and their roles in teaching (Hung et al. 2008). That is, teaching in PBL itself is nothing less than a problem-solving or goal-attaining process, and PBL seems effective in promoting both the professional and personal growth of educators.

O'Meara et al. (2008) defined faculty professional growth as 'change that occurs in a person through the course of her or his academic career or personal life and that allows her or him to bring new and diverse knowledge, skills, values, and professional orientations to her or his work' (p.24). Indeed, through the practice of PBL, teachers can be more relentlessly trained to acquire sound pedagogical content knowledge, know-how, and human qualities to help students grow further as learners and persons. It is recognised, however, that a teacher can never grow alone (Sato 2009). Herein lies the importance of critical collaborative inquiring activities in which teachers learn and encourage each other by mutually offering and receiving candid but constructive opinions on each other's educational efforts (Samaras 2011).

Unlike K-12 teachers, university teachers tend to work as independent researchers, but as noted by Birch (1986), they also need to work together to toward a better balance between academic and operational values. This team effort can help them become more reflective and flexible about their teaching attitude and behaviour. Therefore, it would be practically useful and academically valuable to unravel the process and effects of such cooperative endeavours among scholars on PBL implementation.

Fourth, there is a deficiency in PBL research on the institution. Boud and Feletti (1997) declared that PBL is the most remarkable innovation in higher education seen in years. However, its introduction and implementation appear to be far from easy. Schwartz et al. (2001) presented four major barriers for faculty and students to adopt a PBL approach: (1) resistance to change, (2) fear of loss of control and of the unknown, (3) unfamiliarity with its principles and practices, and (4) lack of evidence proving its superiority over traditional methods. On the other hand, some suggestions have been made to overcome these barriers. For instance, Lantz and Chaves (2001) pointed out that successful transition to a PBL curriculum requires that all participants, namely, students, teachers, and even administrators, come to understand the fundamental nature of the paradigm shift in teaching and learning. Those stakeholders need to share the same vision on this curricular change (Clark 2001). To this end, there must be adequate time and opportunity for faculty (especially sceptics) to try new methods, learn from experience, and have a sense of increased ownership (Schwartz et al. 2001). What is also crucial is the existence of senior or high-level promoters who provide strong leadership and exert appropriate authority from both academic and administrative sides (Cavanaugh 2001; Schwartz 2001).

Still, even after acceptance of PBL, faculty development programmes ought to be implemented in a sustainable manner (Schwartz et al. 2001). Additionally, some incentives would be given to faculty to keep their motivation and engagement in PBL. Neufeld and

Barrows (1974) reported the case of McMaster University, where faculty's contributions to PBL instruction are assessed and reflected in salary increases, promotion, and obtaining tenure. Yet, quite limited research, almost solely in the medical field, has been conducted on such university-wide efforts and systems. Lantz and Chaves (2001) claimed that Vygotsky's zone of proximal development applies to not only individuals but also institutions. If so, organisational challenges will become a subject for research, and findings or lessons learnt can be shared among the same-minded yet struggling institutions around the world. Uncovering such institution-level interventions may hold the key to mainstream PBL in higher education that is expected to prepare students for a global society that requires versatile skills and abilities.

Fifth, there is a deficiency in PBL research on the comprehensive conceptual framework. As mentioned earlier, Van Berkel and Schmidt (2000) demystified how and to what extent students' prior knowledge, problem quality, and tutor performance may affect students' interest and achievement. Similarly, Schmidt et al. (2011) visualised how and to what extent students' prior knowledge would influence their achievement. While these two studies delved into the mechanism underlying PBL, they focused primarily on one aspect (cognitive aspect) among three aspects of learning identified by Cazden (2001). Therefore, the remaining two aspects, that is, the social and internal aspects of learning, were not fully examined. In contrast, Savin-Baden (2000) elaborated the framework 'Dimensions of Learner Experience' comprising three stances, that is, personal stance, pedagogical stance, and interactional stance. While this framework deals mainly with the internal and social aspects of learning, little attention is given to the cognitive aspect of learning, including knowledge acquisition, understanding, and achievement.

Hung (2006) developed another type of conceptual framework that specialises in designing problems in PBL. It holds content, context, and connection as core components,

and researching, reasoning, and reflecting as processing components of PBL. While this model depicts key elements and actions to be considered in the designing stage, it overlooks the complex nature of teaching and learning in PBL at individual and group levels in the implementation stage. Thus, the existing research falls short of clarifying the entire mechanism of teaching and learning in PBL. In this regard, future research can take a more holistic approach from broader perspectives to develop a more elaborative and comprehensive conceptual model of learning generated through PBL.

Sixth, there is a deficiency in PBL research on the practice in the non-English-speaking world. Perhaps due to a language barrier, there is little research on PBL implementation in non-English-speaking countries. Given that PBL has gained increased attention and acceptance in a wide range of educational institutions and disciplines (Savery 2006; Annerstedt et al. 2010), PBL practices may also be on the increase around the globe. However, PBL in one country or region may differ slightly or largely from PBL implemented elsewhere. This is because everything people learn takes place in a social and cultural context (Darling-Hammond et al. 2003). That is, PBL cannot stay unaffected by socio-cultural environments, traditions, values, beliefs, customs, and communication styles on which teachers and students' behaviours are fundamentally based. For instance, students in some countries may take more time to open up to one other and engage in collaborative work. As another example, students in a certain region may culturally regard a teacher or facilitator as a more authoritative person than their counterparts in other regions, so that the former may adamantly believe directive instruction is better than supportive instruction. Or, they may feel more comfortable when being taught unilaterally by a teacher rather than being responsible for their own learning.

Nevertheless, external pressure may require even such a tradition-bound country to review and change its long-time pedagogical styles. As a globalised market is desperately seeking

capable graduates who have a solid basic knowledge base and extensively applicable skills in critical thinking, communication, and self-reflection, etc., higher education institutions are universally exposed to the constant pressure of responding to transnational demands by fostering excellent human resources. In this respect, while the scale of PBL implementation may remain modest in the non-English speaking world, academics from both home and abroad can direct their attentions to these largely as-yet-unknown practices in order to share research findings and practical lessons learnt within the international community.

(2) Concluding Remarks

All things considered, while there are many topics that stay less investigated in PBL research, this study sheds light on the internal or affective aspect of learners majoring in non-medical fields in a non-English-speaking country (Japan). In addition, the study attempts to provide a theory-based inquiry into the structure and mechanism of PBL from a holistic viewpoint. Consequently, the topic of teachers and institutions that implement PBL remains an opportunity for future research.

Chapter 3 Qualitative Case Study

1. The Trading Game

(1) Introduction

In universities, most of faculty members rely on conventional one-way lecturing methods to impart lessons. However, through such teaching and learning processes, students are unlikely to adopt a deeper approach that would help them examine the content (Trigwell et al. 1999). To overcome this issue, PBL has been highlighted across the literature as a pedagogical approach for encouraging students to learn their subjects with high motivation (Boud and Felletti 1997; Mauffette et al. 2004). PBL is an approach to participatory education with: (1) stimulus materials to aid students' discussions or questions; and (2) problems that create simulations of real-life professional practices for the learners. Simulation gaming is one type of PBL that simulates quasi-realistic contexts, where learners solve the given problems and tasks with others.

Over the years, considerable research has been conducted on simulation gaming. Related studies hitherto can be categorised into three types. The first type is the cognitive aspect, where the focus is on the knowledge component of a lesson, such as the content of the given subjects, facts, concepts, theories, or materials used. Regarding this aspect, according to some of the existing studies, gaming is found to be helpful for learners for acquiring deeper knowledge on the subject matter as compared with the conventional teaching approach (Allery 2004; Eckert et al. 2004; Hirose et al. 2004; Kiili 2007; Sleet 1985; Torres and Macedo 2000). On the other hand, Foster et al. (1980) and Hsu (1989) found that gaming can be no different or even less efficient in conveying factual information and conceptual

principles than the conventional teaching methods.

The second type is the social aspect, which focuses on the relationship between peers. Existing studies, argue that gaming helps: (1) learners to acquire the skills for establishing a rapport and negotiating with others (Dandekar and Feldt 1984); (2) encourage participation and interaction between learners (Sleet 1985); (3) generate dialogue about values between learners (Torres and Macedo 2000); (4) them compete and cooperate with each other (Schwartzman 1997); and (5) provide a learning opportunity through confrontational relationships between learners (Lean et al. 2006) and through collaboration (Kiili 2007).

The third type is the internal aspect, where the focus is on the students' internal self-dialogue. Greenblat (1980) and Maxwell et al. (2004) found that games could enhance learners' self-awareness and tolerance of others. Later, Allery (2004) referred to the characteristics of gaming to provide an insight into one's behaviour through peer interaction and feedback.

However, there are a couple of points to be made here. First, the abovementioned studies were largely conducted in the West and there is a severe lack of research on gaming in non-Western or non-English-speaking contexts. In Japan, which is the focus of the present study, university students have been observed as likely to take passive and inactive attitudes towards their learning (Matsushita 2002). In Japanese universities, a majority of the classes are conducted in the lecturing style (Kino 2009). Although some educators have introduced group-based activities (Kino 2009; Nezu et al. 2006; Onohara and Iwasaki 2003; Terakawa and Kita 2008), the pedagogical tendencies still mostly retain the one-way lecture style (Kino 2009).

Turning to gaming at the higher educational level in Japan tends to deal with the development of computer games (Kato and Arakawa 2008; Shirai et al. 2003). There is a serious lack of studies that examine cases of non-computer-based gaming at the higher

educational level in Japan. However, to revise the pedagogical practices, the mode of teaching and learning process cannot always remain computer-based. Rather, it is very important to amend the practices in classrooms.

This study, therefore, aims to focus on practices of face-to-face gaming practices in a Japanese university. Particularly, the author is going to probe the meaning for the students of the experience to introduce a participatory style of teaching in the context of higher education in Japan. To achieve this purpose, this paper will focus on the case of the Trading Game (the TG) played in regular undergraduate courses in a coeducational private university in Tokyo.

(2) Methods

Data Collection

The data for this study were divided into two types. The first type consisted of the open-ended questionnaires or written reflections of students who participated in the lesson. The second type of data was obtained from a series of interviews with the students.

The author taught two classes as a part-time lecturer from 2002 to 2004. A different student group attended each class on Saturdays from April to July for about 13 weeks. The total number of participants was 162 and the details are as follows: in 2002, the groups consisted of 10 males and 31 females; in 2003, of 16 males and 30 females; and in 2004, of 17 males and 58 females. Out of the 13 weeks or periods for each group, two were spent playing the TG: one session for conducting the game and the other for reflection. In two weeks after the second session, students submitted their questionnaires that elicited their thoughts about the TG. The number of respondents was 68 (23 in 2002, 16 in 2003, and 29 in 2004) of the total of 162, and the collection ratio was 41.975%.

The author also interviewed a total of 23 students about this game at the end of the course: 5 from the 2002 groups, 6 from the 2003 groups and 12 from the 2004 groups. He conducted

interviews to examine their general impressions about the lesson as a whole. Only one student was interviewed at a time and the time length of each session was around 25-40 minutes.

Analytical Method and Framework

This study uses the case analysis method (Cohen et al. 2000; Creswell 1998). It provides an in-depth description and interpretation of the case and the generalised lessons learned. To investigate the significance of the experiences of students participating in the TG, the author will use three sets of perspectives (Inagaki and Sato 1996; Cazden 2001). The first type is the cognitive aspect, where the knowledge component in a lesson is considered, such as the content of the given subjects, facts, concepts, theories, or materials used. The second type is the social aspect, which focuses on the relationship between peers. Third is the internal aspect, where the internal self-dialogue of students is considered.

(3) Case

Background

The author was in charge of the course titled 'Integrated Studies Practicum' as a part-time lecturer in the Department of Education of the Faculty of Literature at a private university in Tokyo from 2002 to 2004. This course was one of the compulsory courses for students to obtain their teaching certificate, and it was set up in response to the creation of the subject titled 'Integrated Studies' that were taught in primary and secondary education. In this course, the author took up issues in relation to international development as a consistent theme; this is because this issue is a strong candidate topic for the students to apply in their teaching at schools.

Instead of simply conveying text-based knowledge, the author decided to use the TG for two periods in the course. This method was adopted because the author encountered problems

in his teaching with regard to the students' learning. It was quite likely that the one-way lecture method would lead to boredom among the students, and they would not necessarily be interested in studying international development issues further. Since the early 1990s, quite a few youngsters have expressed a strong interest for participation in development activities in the field (Saito 2004). However, most of the Japanese audience may still be unaware of these issues despite their importance. To raise citizens' interest, a greater focus on these issues can be brought about by expanding learning across various subjects' areas; according to the author, it was important to give potential student teachers an opportunity to develop a closer understanding of these issues. For this purpose, the author believed that the TG would provide better opportunities to students to acquire an emotional understanding and knowledge about development issues. Such an attempt could be a relatively new approach as compared with the traditional teaching methods employed in Japanese higher education; in other words, it presents a meaningful challenge to the conventional teaching methods in Japan. Therefore, in this course, the author conducted the TG for two periods.

The Trading Game

The TG is a game requiring real and active interpersonal contact. The aim of the TG is to enable players to: (1) understand the basic structure of international trade; (2) experience the helplessness and necessity of cooperation under a globalised economy; and (3) develop interests and opportunities for considering ways to overcome difficulties such as international development problems, environmental issues, and the digital divide.

Generally, the TG involves between 15 and 50 players, and it includes sessions of the real game and reflective discussions on the game. It takes at least 90 minutes to conduct both parts of the game. The players are randomly assigned to several groups; the number of members may vary from a minimum of four to a maximum of eight.

Process of the TG in the Case Lesson Period

In this subsection, the typical process of the TG observed by the author over three years will be explained. This process usually consisted of four stages: exploration, adaptation, absorption and reflection. While the students experienced the first three stages in a natural causal process during the gaming session, the author intentionally included reflection to allow the students to look back and analyse what they experienced.

Exploration stage

At the beginning of the TG, each group randomly receives an envelope containing stationery from a facilitator, but they do not know the contents of the envelope until the game begins. Each group receives different sets of materials such as scissors, rulers, compasses, protractors, pencils and sheets of paper. Many materials are provided only to a few groups; a larger number of groups are given few or almost no materials. Depending on the materials they possess, there are four types of groups: the richest, middle class, poorer and poorest. The students showed tense facial expressions and bodily actions. They seemingly felt quite awkward for the following two reasons. First, they knew very little about each other, so they had to introduce themselves and learn about the personalities of the other members of their group. In usual cases, their classes tended to be one-way lecture, where the students did not have to communicate with each other. Thus, they did not know each other well. Second, since the facilitator intentionally gave no detailed explanations of a rule, students had almost no idea about what the TG would be like and how they would assume and play their roles.

Thus, they began to communicate with each other within a group and started to walk around to take a look at the other groups and check the materials that their other classmates had received. Then, they gradually understood the differences between/among their group and

those of others. The moment they recognised the differences in terms of materials, the groups with more materials (hereafter called ‘rich groups’) tended to shout with joy, whereas the groups with less materials (hereafter called ‘poor groups’) were likely to despair. Student A later commented, ‘I believed that as long as it was a game, the competition would start under the same conditions, but there were huge disparities between/among groups from the beginning, which came as something of a surprise to us’. Student B stated, ‘There are almost no rules in this game. Rather, players will explore and develop the rules while playing the game. In this sense, the game resembles real-world trade’.

Adaptation stage

As time elapsed, the students were most likely to gradually adjust to their peers, have discussions, and develop a strategy to win the game. After developing strategies, students started negotiating with other groups to engage in borrowing, lending, bartering, and so forth. Through various types of negotiations with other peers, the opinions of some students changed.

Some students developed unique strategies to win the game. Nevertheless, in such cases, they had to first convince the other members of their group, and then had to further negotiate with other groups as advantageously as possible for their own benefit. Their opponents did not compromise easily, so tough negotiations were made between/among groups.

Some of the students were able to improve their interaction and decision-making skills. For instance, Student C wrote later in her mid-term paper:

have never found it difficult to express my opinions to my friends in my personal life,
but the game made me realise that it can be difficult to do so.

Student D spoke about the importance of the examination of information:

It is important to listen to the opinions of other members, but all the opinions are not always right. So it is necessary to analyse the information in a calm manner and reach a consensus as a group.

On the other hand, Student E shared the learning about the principle of the majority: ‘A final decision was made by the majority method in our group, but I personally thought it was not always the best way’. Further, student F said, ‘The best strategy cannot be found without heterogeneity of opinions’.

Absorption stage

While the students were playing the game, the author walked around to keep a close watch on the supply and demand of the products, and changed their prices on the basis of the market mechanism as the facilitator. In addition, he sometimes even announced information on the emerging demand for new products with different sizes, shapes and prices. The author also provided a pair of scissors to some groups whose players did not have them; similarly, he gave some paper to another group. Here, scissors symbolise technology and paper symbolises natural resources. This provision would represent assistance from international organisations. However, in some cases, the author intentionally gave another pair of scissors with nicked edges to the poorest group. Further, the author sometimes displayed an envelope containing seemingly important information. Since the information was very costly, only affluent groups could access it. After the purchase, such groups often started exploiting others to retain their wealth monopoly in the game. Thus, the wealth gap between haves and have-nots continued to widen.

Regardless of such a gap, students were desperate to win the game. They stirred up discussions inside and outside their groups, expressing their own ideas, refuting other opinions or proposing alternatives. Some of the students sought for win-win situations and some others even adopted astute tactics to secure an overwhelming victory over their opponents. Despite the differences in approaches, all in all, the students concentrated fully on, and became deeply obsessed, with the thrilling nature of the game.

For instance, Student G commented, ‘The game was fun, and competition drove us into a frenzy to win’. Student H commented, ‘We felt constantly pressured, and this made us serious and absorbed in the game’. Student I remarked, ‘The fluctuation of product prices thrilled us and it took us some time to learn how to cope with such a change, but the process was exciting’. In addition, Student J said, ‘Everyone is a central player in the TG. Unless each and every player takes an active part in the game, it will not work out. No one can be an innocent bystander’. Thus, students became so involved in the game that they even lost track of time. By playing the game, they learned a complex or abstruse mechanism of world trade and the essence of the international development problem.

Reflection stage

After the game was over, a winning group was identified. However, winning was not the purpose of the game. It was more important for the players to reflect on their processes in the TG. In his role as a facilitator, the author explained what each material used and each event occurring in the game symbolised in real settings. The explanations helped students remember their experiences during the game. They were then surprised by the profound hidden meaning of the game. Students’ comments can be roughly categorised into three aspects: learning about international trade, participatory learning and character development. Examples of students’ reflections on each item will be given below.

First, many of the students reflected on international trade. One student said, 'I became keenly aware that the world economy is interdependent. No single country can enjoy lasting prosperity without the development of others'. Another student reflected that 'by putting myself in the shoes of people living in the third world, I was able to understand how difficult it is to develop a country'. Yet another student said, 'I was deeply impressed and inspired when I understood that what is happening in real society was happening in this small corner of a university'.

Second, other opinions given by many students concerned the learning style. One student stated, 'I have never experienced such a participatory lesson ever since I entered university. No other lesson has made us rack our brains, collaborate with others, and thrive on a clash of ideas'. Further, another student said, 'We will not forget what we have experienced. We can notice something small but important through a simulation game because it allows us to learn by feeling. This would never happen in a lecture-type class'. A third student stated, 'The TG has given us not only an enjoyable time but also an opportunity to think about ourselves and our relationship with others. The game was over, but my inquiry for a better tomorrow has just begun'.

Third, another point made by many students was related to their character development. For example, one student said that the TG helped them to break out of their shell and become more open-minded. Another student spoke about the need to be flexible during the game process and said, 'The TG will foster the ability to think and cope flexibly with unexpected situations'. Yet another student referred to the capacity of the game to expand their understanding of others by saying, 'The TG will equip us with the ability to understand others' situations and wrap up negotiations for coexistence and co-prosperity'.

(4) Discussion

The author has compiled the process of the TG that was described in the previous section according to a threefold framework. As indicated in Table 3-1, there is a pattern of change with regard to each item of the framework.

First, regarding the cognitive aspect, the students began the TG by trying to understand the rules that were intentionally made ambiguous by the author, and by comprehending the wealth disparity between the groups. After this they grasped the meaning of their actions in the game in relation to the global economy at the reflection stage. The students were placed in a simulated context of the global economy to gain an insight into the severe gap between affluent and underdeveloping countries and the widening of this gap because of the arbitrary nature of market mechanisms. In the process of the game, the students were engaged in bargaining activities with each other. The goal that students attempted to achieve was maximising their profits in the bargain and learning how the rich wish to maintain and increase their wealth, whereas the poor face immense hardships in progressing as the rich despite their struggles. Thus, the TG is a powerful tool that helps students gain a deeper understanding of the problems that face the global economy and developing countries. Previous research supports this reasoning and indicates the competence of simulation gaming in helping learners understand the topic of study (Allery 2004; Eckert et al. 2004; Hirose et al. 2004; Kiili 2007; Sleet 1985; Torres and Macedo 2000).

Second, with regard to the social aspect, the students started the game by getting acquainted with each other, and they gradually began working towards a common interest as a group. In general, as stated in previous studies (Dandekar and Feldt 1984; Sleet 1985; Torres and Macedo 2000), they had more opportunities to interact with others as compared with the conventional method.

Still, two points need to be discussed. The first point is that, as observed earlier, some students found it difficult to work with others because they had trouble communicating with

them and reaching a consensus within the group. According to Lean et al. (2006), simulation gaming can provide learning opportunities by promoting confrontational relationships between the learners; however, some students did not succeed in this regard. It seems that the ability to learn in this manner is related to the attitudes of participants towards others. This issue will be discussed in the next sub-section. The second point is that, as Schwartzman (1997) discuss, there were many occasions when students could compete and cooperate with each other. In many cases, students from other groups were most likely to be perceived as rivals and competitors in the TG. One of the purposes of the TG is to help learners understand the importance of international cooperation after realising the tough competitive context of the global economy. Yet, it is far from clear how such a view can be fostered; on the contrary, there is a risk that learners may focus primarily on the difficult and unfeasible nature of international cooperation.

Table 3-1. Learning process of the students observed in the TG

	Exploration	Adaptation	Absorption	Reflection
Cognitive	Ascertaining the rules and understanding wealth disparity between groups	Setting tentative strategies to increase their wealth	Adjusting strategies with the expanding wealth gap between the groups	Understanding the meaning of the TG as a simulation of the actual global economy
Social	Familiarising oneself with peers	Having discussions with peers in one's group and initiating negotiations with other groups	Engaging themselves in negotiations with other groups	Realising the difference in the participatory style between usual lessons and the TG
Internal	Feeling tense and uncomfortable with the new situation	Recognising difference of opinions, and adapting to each other	Assuming roles for the group	Learning the importance of being honest and cooperating with others

Third, as for the internal characteristics of the students, their experiences could be characterised as the disclosure of their opinions to others. They were rather reserved and isolated at the outset of the game, but their attitudes gradually became more honest. As demonstrated in the description of the case, many students referred to the importance of being honest with others. Therefore, in the TG, students wrote more positively about their internal changes on their stances towards others by collaborating with others (Allery 2004).

However, there arises one question: whether openness can be called ‘tolerance’ (Maxwell et al. 2004). This is a concern because the students’ cooperation was mostly restricted to their own groups, with the exception of some students who pursued a mutually benefiting relationship with other groups in the different positions. Moreover, students, as citizens of a global economy, were less likely to continue exploring the solutions after class, to overcome such inequality in the world. Alternatively, their reflections tended to focus on their relationships with other students within the class or university – still they kept being domestic. Therefore, while students learned the importance of being decent and cooperative with others, they seem to have fallen short of being determined to enlighten themselves to better serve the needs of the international community.

(5) Conclusion

The purpose of this study was to investigate the significance of students’ experiences with the introduction of a participatory style of teaching in the context of higher education in Japan. The results reveal the following: (1) students showed an increased understanding of the realities of the global economy; (2) there was greater interaction between students in the participatory style of teaching than in the conventional method; and (3) the students realised the importance of developing a broader outlook.

In the higher education context in Japan, students experienced a form of learning in the

TG, which differed from that in conventional lessons, and interaction with peers was emphasised considerably. This finding differed from that of previous studies (Matsushita 2002). The results of this study suggest that if faculty members are keen on changing pedagogical styles, the degree of participation of students will be enhanced. However, as Kino (2009) points out, if the number of faculty members who attempt to change their pedagogical practices is limited, such small changes in teaching methods would not necessarily lead to a huge impact.

Further, the author wishes to reflect on one issue from the lecturer's perspective. He has been working as a consultant in the field of international development for over a decade. Usually, the projects that he is involved in are most likely to prepare a set of standardised prototype of activities for dissemination. By teaching this course to students, he newly gained an understanding of the complexity and diversity of teaching and learning processes. Relevant literature states that large-scale, standardised programmes cannot be impactful and sustainable (Giles and Hargreaves 2006). The author will explore an alternative approach to developing the international educational development project by considering complexities and diversities in classrooms and schools.

Finally, it is important to state the limitations of the TG. According to the Development Education Council of Japan (DECJ), and Kanagawa International Association (KIA) (2001), the TG helps learners understand the fundamental structure of the global economy, and initiate discussions and explore the economic and social gap between developed and developing countries (p. 1). However, its function does not go beyond that of an initiator or trigger, although it is important to nurture and develop learners' interest in international development by other means. After all, the TG is a simulation game and does not ensure that participants will gain systematic content knowledge and master long-established overarching skills. Nor will it guarantee learners' stronger engagement in self-development and social

contribution. Therefore, the author subsequently conducted another type of PBL using a more concrete, influential, and broadly applicable method in his classes. Further research will examine the practice employing this method in the following section and chapter.

2. The Project Cycle Management Method

(1) Introduction

Much research has hitherto addressed learning outcomes or achievement of PBL instruction (Fenwick 2002; Goodnough 2006; Hung 2011), comparing in particular the effectiveness or test results of PBL with those of traditional lecture-based teaching. Similarly, many studies have focused on various skills that are acquired through PBL. Among them, Schmidt et al. (2006) uncovered that the effect of PBL was the largest in interpersonal skills. They averred that it was partly attributed to the feature of PBL in which learners work collaboratively and intensely in small groups. Koh et al. (2008) also identified that PBL has positive effects on professionals' competencies, especially in the cognitive and social aspects.

Since it is in the intrinsic nature of PBL for learners to interact with others, it is necessary to investigate learners' experiences from various perspectives to fully understand how the PBL process influences their learning. In other words, in addition to output- and solution-oriented research on PBL, a holistic insight into learners' experiences in PBL, namely, from the perspectives of cognitive, social, and internal aspects, needs to be drawn from practice. Particularly, the internal or affective aspect has not been discussed much in previous research on PBL. The issue of what type of learning students would experience in the classroom has also been neglected. Thus, it is important to understand the process and changes that students may undergo in PBL in order to find ways to improve their learning.

On the basis of these points, this study examines the process and meaning of PBL employing the Project Cycle Management (PCM) method that students may experience, from the viewpoint of multiple dimensions. The guiding research questions are as follows: first,

what kind of process are students likely to experience in PBL? and second, what kinds of meaningful changes are students likely to undergo through PBL?

(2) Methods

Data Collection

The data for this study are categorised into two sets. The first data set consists of the written reflections of students who attended the lessons at a private women's college in Tokyo that has long served to educate children of the Japanese imperial family. The author was invited there to teach the PCM method to undergraduate students from 2002 to 2006. He provided a 90-minute lesson on Saturdays for two consecutive weeks as part of a 13-week course. The position of PCM in this course will be explained in detail in the 'Background' section. During the 5-year study, 217 students participated: they numbered 53, 59, 50, 36, and 19 in 2002–2006, respectively. The author administered a questionnaire survey to all students, in which they were allowed to freely describe what they had learned in the lessons. The number of respondents was the same as that of participants, because the questionnaire was distributed and collected during the lesson. Therefore, the response rate was 100 % each time.

Concerning the second data set, the author interviewed 13 students about the PCM method shortly after the class: the number of students interviewed was two, four, two, three, and two in 2002–2006, respectively. The author did not select the interviewees but instead asked the whole class who would be willing to stay after the class to be interviewed. A total of 13 students volunteered to stay in the classroom to discuss their experiences. Each year, the students were interviewed together. Each interview session lasted approximately 30 minutes.

Analytical Method and Framework

The author used the case analysis method (Creswell 1998; Cohen et al. 2000). This method

provides a rich and in-depth description and an insightful interpretation of the case examined. To investigate the significance of the experiences of the students who learned through PCM, the author considered the following three aspects of learning identified by Cazden (2001).

First was the cognitive aspect, which refers to the knowledge components of the lessons. Second was the social aspect, which focuses on peer interaction and group discussions. Third was the internal aspect, which relates to students' self-awareness and self-reflection.

(3) Case

Background

Since the 1990s, public exposure to international development has increased in Japan, and interest in issues concerning developing countries has intensified, particularly among the younger generations. In accordance with these increased interests and demands, over the last 20 years, various higher education institutions have established departments for teaching and researching international development at the undergraduate and postgraduate levels. In this context, GWC invited a lecturer from the Japan International Cooperation Agency to teach a 13-week course titled 'International Cultural Exchange'. The lecturer adopted a conventional style of lecturing to undergraduate students who had little knowledge of issues in international development. To provide the students with hands-on learning in this field, she invited the author to teach special PBL-based lessons for 2 weeks.

The author had prior experience teaching about development issues (including the North–South problems) in other universities. In Japan, university students tend to maintain passive attitudes towards their learning (Matsushita 2002). A majority of lessons are conducted in a one-way teaching style (Kino 2009). In fact, the author was rather surprised when, during his first teaching opportunity at another university, he saw students chatting, whispering, and sleeping during a class. Subsequently, he sought a more engaged teaching style that would

keep students alert, motivated, and active in their thinking and learning. Rather than unilaterally conveying knowledge about international development, he decided to equip students with the basic skills of problem solving through PCM, which necessitates the students' active involvement in group work, in his class at this private women's college as well.

The PCM Method

The PCM method is a participatory planning and management tool for development assistance. The Foundation for Advanced Studies on International Development (FASID) developed it in the early 1990s, based on similar models previously developed by other donors. Since then, this method has been broadly used in Japanese official development assistance projects, especially in technical cooperation (FASID 2008).

However, Horii (2004) claimed that the PCM method can be extensively applied to many other issues, from the personal to the societal, that require problem solving. Takeda and Hayashi (2006) implemented the PCM method in a high school class and found it useful for enhancing students' critical thinking ability through group work in which they explored the best possible solutions to a given problem. Because of its success with students, Takeda and Hayashi suggested that the PCM method be applied to the training of prospective teachers in universities and the professional development of faculty. As such, although this method was originally developed for problem solving in the real world rather than in educational settings, it can also be taught and utilised in schools as one of the various forms of PBL.

The PCM method consists of three stages of planning, implementation, and evaluation. Each stage is an integral part of the entire cycle of project management. As shown in Figure 3-1, lessons learned and feedback gained through such a cycle will be utilised for the betterment of the succeeding projects in the future.

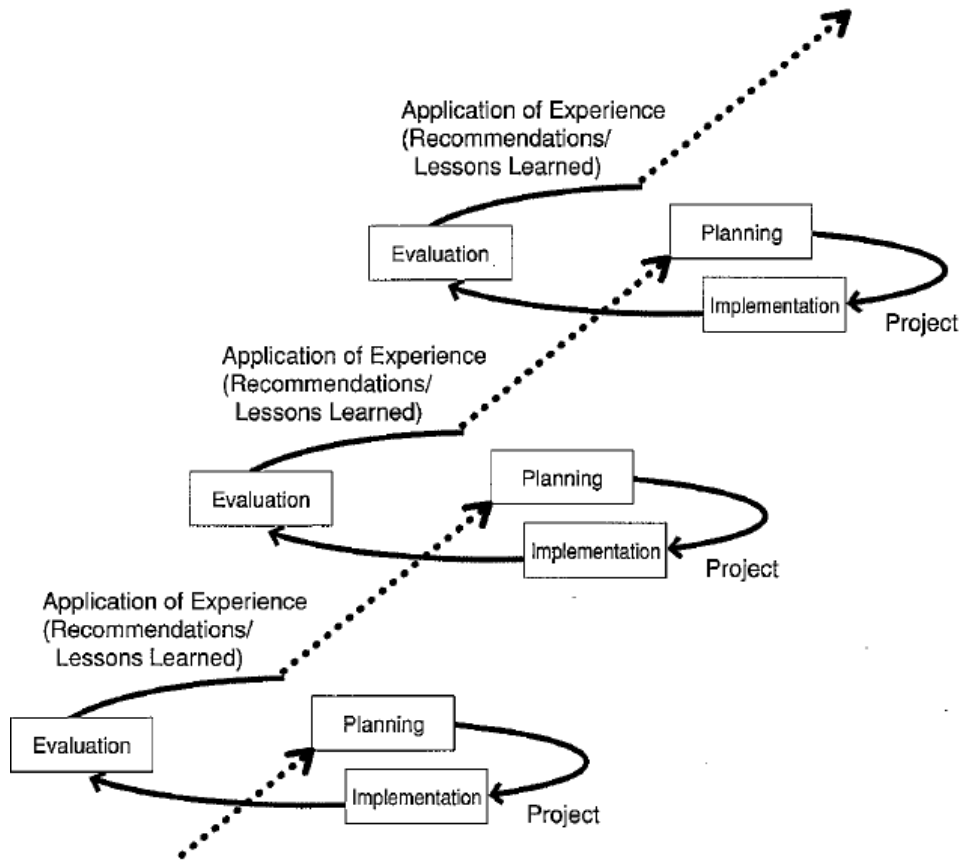


Figure 3-1. Upward spiral of PCM. *Source* FASID (2008)

There are seven steps in the planning stage: stakeholder analysis, problems analysis, objectives analysis, project selection, formulation of the project design matrix (PDM), PDM appraisal, and planning of operations. Thus, the steps in this stage are basically consistent with those of the PBL process described by the existing literature (Schmidt 1983; Birch 1986; Ramsay and Sorrell 2007; Massa 2008). It normally takes approximately 4 days to master the entire process of PCM in a full-scale training program. The author therefore focused on problems analysis and objectives analysis as two of the most critical steps, which allowed students to experience the essence of the method within a limited period.

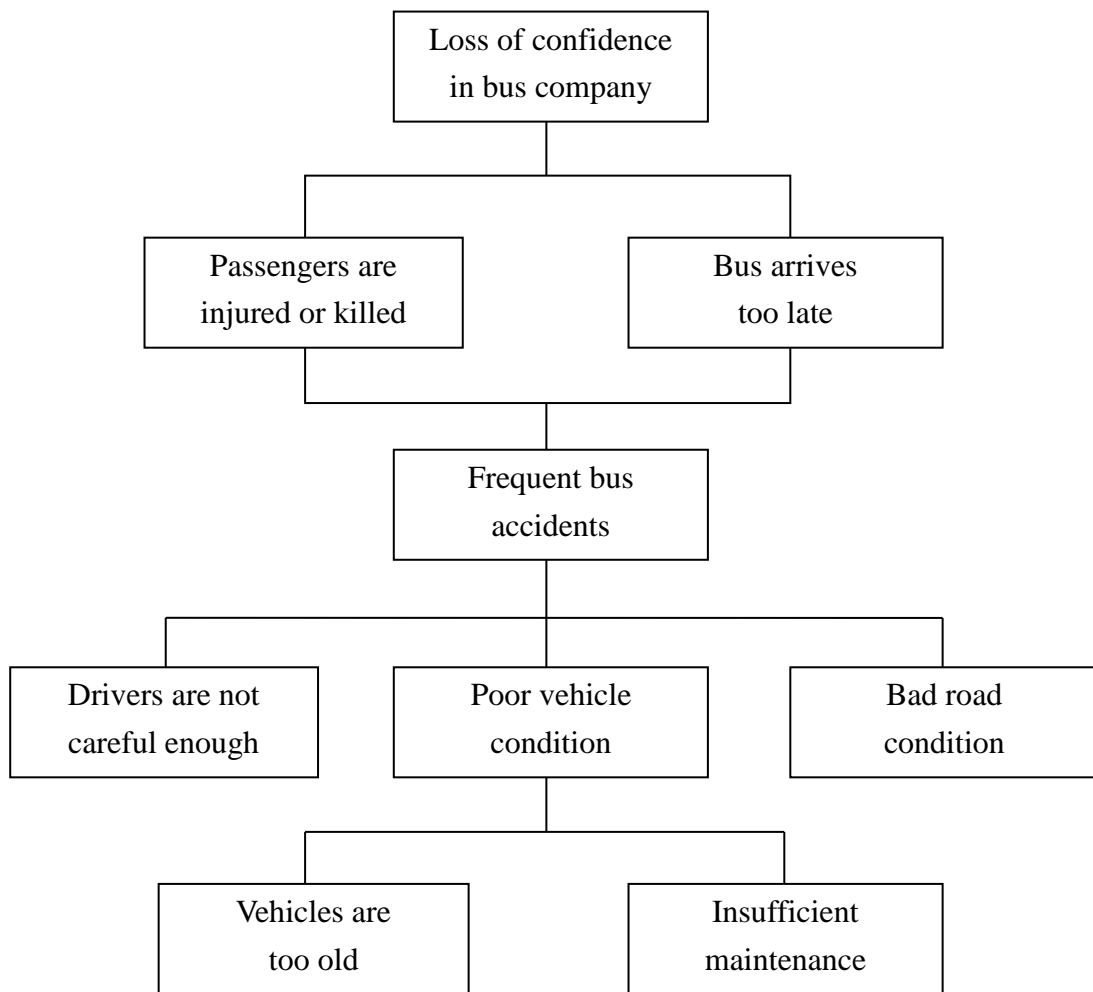


Figure 3-2. Example of a problems tree. *Source* FASID (1993)

In a PCM workshop organised by a facilitator, participants are divided into small groups. In each group, they conduct the aforementioned activities. Problems analysis is a process in which participants analyse the current problems or issues to be treated. The approach requires participants to (1) identify any existing problems, (2) write down the problems on separate sticky notes (e.g. Post-it® notes), (3) place the sticky notes on plain vellum papers on the wall, and (4) sort them out based on cause-and-effect relationships in the form of a tree-like structure (Figure 3-2).

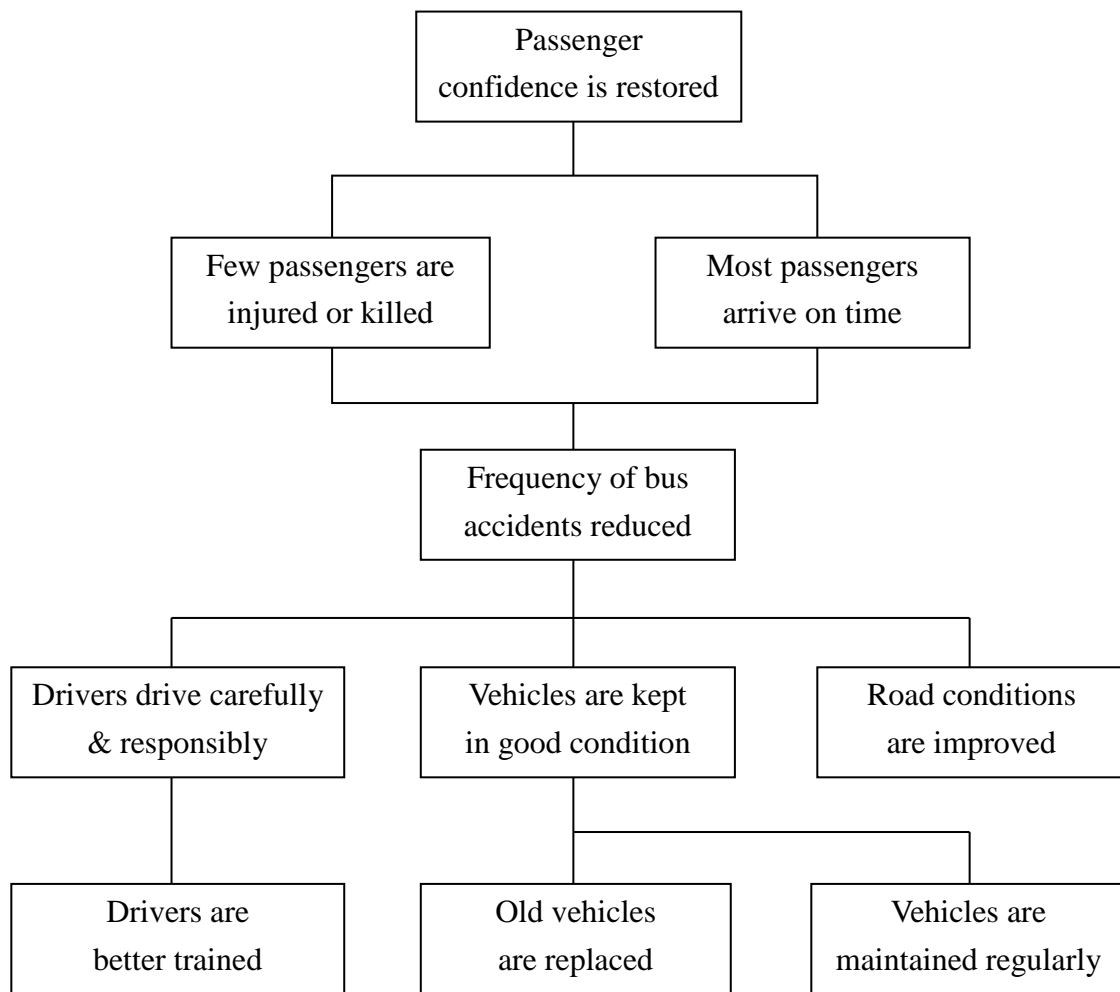


Figure 3-3. Example of an objectives tree. *Source* FASID (1993)

Objectives analysis (i.e. solutions analysis) is a process in which participants think about desired situations and the means to realise such situations based on a means-end relationship. In problems analysis, participants describe the problems or causal factors in negative terms and expressions. By contrast, objectives analysis uses narratives with positive expressions, adding new ideas or measures on cards to achieve the objectives or goals. The order of items in the tree-shaped structure at the point of objectives analysis essentially follows that of problems analysis (Figure 3-3). However, if the participants find anything awkward or inappropriate, they can reconsider the issues and reorder the items through a consensus.

Throughout the process, active discussion is encouraged, and decision making by a simple majority must be avoided.

Process of the PCM Method in the Case Lessons

Facilitator explanation

The author acted as a facilitator and provided students with a general explanation about PCM in the historical and global contexts of PBL and international development. Next, he randomly split the students into several small groups, instructing them to introduce themselves within their group. He then gave each student a sheet of paper that described a case scenario in a developing country.

From 2002 to 2005, he used the same case scenario presented in the textbook developed by FASID (1993). A brief summary of the case is as follows:

The capital city in a Latin American country has one public bus corporation which owns 90 % of all commercial buses. The remaining 10 % belong to small private companies. Buses are the major means of transportation for citizens. During the last ten years, the frequency of bus accidents has soared and has been the major cause of traffic congestion. There have also been fatal accidents, resulting in a growing distrust among citizens. Many accidents are due to technical reasons: The buses are dilapidated with no regular maintenance, and the shortage of spare parts prevents them being fixed when needed. In addition, the buses are operated by ill-mannered drivers who speed up on bad roads and even disregard traffic signals.

In 2006, he used a self-made case about the education sector, outlined as follows:

A country in South Asia is promoting poverty reduction and economic development, focusing on human development, especially primary education. Roughly 80 % of

school-aged children go to school, but one-third of them drop out partly because they are busy doing household chores. The average number of children in a classroom is over 80. Teachers are unsatisfied with their working conditions and low salaries. They participate in ad-hoc teacher training, but no positive changes are made to teaching and learning methods as a result. Schools have no electricity or water. Children, however, do not question this because they have always known this to be the case and are not aware that a change is possible.

After silently reading the case, the students started a problems analysis. The following is the overall process of the PCM workshop observed by the author over a period of 5 years. This process, as experienced by students, roughly consists of and is seamlessly connected in four stages: anxiety, struggle, breakthrough, and transformation.

Exploration stage

Despite the facilitator's explanation, the students were puzzled because it was the first time they had experienced this type of participatory lesson. They were also surrounded by unfamiliar peers. In addition, the case was complex, and they had just read about it that morning. Student A stated, 'In the beginning, I was very nervous being among the other students with whom I had no personal acquaintance. I could not express myself well'. Student B wrote, 'There was a stifling mood hanging over my group in which everyone tried to remain taciturn and keep a low profile. The lesson style was so new to us. We usually have no chance to interact with others or express opinions in a classroom'. Student C referred to the influence of culture and said, 'I believe Japanese people are shy and hesitant to speak up, and I am no exception. So I was extremely fearful about what would happen in this lesson'. Student D remarked, 'When I listened to the explanation by the facilitator, it seemed so difficult, making me anxious about whether I could do it'. Student E,

describing a scenario during this uncomfortable stage, stated ‘We were uneasily making a problem tree without even exchanging a single word’. Thus, at this stage, students felt initial uncertainty and discomfort (Nel et al. 2008).

Adjustment stage

As time elapsed, the students became familiar with each other. As they became more actively involved in group-based activities, the discussions became more controversial and tangled. Barrett (2010) described this chaotic process unique to PBL as a transient but necessary messiness to shift into deeper learning. Student F wrote, ‘I found group work difficult. Each person had a different viewpoint. It took a lot of effort for us to reach a consensus’. Student G complained, ‘I expressed my opinion, but I was often refuted. If you were in the minority, you could not push through their opinions at all’. However, Student H commented, ‘I was surprised but enjoyed the divergence of opinions. Nonetheless, it was very difficult to draw a consensus’. Student I stated, ‘The more we considered, the more we got messed up in the head. It’s probably because there was no single definitively correct answer’. Meanwhile, the facilitator quietly walked around to each group and offered limited advice only when they were at a loss as to how to move forward. He stayed intentionally inactive (Kato 2005) but covertly helped them enjoy the dialogue within the team (Kumar and Natarajan 2007; De Simon 2008). Student J, in describing the behaviour of the author, noted ‘During group work, the facilitator did not rush us at all. He allowed us to freely discuss the issue to the hilt, so we felt safe to continue our work’. In this way, as Hmelo-Silver (2004) extracted two core features of PBL, during the lesson on PCM, students were guided to create new knowledge in collaborative groups while their intrinsic motivation was tactfully and indirectly tapped by the teacher, who acted as a facilitator of learning, not as a source of knowledge.

Synthesis stage

In the course of group activities, original ideas presented through peer collaboration made the students think and broadened their intellectual horizons. During the problems analysis, they clarified the cause-and-effect sequence of complex problems. This task helped them understand the overall picture and structure of the problems. Then, based on this analytical work, they moved on to an objectives analysis, searching for the best possible approach towards problem solving. They visualised the entire process of thinking and understanding and shared it through trial and error to the point where all members of the group could agree. Student K commented, 'What struck me the most in this lesson was making the invisible visible. Visualisation, simply done by writing ideas on cards and posting them, enhanced our understanding and learning'. Student L mentioned, 'Today's class was more like a fun game than a lesson and a sense of participation was a great joy to me. I was so engrossed that I lost track of time, but it was good not only to gain knowledge but also to learn how to learn. I bet learning through experience is less likely to be forgotten'. Student M further stated, 'There were so many discoveries. I learned that all things have a cause and effect and that they are inseparably connected. A problem-solving skill like PCM cannot be mastered without experiencing it'. Characterising the nature of PCM accurately, Student Q mentioned, 'I found PCM simple, logical, and practical. I would like to apply this method to my college life and job hunting, too'. This student added, 'Perhaps my thinking ability has been developed. If I continue this, I will become a more efficient problem solver'. From a different perspective, Student N said, 'Initially, I covered in fear. But after the group work, I gained some self-confidence in speaking up'. These vivid comments would never have been made if the students had worked independently. Through the PCM method, the students became keenly aware of the importance of overcoming fear and generating ideas visually and gained a sense of achievement.

Transformation stage

After the students completed the objectives analysis, the facilitator ended the group work and reviewed the lesson for the whole class. He then instructed the students to reflect on and share their learning experience within their group. Finally, he asked each student to submit an open-ended questionnaire similar to a 'minute paper' or 'half-sheet response' (Stead 2005). In their questionnaire responses, the students wrote qualitatively rich comments showing their transformative change from the perspectives of cognitive, social, and internal aspects. For example, Student O commented, 'I got to know how difficult it is to solve a problem in a developing country. I also felt that our society, faced with complex problems as well, is not alien to the well-being of other countries'. Student P wrote, 'Some people say that PCM is difficult because there's no correct answer. However, that drove us to examine all the aspects of an issue, enabling us to think deeper. This makes the learning process meaningful as we must struggle, discuss, and work together'. Another student, in referring to her peer, observed, 'There was a person in my group who led us to a better direction, creating a warm atmosphere. I want to be a person like her who can proceed with things in a smart manner'. Student R commented, 'I found it valuable to come up with an answer by gathering the wisdom of all members. I think that passive learning will eventually deprive us of creative faculties. I would like the university to offer more lessons like this, with discussion or interaction with my peers'. Student S discussed her eye-opening experience, 'It was only 2 weeks, but I really learned a lot. I became equipped with a more positive attitude in my learning and communication with peers. I understand that dialogue with others prompts mutual growth as a person'. Student T also made an interesting comment: 'The discussion made me find a different and surprising part of my friends as well as that of me. Besides doing case analysis, I unknowingly did self-analysis as well. So this method is instrumental in knowing who you are

and who I am'. Another student discovered her own potential and self-value. She reflected, 'I found it delightful to express myself and be accepted by others. I feel proud of myself, having made a greater-than-expected contribution to my group. Now I feel a bit like a different person'. Student U further stated, 'Problems on the earth in fact relate to all of us. So we would be selfish if we showed no interest in them and concerned ourselves only with our own happiness and prosperity.' Thus, implementing and reflecting on PBL led the students to examine themselves and even provided an opportunity for enhancing personal development (Fenwick 2002) and raising awareness of social responsibility.

(4) Discussion

Having described the students' learning process in the PCM method, in this section, the author examine the results from the perspectives of the three learning aspects. As indicated in Table 3-2, there is a pattern of transition with regard to each item of the framework. Upon examination, the results for the three perspectives—the cognitive, social, and internal aspects—reveal that students went through a pattern of transition from one item of the framework to the next.

First, concerning the cognitive aspect, the students understood little about PCM when they initially listened to the general explanation of it. However, once assigned to groups, they started a problems analysis by reading the case individually and silently. Following the procedure for problems analysis, they wrote down things they considered as problematic and posted them on the vellum papers. By doing so, they were able to visually understand their own views as well as those of others. Then, they placed and re-placed the cards, keeping in mind cause-and-effect logic. In a subsequent objectives analysis, they brainstormed new ideas or concrete measures by stretching their ingenuity to improve the given case scenario. Then, by the time the objectives tree was organised, specific measures to change the scenario for the

better came into view. This practicum enabled the students to master the basic skills of PCM. In the end, they expressed their motivation to apply problem-solving skills to various issues they might come across in the future. Thus, PBL utilising the PCM method can help students become flexible and reflective thinkers with practical problem-solving skills and the ability to think out of the box (Hmelo-Siver 2004).

Table 3-2. Learning process of the students observed in lessons on PCM

	Exploration	Adjustment	Synthesis	Transformation
Cognitive	Writing down the problematic factors on sticky notes and placing them on plain vellum papers (Externalisation)	Exploring the causal relationship of factors through shared visualisation (Sharing)	Gathering wisdom to identify best possible solutions among multiple choices (Integration)	Acquiring subject matter knowledge and basic problem-solving skills (Internalisation)
Social	Staying aloof, shying away from each other (Separation)	Arguing back and forth with people who hold different views (Interaction)	Reaching a consensus through creative dissonance (Agreement)	Learning the importance of dialogue that promotes mutual understanding (Empathy)
Internal	Feeling tense and uncomfortable with a new lesson style, surrounded by unfamiliar peers (Apprehension)	Conducting self-reflection while monitoring one's own thinking and behaviour (Reflection)	Expanding one's view and finding potentials and values within the self and others (Development)	Not only concerning oneself but also wishing to be of use to society at large (Contribution)

Second, regarding the social aspect, the students were tense and quiet in the beginning. However, as they became familiar with each other, they began to express themselves more actively. Various conflicts of ideas took place, but as the students sought to understand and respect each other, the dissonant atmosphere gradually changed into a constructive and

creative environment. Finally, the students reached a consensus with others despite having originally held differing views. Thus, PBL ushered students from anxiety, uncertainty, and reservation to confidence, certitude, and open-mindedness. In the end, they improved the interpersonal skills necessary for thriving in a teamwork setting. Moreover, beyond skill acquisition, they came to understand the importance of dialogue that opens up their hearts and helps them discover more shared values than differences (Ikeda and Unger 2005).

Third, for the internal aspect, it is important to accept others with different values and know how to broaden one's own perspectives. The students in the study were first overwhelmed by the abundance of diverse opinions, but later found it interesting and enjoyed and appreciated these differences. Having fun, they came to recognise the values and potentials within the self and others. This implies that PBL, even when implemented within a limited period in a single course, can help learners acquire different types of views, values, and feelings that are less likely to appear in the process of conventional teaching. That is, as discussed in the section titled 'Transformation stage', the learners described their various changes they went through after participating in PBL. Although their reflective accounts are still somewhat abstract and brief, as Fenwick (2002) pointed out, these narratives suggest the personal transformation of participants as a significant or ultimate outcome of PBL. In other words, students' perceptions are likely to go further than the acquisition of new knowledge or social skills that has been largely discussed in the existing literature on PBL (Moust et al. 2005; Strobel and van Barneveld 2009; Reynolds and Hancock 2010; Yew et al. 2011).

The students' comments indicate that they hope for activity-based, dialogical, and interactive learning such as PBL in future lessons. They may be eager to search for clues or vehicles that will guide them to grow as learners as well as persons. Their sincere expressions led the author to think further about the importance of studying the affective or psychological aspect of learners. Schmidt (1993) suggested the need for future research to analyse where

students come from and what they think while being engaged in the PBL process. To date, however, such questions have not been fully discussed.

Generally, learning is likely to occur when learners enjoy themselves (Petranek 1994) and have a sense of self-worth and self-efficacy (Kaufman and Mann 2001). When such conditions are fulfilled, then, as claimed in earlier research (Barrows 1986; Norman and Schmidt 1992; Colliver 2000; Williams 2001; Askell-Williams et al. 2007), PBL will contribute to enhancing self-directed learning. These findings suggest that fostering positive emotions among students can provide the basis for meaningful learning. In this sense, the emotionality of learners in PBL is of great importance, and teachers are expected to be sensitive enough to understand how individual students feel as well as how they think and interact with others in the PBL process. Existing research on PBL, however, has not sufficiently addressed this affective element, which is not an end product of PBL but rather emerges in its process. The aim of PBL is not only to acquire problem-solving and interpersonal skills but also to enhance the reflective capacity or self-knowledge of participants (Fenwick 2002). Indeed, PBL involves a personal domain (Keville et al. 2009). In this regard, as described above, the results of this research elucidated that learners had certain feelings or sentiments concurrently as they furthered their enquiry on the topics they encountered in the lesson. That is, there are always emotional reactions that coincide with cognitive and social ones in the PBL process.

Obviously, PBL has some difficulties and limitations. For instance, it requires teachers' time and energy (Barrows 1986), and it is often arduous to change the mindsets of faculty and familiarise students with this innovative approach (Akinoğlu and Tandoğan 2007). PBL can be challenging or even daunting for socially inept, introverted learners, as seen in the case in the previous section of this chapter. In addition, PBL requires attentive assessment in both formative and summative ways (Lovie-Kitchin 2001). However, no challenge is immune to

initial difficulties. Thus, PBL advocates need a great deal of fortitude and endurance (Harland 2003). Additionally, to make PBL efforts sustainable, it is essential to create a university-wide climate or system of encouraging and rewarding academics with incentives (Hitchcock and Mylona 2000), spearheaded by strong management leadership.

This study has several implications for future research. First, the process of exploring the self and its impact on learning at the individual level are worth examining deeper and further. Additionally, it would be possible to identify variables, using both qualitative and quantitative approaches, that are conducive to the personal transformation of learners. This would raise the potential and rationality of conducting a longitudinal study of learners during and after the PBL courses they take or even after their graduation from university. Besides, the professional growth of the faculty through the PBL process can be further studied. Åkerlind (2003) clarified seven stages of teacher professional development in university education in general, but this study mainly focuses on the cognitive or conceptual dimension of teaching, thereby paying little heed to the innermost change of the teaching self.

(5) Conclusion

The present study investigated the process and meaning of PBL that students may experience from the perspectives of cognitive, social and internal aspects. Despite the relative ignorance about the internal aspect of learners in previous research, the results of the study revealed that the internal aspect is inseparably linked with the other two aspects, and the three of them simultaneously undergo their own changes in the PBL process. Then, beyond knowledge building and skill acquirement, PBL may have contributed to broadening learners' perspectives and promoting their personal development. In this regard, PBL can be defined anew, from an angle different from that of previous research, as learning that can generate rich and varied emotions in learners concurrently as they face problems, enable them to

acquire subject matter knowledge and relational skills through dialogue, and eventually guide them to the threshold of personal transformation.

As discussed at the beginning of this research, PBL was developed to increase practical strength in university education. Because of its origin, the research hitherto has mainly focused on knowledge or skill acquirements and social interactions by the learners, not on their inner landscape emerging in the PBL process. However, this research has revealed that learners, being also influenced by their emotions, have much deeper experiences, namely, personal transformations in terms of values and perspectives. It is crucial for researchers of PBL or higher education to shed light on such matters, because meaningful learning experiences seem to be no less importantly affected by the feelings or internal aspect of learners than by cognitive and social counterparts.

The need to pay attention to internal aspect gives rise to some suggestions for further research tasks and has practical implications for teaching. First, a need exists to clarify how emotions or internal variables affect learning in the cognitive and social dimensions. Their relationships may not necessarily be linear, but it is important to map out how they are related. Likewise, in terms of practice, teaching may roughly result in either a satisfactory or an unsatisfactory manner in terms of student engagement in learning. Therefore, teachers should analyse learners' attitudes by observing the learners carefully throughout the process of PCM in order to identify which stage they are at and what kinds of support or help they need. As Sato (2011) averred, teachers can observe how learners are engaged in their tasks—e.g. whether they are left out or thinking hard—by carefully gauging their non-verbal signals. In their study of lower secondary education, Sato and Sato pointed out that it is important for teachers to notice and understand both verbal and non-verbal signals given by learners, and the same can also be said for higher education. For example, some learners are too shy to communicate well with their classmates; others choose not to work on the task because they

do not feel it is relevant to their lives; and still others dominate the process of learning. In each situation, there are different reasons for the given phenomenon. A teacher has to be able to identify which factors are affecting the situation, whether he or she should intervene or not, and if he or she needs to, what kind of intervention is most appropriate. Then, the teacher needs to help learners move forward to the next phase of learning, as shown in Table 3-2. Further, it becomes crucial for the teacher to reflect on his or her practice to see whether it includes effective methods of facilitating learning. Paying attention to learners' subtle signals and inner voices and reflecting on ones' own behaviour may promote the professional growth of academics as teachers.

Chapter 4 Quantitative Case Study

1. Introduction

In Chapter 3, the process and meaning of PBL experienced by university students was unravelled based on the two qualitative case studies. In addition, Chapter 3 clarified that PBL has positive effects on the understanding of subject matter, acquisition of interpersonal skills, and promotion of personal transformation. Chapter 4 verifies those effects through quantitative analysis. In fact, while the cognitive and social dimensions of PBL have been extensively studied through statistical analysis, little or no quantitative research has been conducted on learners' internal changes that take place through the PBL process.

Dahlgren et al. (1998) mentioned that small-group discussion is one of the most characteristic features of PBL. So, in order to accentuate this distinctive point, the author implemented individual PBL and group PBL to compare them. Individual PBL involves a problem-based learning activity conducted by a learner without interacting with others; each individual attempts to solve problems independently. Group PBL is a more orthodox type of PBL in which learners work together for problem solving through discussion. In short, the underlying questions in this chapter are as follows.

- (1) What if there is no small-group discussion in PBL?
- (2) What is small-group discussion particularly effective for in PBL?

2. Methods

Context

In January 2014, a lesson was conducted as part of this study in a course titled 'Art Education'

offered by the Faculty of Education of a national university in the Kanto area of Japan. An associate professor of the university taught the whole course, but she invited the author as a guest lecturer by asking him to conduct a lesson on the PCM method in the context of art education in the third world. As the professor normally adopted a lecture-based style of teaching, she expected the author to provide students with a more interactive and participatory learning opportunity.

Participants

Participants included two different groups of undergraduate students who took the same course. Both groups were studying to earn a teaching certificate in primary and secondary education, but one group comprised varied students majoring in health and physical education, technology education, and special needs education while the other majored in social studies education alone. The former attended class during the third period on Tuesdays while the latter attended the fourth period on the same day. As a consequence, the associate professor usually repeats the same lesson twice for different groups of students. On the day of the lesson, 50 students (25 males, 25 females) participated in the third period, and 53 students (47 males, 6 females) participated in the fourth.

Measures

Based on the three aspects of learning attested by Cazden (2001)—cognitive, social, and internal—this study measured learners' changes in perceptions with regard to subject matter, others, and self. Correspondingly, the author devised the hypothetical constructs, namely, 'understanding of and interest in subject matter', 'communication and empathetic attitudes', and 'self-reflection and metacognition'.

The author referenced the questionnaires administered in the studies of Sungur et al.

(2006) and Klegeris and Hurren (2011) for the first construct, and the research of Fujimoto and Daibo (2007) for the second construct, especially concerning ‘expressivity’, ‘assertiveness’ and ‘acceptance of others’. Regarding the third construct, the author referred to some question items used in the papers of Hirayama and Kusumi (2004), Gurpinar et al. (2010), and Downing et al. (2011) and modified them for the present study. Then two types of nearly identical questionnaires were developed with 30 and 27 question items respectively; one for pre-class assessment (Appendix A), and the other for post-class assessment (Appendix B). In addition to the 27 question items used in both questionnaires, pre-assessment included three additional items asking about the students’ dispositions toward sociality and experiences in hands-on and group-based lessons in university. All items were answered on a 1-7 scale (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = agree, and 7 = strongly agree).

Materials and Procedure

Prior to his lesson titled ‘Official Development Assistance in the Education Sector by the Japan International Cooperation Agency’, the author prepared a problem statement or a quasi-realistic case that described an unfavourable situation in a foreign country (Appendix C).

The lesson was composed of two major parts; a lecture and a problem-based learning activity consisting of problems analysis and objectives analysis in the PCM method. In this regard, the lesson is not a pure but rather a mixed form of PBL because it includes a one-way lecture as well. Students in the third period were to have a lecture and then perform individual PBL. Their counterparts in the fourth period were to receive a lecture first and move on to implement group PBL. Thus, while both lessons adopt a blended mode of PBL, the author refers to the former as individual PBL and the latter as group PBL for the sake of simplicity.

Each lesson was 90 minutes long, and its detailed time allocation is presented in Appendix D. The exemplary outcomes of the two analyses that were prepared and distributed by the author to students for explanation and reflection are shown in Appendix E and F.

Statistical Analysis

All participants were to answer and submit both pre-class and post-class questionnaires. The number of collected datasets excluding missing values was 38 (18 males, 20 females) in individual PBL and 47 (41 males, 6 females) in group PBL. The answers of those who arrived late, left early, and marked erroneously were excluded. Consequently only perfectly-marked sets of questionnaires were utilised for statistical analysis.

The unpaired Student's *t*-test (hereafter called 't-test') was conducted to make comparisons on pre-class assessment between the two types of PBL students. Exploratory factor analysis was also adopted to determine the nature and number of unobserved latent constructs and the underlying structure of a set of observed variables (Cohen et al. 2000; Preacher et al. 2013). Additionally, the analysis of variance (ANOVA) was employed with regard to two factors: time (before class, after class) and the teaching style (individual PBL, group PBL).

3. Results

Students' Dispositions and Learning Experiences

The unpaired *t*-test revealed no statistically significant differences between the two groups concerning their dispositions toward sociality and hands-on learning experiences (see Table 4-1). As mentioned previously, the third-period students variedly majored in health and physical education, technology education, and special needs education, whereas their fourth-period counterparts solely specialised in social studies education. Also, the third-period

class was composed of an equal number of males and females, while the fourth-period class was made up overwhelmingly of males. Nonetheless, no differences were found between the two groups.

Another unpaired *t*-test was administered and found no statistically significant differences between males and females in the third period and between those in the fourth period with regard to their dispositions and learning experiences (see Table 4-2 and 4-3).

Table 4-1. Results of unpaired *t*-test between third-period students and fourth-period students concerning their dispositions and learning experiences

Question item	Third-period students (Individual PBL)		Fourth-period students (Group PBL)		<i>t</i> -value (<i>df</i> =83)
	Mean	SD	Mean	SD	
q28	5.13	1.40	4.91	1.61	0.65
q29	4.63	1.62	4.00	1.73	1.72
q30	4.39	1.31	4.02	1.61	1.16

Note: third-period students (n=38), fourth-period students (n=47)

Table 4-2. Results of unpaired *t*-test between males and females in the third period concerning their dispositions and learning experiences

Question item	Males		Females		<i>t</i> -value (<i>df</i> =36)
	Mean	SD	Mean	SD	
q28	5.33	1.57	4.95	1.23	0.84
q29	4.94	1.63	4.35	1.60	1.14
q30	4.56	1.38	4.25	1.25	0.72

Note: males (n=18), females (n=20)

Table 4-3. Results of unpaired *t*-test between males and females in the fourth period concerning their dispositions and learning experiences

Question item	Males		Females		<i>t</i> -value (<i>df</i> =45)
	Mean	SD	Mean	SD	
q28	4.93	1.66	4.83	1.33	0.13
q29	4.05	1.73	3.67	1.86	0.50
q30	4.05	1.70	3.83	0.75	0.30

Note: males (n=41), females (n=6)

Table 4-4. Results of exploratory factor analysis

(Principal axis factoring with varimax rotation)

No.	Item						Commun- ality
		I	II	III	IV	V	
I. Thinking & Attitude ($\alpha=.90$)							
8	There is more than one right answer or solution.	.86	-.02	-.01	-.17	-.05	.60
7	I am impressed by ideas I would never hit upon by myself.	.82	-.07	-.02	-.04	.07	.66
10	I realise and accept others who see things differently from me.	.70	-.01	.01	.19	.23	.61
13	I want to learn a lot by meeting many people with different ideas.	.70	-.08	.02	-.05	-.05	.66
11	I gather ideas of mine and others and make better choices based on them.	.63	.10	-.03	.14	.06	.58
14	I want to acquire skills to solve problems of mine and those around me.	.61	-.05	.19	-.31	.13	.53
6	There are some things one can learn only by doing.	.60	-.09	-.02	.01	.07	.37
9	Concerning complex problems, I sort out the connections among them.	.52	.12	-.08	.31	-.02	.50
16	I examine things from as many perspectives as possible.	.51	.15	.16	.18	-.22	.51
15	I examine myself to see whether I unknowingly have a biased view.	.42	.10	.06	.29	.05	.41
II. Understanding & Interest ($\alpha=.84$)							
4	I feel familiar with Japan's official development assistance.	-.18	.85	-.06	.20	.09	.81
2	I feel familiar with developing countries.	-.18	.84	.16	-.08	.09	.73
3	I know of Japan's official development assistance.	.16	.79	-.14	-.10	-.02	.57
1	I know of developing countries.	.07	.66	.05	-.24	-.04	.40
III. Empathy ($\alpha=.86$)							
26	I want to be a person who has empathy for troubled people around me.	.06	-.04	.89	.00	-.08	.76
27	I want to be a teacher who has empathy for troubled students.	.04	-.02	.88	-.01	-.03	.77
25	I want to be a person who has empathy for developing countries.	.12	.16	.55	.02	.06	.56
IV. Communication ($\alpha=.74$)							
20	I express my ideas and opinions clearly.	.03	-.07	-.06	.82	-.07	.59
21	I express my feelings honestly.	-.15	-.19	.10	.74	.17	.52
V. Development & Contribution ($\alpha=.79$)							
23	I want to have a lot of different experiences during my college years.	.20	.05	-.18	-.03	.82	.59
22	I want to study a lot during my college years.	-.03	.06	.10	.06	.70	.70
24	I want to conduct myself to be of use to people and society.	.11	-.05	.29	.23	.36	.57
Factor Correlation		I	—	.24	.66	.44	.51
		II		—	.35	.40	.13
		III			—	.49	.53
		IV				—	.21
		V					—

Excluded Items

- 5 I feel like that I will be of use to people and society.
- 12 I want to increase my knowledge of my major field of study.
- 17 I make a judgment based on as many facts as possible.
- 18 I pay attention to others' ideas and opinions.
- 19 I put myself in someone's shoes.

Exclusion Criteria

- Items that do not contribute to any factors (or its factor loading is less than .35)
- Items that contribute to more than one factor

Identification of Constructs

Five latent constructs were extracted, as shown in Table 4-4, through exploratory factor analysis employing principal axis factoring with varimax rotation. Excluded were any items that contributed to more than one factor or did not contribute to any factors (or with factor loading of less than .35). Given the nature and content of each cluster of question items, they were named as ‘understanding of and interest in subject matter’, ‘high respect for communication’, ‘empathy’, ‘flexible and objective thinking and attitude’, and ‘eagerness toward self- development and contribution to society’. These constructs are abridged and appear in the forthcoming tables and figures respectively as ‘Understanding & Interest’, ‘Communication’, ‘Empathy’, ‘Thinking & Attitude’, and ‘Development & Contribution’.

Comparison between Individual PBL and Group PBL

The unpaired *t*-test was carried out for each construct in the pre-class assessment scores between individual PBL students and group PBL counterparts. The results demonstrated that there were no significant differences between the two types. Table 4-5 shows the results based on factor scores.

Table 4-5. Results of pre- and post-class assessment between individual PBL and group PBL based on factor scores

Time	Measured Construct	Individual PBL		Group PBL		<i>t</i> -value (<i>df</i> =83)
		Mean	SD	Mean	SD	
Pre-class	Thinking & Attitude	-0.06	0.87	-0.27	1.08	0.93
	Understanding & Interest	-0.51	0.74	-0.39	0.78	-0.70
	Empathy	-0.24	0.83	-0.36	1.08	0.59
	Communication	-0.36	0.73	-0.43	0.94	0.32
	Development & Contribution	0.08	0.79	-0.23	1.08	1.47
Post-class	Thinking & Attitude	0.11	0.84	0.23	0.95	-0.60
	Understanding & Interest	0.52	0.88	0.39	0.93	0.67
	Empathy	0.29	0.83	0.32	0.83	-0.19
	Communication	0.51	0.83	0.31	0.90	1.20
	Development & Contribution	0.11	0.72	0.08	0.79	0.17

Two-factor ANOVA

The two-factor ANOVA was administered with regard to the time (before class, after class) and the PBL type (individual PBL, group PBL). The main effects were identified for the time in terms of all the five constructs at the $p < .01$ level. The interaction between the time and the PBL type was found to be statistically significant ($p < .01$) regarding the construct of ‘Thinking & Attitude’ and be marginally significant ($p < .10$) concerning the construct of ‘Development & Contribution’. Therefore, the simple-main-effect test was conducted, and the results revealed that post-class scores were significantly higher than pre-class scores only in group PBL as for both constructs ($p < .001$ and $p < .01$ respectively).

Table 4-6 shows the results of the two-factor ANOVA based on factor scores. Figure 4-1 and Figure 4-2 present how these two factors were associated in the constructs of ‘Thinking & Attitude’ and ‘Development & Contribution’.

Table 4-6. Results of two-factor ANOVA (time, PBL type) based on factor scores

PBL type Time	Individual PBL ($n=38$)				Group PBL ($n=47$)				F-value (df = 1, 83)		
	Pre-class		Post-class		Pre-class		Post-class		Time	PBL type	Interaction
	Mean	SD	Mean	SD	Mean	SD	Mean	SD			
Thinking & Attitude	-0.06	0.87	0.11	0.84	-0.27	1.08	0.23	0.95	30.15***	0.04	6.89*
Understanding & Interest	-0.51	0.74	0.52	0.88	-0.39	0.78	0.39	0.93	122.72***	0.00	2.34
Empathy	-0.24	0.83	0.29	0.83	-0.36	1.08	0.32	0.83	69.33***	0.06	1.21
Communication	-0.36	0.79	0.51	0.72	-0.43	0.94	0.31	0.79	116.52***	0.64	0.86
Development & Contribution	0.08	0.73	0.11	0.83	-0.23	1.08	0.08	0.90	4.59**	0.89	2.92 [†]

Note: *** $p < .001$, ** $p < .01$, * $p < .05$, [†] $p < .10$

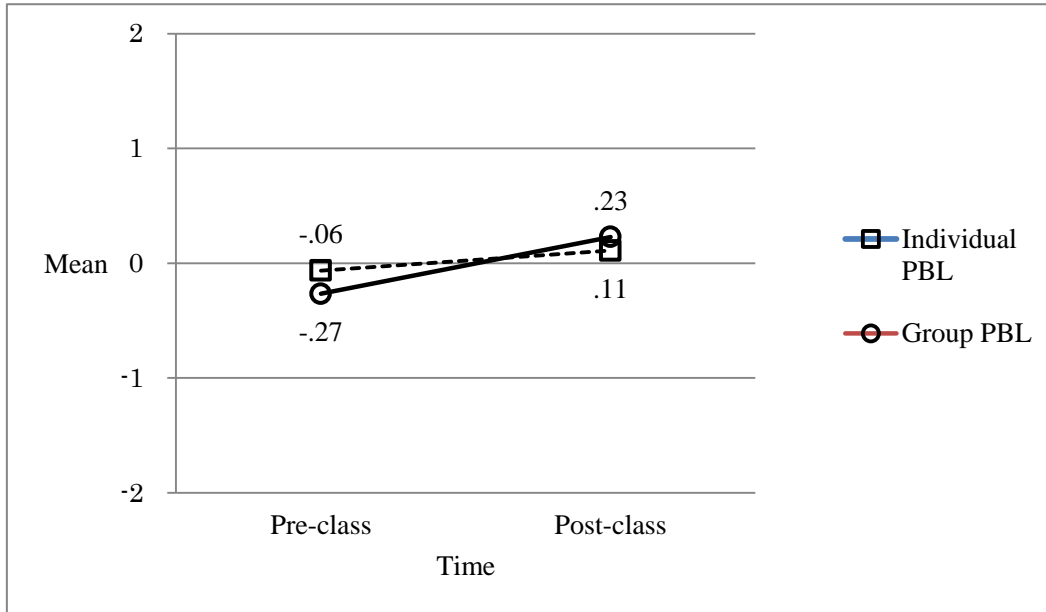


Figure 4-1. Interaction between the time and PBL type regarding ‘Thinking & Attitude’ based on factor scores

Note: The interaction was statistically significant at the $p < .01$ level. Post-class scores were significantly higher than pre-class scores only in group PBL ($p < .001$).

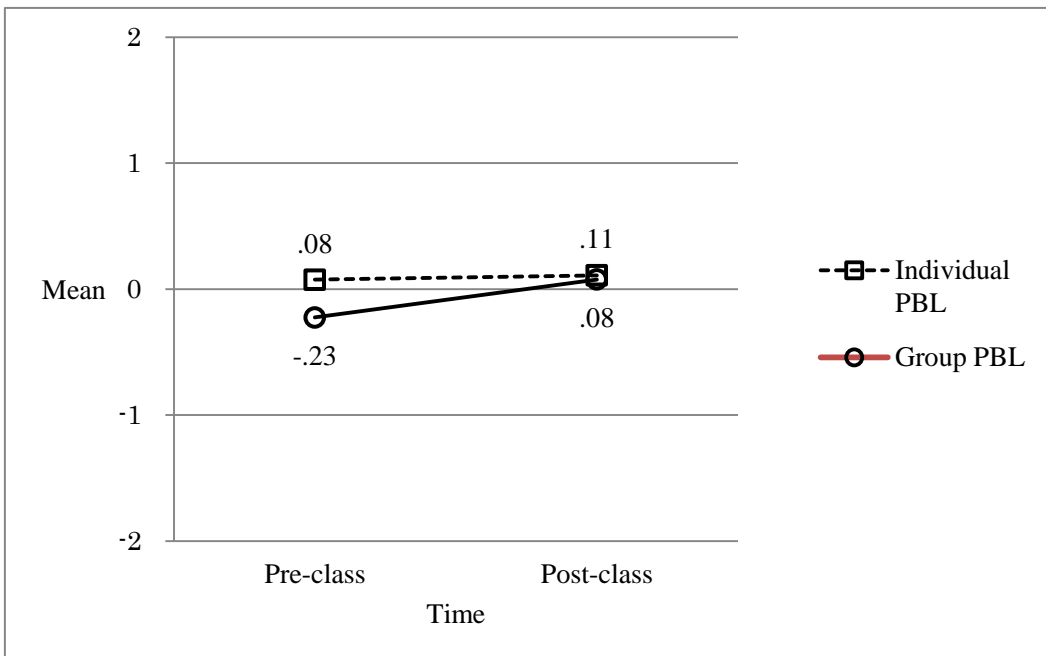


Figure 4-2. Interaction between the time and PBL type regarding ‘Development & Contribution’ based on factor scores

Note: The interaction was marginally significant at the $p < .10$ level. Post-class scores were significantly higher than pre-class scores only in group PBL ($p < .01$).

4. Discussion

As depicted in the previous section, the results of the simple main-effect-test revealed that only group PBL students significantly increased their awareness of the importance of: (1) flexible and objective thinking and attitude, and (2) self-development and contribution to society.

These findings imply that PBL without discussion may fall short of creating changes in the innermost part of learners. That is, in contrast to students who attempt to solve problems in isolation, those who try to solve problems collaboratively with their peers are more likely to have academic, social, and internal stimuli, examine their language and behaviour, and broaden their outlook. Such interaction with others may have inspired them and had a positive influence on their thinking and attitude and a zest for personal development and social contribution. Indeed, discussion, collaboration, interaction, dialogue, and the like are essential ingredients that make PBL genuinely unique. Listening patiently to others and talking concisely to them are cumbersome tasks. However, as Sungur and Tekkaya (2006) noted, this indispensable process helps students revise their ideas and realise the deficiencies in their thoughts, thereby promoting their reflective practice and metacognitive development.

This line of argument led the author to consider further the function and effects of small-group discussion. Through a series of discussions, learners may eventually feel a sense of gratitude for their peers. Within a group that can be regarded as a microcosm of society, some members may doubt the opinions of others, but at the same time they may provide valuable feedback and eye-opening comments. Through this rough-and-tumble process, learners who have received benefits may gradually become more respectful and grateful toward others. In return, they also become esteemed and appreciated by others for their contribution to the group. Learners then seem to recognise the necessity of being more knowledgeable and skilled to repay the favour they received. This may be a mechanism of

how students may become conscious through dialogue about the significance of personal growth and social contribution.

Small-group collaborative discussion has long been regarded as a requisite for PBL (Barrows 1996; Dahlgren et al. 1998; Savery 2006; Schmidt et al. 2009; Yew and Schmidt 2009). However, the results of this study showed that even in individual PBL, the scores of post-class assessment were significantly higher than those of pre-class assessment regarding the four constructs of 'Thinking & Attitude', 'Understanding & Interest', 'Communication', and 'Empathy'. It is notable that students who worked alone came to appreciate the importance of communication and empathy as well. This implies that despite no interaction in PBL, if learners rack their brains and struggle toward problem solving, PBL can foster an awareness of placing value on such constructs to some extent. This may suggest that even in a lecture-oriented lesson, if a teacher adopts somewhat problem-solving and decision-making activities during class, it can partly yield comparable effects on learners just as traditional group PBL does.

This study focused two types of PBL lessons that dealt with international cooperation. It cannot be denied that the content may have affected the results of statistical analysis. In other words, if the author had taken up other topics such as educational problems in Japan, low birth rate and longevity, youth unemployment, and natural disasters, the results might have been different from the current ones. Also, if the lecturer and students are different from those in this study, different results may be obtained even though the same PBL lessons are conducted with the same materials and procedure. Future research, therefore, can examine various combinations of such variables.

Lastly, this study invented individual PBL and compared it with group PBL. However, yet another type of PBL can be devised and analysed. For instance, there may be PBL without problem solving in which learners discuss for problem recognition but not for problem

solving. This type of PBL is implemented to deepen learners' understanding of problems or problematic phenomena but not to guide them to go beyond that. There may also be PBL without decision-making in which learners are to discuss possible solutions but need not agree to make any choices. They do not have to reach a consensus but rather limit themselves to an exchange of views. Thus, by including and excluding such components that have been largely taken for granted, researchers can pursue the characteristics, possibilities, and limitations of PBL.

5. Conclusion

The present study compared individual PBL and group PBL to respond to the two research questions. First, what if there is no small-group discussion in PBL? Second, what is small-group discussion particularly effective for in PBL?

The answer to the first question is that PBL without discussion appears to contribute to increasing learners' awareness of the importance of: (1) understanding of and interest in subject matter, (2) high respect for communication, (3) empathy, and (4) flexible and objective thinking and attitude. Still, this type of PBL cannot fully nurture their willingness toward self-development and contribution to society. The answer to the second question is that PBL with discussion seems to have positive effects on the above-mentioned four constructs plus eagerness toward personal growth and social contribution. The results of the study suggest that only through group work, learners' internal inspiration is evoked, and they may feel a deeper sense of gratitude for their peers and become serious about being more knowledgeable and skilled to return the favour they received. In this regard, small-group discussion could be a vital component that makes PBL (orthodox PBL with discussion) a genuinely unique educational approach.

This study measured the PBL learners' changes in perceptions with regard to subject

matter, others, and self in a quantitative fashion. However, there is still a need for more theory-based research to build a conceptual framework that explains how PBL can stimulate learners' academic quests, foster their respect for dialogue and empathy for others, and increase their motivation toward personal transformation through which they contribute to society. The next chapter tackles this challenge based on the findings of the third and current chapters.

Chapter 5 General Discussion

1. Insights Gained from the Previous Chapters

As reviewed and expounded in the ‘Synthesis’ section of Chapter 2, PBL research is deficient in the following: (1) in non-medical disciplines, (2) on the internal aspect of learners, (3) on the teacher, (4) on the education institution, (5) on the comprehensive conceptual framework, and (6) in the non-English-speaking world. This study addresses the four of them, namely, the first, second, fifth, and sixth deficiencies listed above as topics of inquiry.

Through two qualitative case studies, the process and meaning of PBL have been elucidated. First, the internal aspect of learners—which has been relatively neglected in previous studies—is indivisibly connected with the cognitive and social aspects, and the three of them concurrently go through their own developments in the PBL process. Then, beyond the acquisition of knowledge and skills, PBL may contribute to expanding learners’ horizons and propelling their personal transformation

Subsequently, the quantitative case study revealed that group PBL seems to have positive effects in raising students’ awareness of valuing the constructs as follows: (1) understanding of and interest in subject matter (Understanding & Interest), (2) high respect for communication (Communication), (3) empathy (Empathy), and (4) flexible and objective thinking and attitude (Thinking & Attitude), and (5) eagerness towards personal development and social contribution (Development & Contribution). By contrast, individual PBL appears to be effective for the first four constructs, but not for the last one. This suggests that only group work may help students evoke deeper self-reflection and facilitate an increased sense of gratitude toward their peers and responsibility to be more knowledgeable and skilled to return

the favour they received from others. In this regard, in order for PBL to help learners recognise the importance of ‘Development & Contribution’, the innermost part of their minds or framework of values needs to be awakened and inspired through interaction with their peers.

Incidentally, three aspects of learning in PBL presented in Table 3-1 and 3-2—the cognitive, social, and internal aspects—seem to be associated with five constructs extracted from exploratory factor analysis. Specifically, the cognitive aspect as a perception regarding content knowledge corresponds to ‘Understanding & Interest’. The social aspect as an interpersonal relationship with others pertains to ‘Communication’ and ‘Empathy’. The internal aspect as a consciousness of self relates to ‘Thinking & Attitude’ and ‘Development & Contribution’.

In the next section, based on the PBL flow clarified in the previous chapters, the author examines the structure and mechanism of how learning is generated through PBL from a holistic perspective. To that end, the dynamic model of knowledge creation developed by Nonaka (1994) is critically reviewed and utilised as a clue for developing a hypothesised conceptual model of PBL.

2. The SECI Model as a Clue for PBL Model Development

(1) The SECI Model

Nonaka (1991) originally presented the principle and process of knowledge creation by taking a cue from practices deeply rooted in Japanese manufacturing companies that flourished in the 1980s. Based on this argument, Nonaka (1994) developed a theoretical model of organisational knowledge creation. This model consists of four different knowledge conversion modes, that is, (1) socialisation, (2) externalisation, (3) combination, and (4) internalisation, so it is abbreviated and widely acknowledged as the SECI model. This model

explains how new ideas and concepts are created through a continuous interaction between tacit and explicit knowledge, undergoing each of the four modes of knowledge conversion (see Figure 5-1).

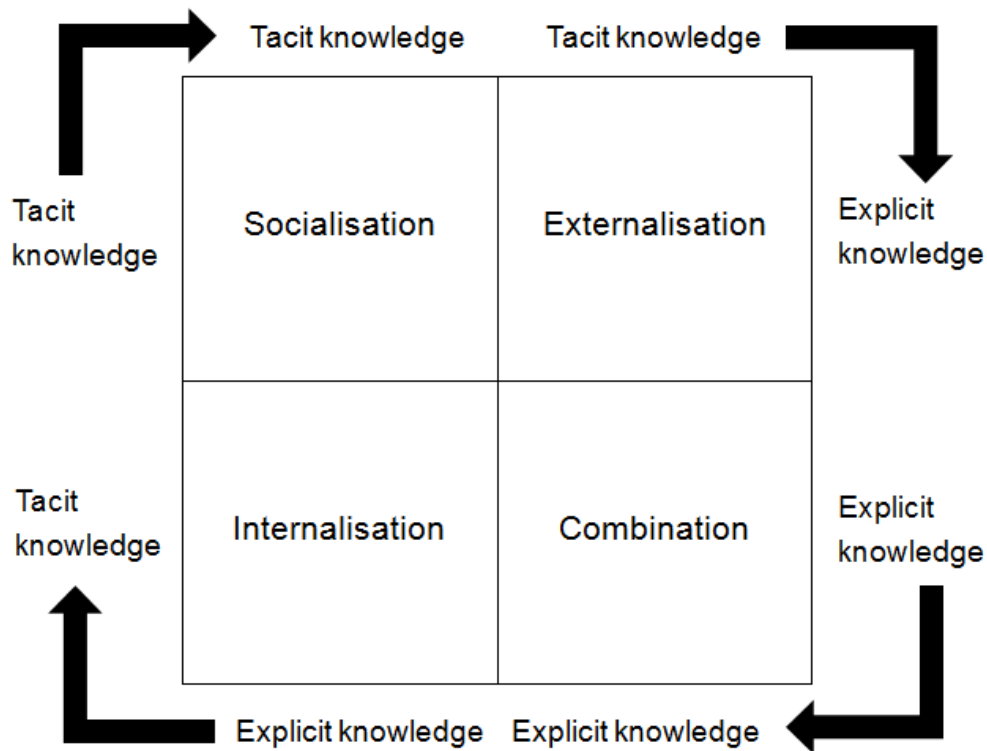


Figure 5-1. The SECI model: Four modes of knowledge conversion

Source Nonaka and Takeuchi (1995)

The notion of tacit knowledge originated with Polanyi (1966), who wrote that ‘we can know more than we can tell.’ However, it was Nonaka who first saw the importance of the distinction between tacit and explicit forms of knowledge (Martin and Root 2009). Difficult to express or explain with formal language, tacit knowledge is ‘personal knowledge embedded in individual experience and involves intangible factors such as personal belief, perspective and value system’ (Nonaka and Takeuchi 1995). On the other hand, explicit knowledge is objective and transferable knowledge that ‘can be articulated in formal language including

grammatical statements, mathematical expressions, specifications, manuals, and so forth' (Nonaka and Takeuchi 1995).

Concerning the four modes of knowledge conversion, socialisation is a process of sharing tacit knowledge with others. Nonaka et al. (2008) depicted that this example is typically seen in the apprenticeship system where the apprentice acquires know-how or inexpressible expertise from the master not through language but by close observation, imitation, and practice. They also added that the same applies to on-the-job training in modern corporations. Externalisation is a process of converting individuals' tacit knowledge into a group's or an organisation's explicit knowledge. This mode is prompted by group discussion or workshops in which every participant can feel free to express, exchange, and critique one another in a constructive manner. Combination is a process of synthesising diverse explicit concepts and creating new collective knowledge for practical and broad application. Finally, internalisation is a process of embodying organisational knowledge into each individual's tacit knowledge anew.

Two points should be noted here. First, socialisation is not always a starting point. As the SECI model is a cycle of four modes of knowledge conversion that takes place in real settings, it is often hard to identify its origination. Second, this model illustrates not two-dimensional but three-dimensional space, as Nonaka and Takeuchi (1995) described it as the knowledge spiral. While yielding innovations in individuals, organisations, and societies, knowledge is created and recreated as it moves upward.

(2) Limitations of the SECI Model

While the SECI model has drawn attention around the world and has been frequently cited in international journals (Chung 2004), critiques on various aspects of the model exist. Abe (2010) referred to some critiques that: (1) the model is a too simplistic dichotomy between

tacit and explicit knowledge, (2) the demarcation of each knowledge conversion mode is vague, and (3) the model was built without any quantitative evidence. In addition to these critiques, the author points out the following three points from new perspectives.

First, the SECI model is heavily inclined toward analysis from the cognitive and technical aspects. This seems inevitable, as the model deals with knowledge as the object of scrutiny. However, while Nonaka and Takeuchi (1995) asserted that ‘human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge’, no thorough analysis has been made on the human or social aspect. That is, although the model specialised in demystifying the process of knowledge creation, it failed to probe deeply into the interpersonal aspect (including communication, cooperation, and empathy), which provides a foundation for knowledge creation. Furthermore, although Nonaka (1991, 1994) averred that new knowledge is always created by the individual, not by the organisation, he conducted no further inquiry into the individual’s identity or affective aspect. Lave and Wenger (1991) maintained that, ‘knowing is inherent in the growth and transformation of identities’, but the SECI model does not expressly discuss ‘a new existence’ (Polanyi 1966) engendered in the self through the process of knowledge creation. Consequently, there is a lack of in-depth study of the synchronous coexistence of other conversion modes regarding the relational and internal aspects.

Second, the SECI model is confined to a theory of knowledge creation in a company or organisation. New ideas and concepts may also be created at home, in school, and even among friends in informal settings. While there is a type of knowledge that is conveyed unilaterally from the master or knower to the apprentice or non-knower, there exists another type of knowledge that is created and shared by those who possess the same level of knowledge. Suppose, for instance, a group of students in a science class who evenly have little knowledge about any given natural phenomena. They may be at a loss in the beginning,

but as they think together as a group, they may be able to come up with good logical hypotheses. Thus, knowledge can be co-constructed as group members participate in and contribute to each other. Because the SECI model is anchored to the assumption that there are knowledge gaps and hierarchical relationships between and among stakeholders, it cannot fully explain the rich and varied nature of learning generated through interaction among those who stand on an equal footing.

Third, the SECI model may hold true in peacetime, but it may not in unexpected or unprecedented situations. For example, in case of a nuclear accident that nobody has ever experienced, there would be no time to lose. No one could learn from knowers in such a circumstance because there are no experts on the issue. In such a case, ‘a typical method’, (Nonaka et al. 2008) by which the disciple should quietly observe the master to acquire know-how through imitation and practice, would be useless. As such, when there appears to be no single correct answer, all stakeholders need to begin externalising their thoughts in words and with pictures. Such collective and collaborative efforts through verbalisation and visualisation allow them to construct and share new ideas in order to solve a pressing problem.

3. Comprehensive Conceptual Model of PBL

In this section, the author presents a hypothesised but elaborative model of learning generated through PBL from the holistic perspectives of cognitive, social, and internal aspects. Drawing on the SECI model as a clue, the author has newly developed the comprehensive conceptual model that consists of: (1) the sub-model of knowledge creation, (2) the sub-model of relation building, and (3) the sub-model of personal transformation. Figure 5-2 portrays the three-layer structure of this model. Then the following three figures, or sub-models, which view this figure from above, depict the conversion process of each aspect.

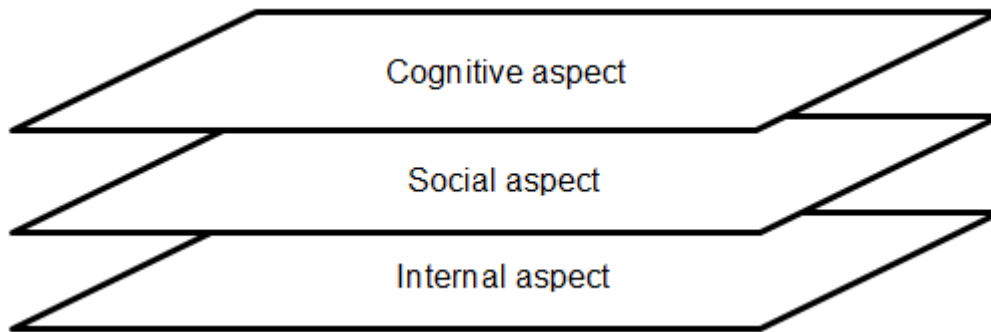


Figure 5-2. Three-layer structure of learning generated through PBL

(1) Sub-Model of Knowledge Creation in PBL

The sub-model of knowledge creation (Figure 5-3) shows the process of learning generated through PBL in the cognitive aspect. Unlike the assumption of the SECI model, in PBL each learner needs to externalise his or her ideas toward group members. In this respect, externalisation comes first in PBL. Expressing opinions and images through vocalisation and visualisation enables the learners to better understand one another. Next, they share each other's thoughts as shown on the vellum papers (see examples in Figure 3-2 and 3-3). At this time, while they abstain from letting out voices of dissent, they may actually feel confused or awkward about different views presented by their peers. As the learners become more actively involved in group work, the discussion becomes more controversial and complex. Through this chaotic process, however, they can deepen their understanding, gather wisdom of the group, and finally decide on the best solution possible under the given circumstances. This phase can be described as the integration of abundant but divergent views. The fourth phase is internalisation. In the course of discussion, learners co-construct or create new knowledge by learning from each other. They can not only gain greater insight into subject matter but also acquire logical thinking skills. Those experiences become valuable assets to them. Then upon

reflection, each learner personalises such assets and embodies them into daily practice.

Figure 5-3 indicates the process by which unrefined knowledge that each learner inarticulately possesses in the beginning is examined, organised and transformed into refined knowledge. Although the fourth phase, namely, internalisation may seem like a terminal one, it is also a starting point from which unrefined knowledge is newly generated. As explained earlier, knowledge moves upward in three-dimensional space as it continues to be honed, enriched, and improved in both quality and quantity. By the same token, the three-dimensional structure applies to the next two sub-models.

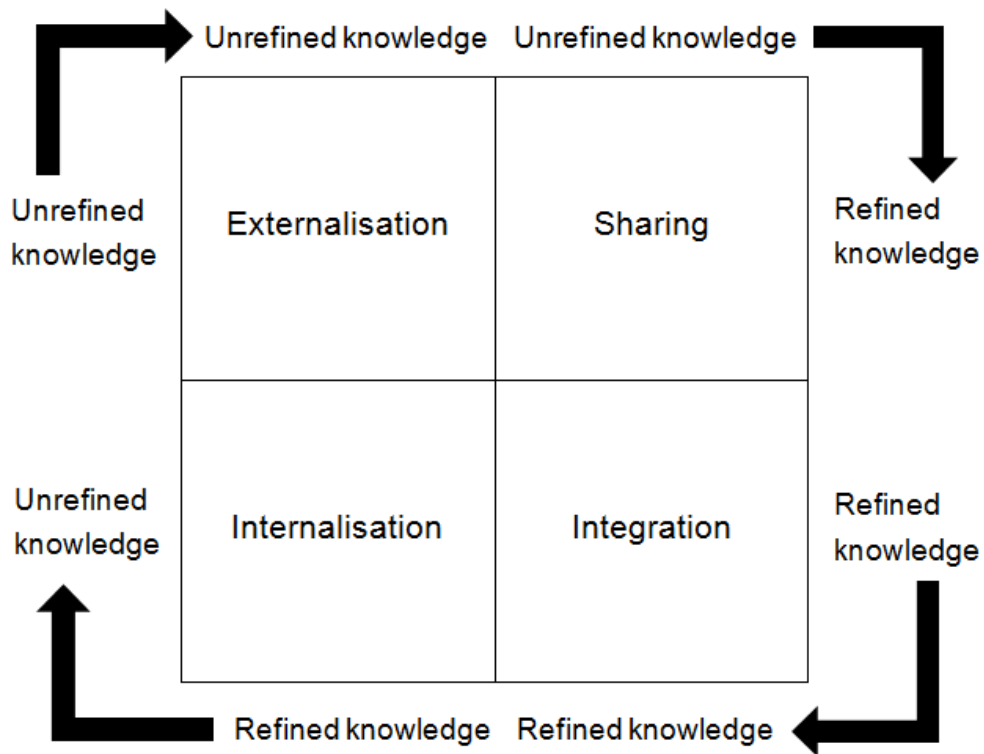


Figure 5-3. Sub-model of knowledge creation in PBL (Cognitive aspect)

(2) Sub-Model of Relation Building in PBL

The sub-model of relation building (Figure 5-4) shows the process of learning engendered

through PBL in the social or interpersonal aspect. The SECI model does not address this aspect, but original and practical knowledge cannot be created unless an environment in which people with different backgrounds and beliefs feel safe to exchange candid views is provided and ensured.

As mentioned previously, lecturing is still the method most widely adopted in universities around the globe (McKeachie and Svinicki 2006), and therein the teacher is the central figure who transmits knowledge to students who take notes without even thinking about the content (King 1993). In PBL, however, the main actor who engages in learning is none other than the student. Therefore, many students feel puzzled when they first encounter this participatory learning approach. They may only be on nodding terms with their peers because they may not have to communicate with each other in other classes. Despite such circumstances, students find themselves assigned to several small groups composed of their peers with whom they have little or no personal acquaintance. Thus, although they stay physically together, they in fact remain mentally separated or isolated from each other. With the guidance of a facilitator, students introduce themselves within a group and move on to collaborative work for problem solving. In this phase, dialogue and discussion are the major means of conveying messages. Interaction through verbalisation and visualisation enables students to open up gradually to one another and to cooperate more closely. Then, through a circle of heated debate, a transient but unavoidable mess shifts into deeper learning (Barrett 2010), and students may finally reach points of agreement. These series of group-based activities create a sense of oneness within a group and cultivate each member's empathy toward others.

Figure 5-4 shows the process through which tense relationships are transubstantiated into cooperative relationships through the concerted efforts of group members. Tension that learners initially felt is eased, removed, and metamorphosed into a state of cooperation as they work together. Then those who acquired a spirit of teamwork and communication skills

through PBL are more likely to start afresh to build cooperative relationships wherever and whenever they are placed in a situation that requires collective endeavours of people from different backgrounds.

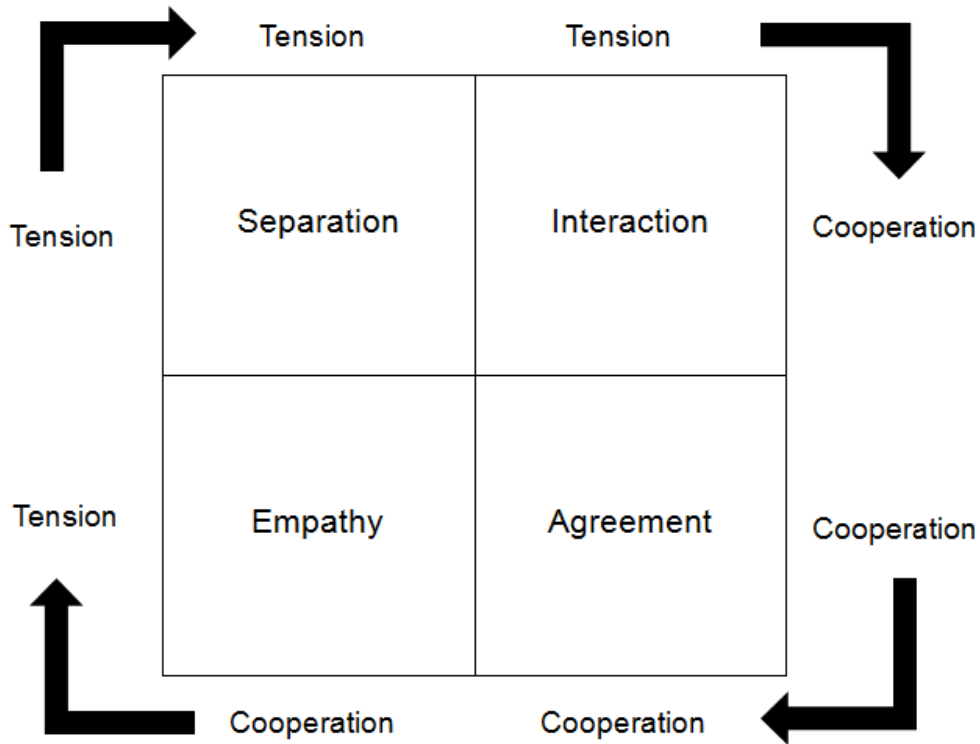


Figure 5-4. Sub-model of relation building in PBL (Social aspect)

(3) Sub-Model of Personal Transformation in PBL

The sub-model of personal transformation (Figure 5-5) depicts the process of learning created through PBL in the internal or affective aspect, the least researched area of PBL (as reviewed in Chapter 2). Barret (2012) argued that while involved in the PBL process, learners are exploring their identities and their sense of being. They are not only constructing knowledge but also their own identities through a social practice embedded in PBL. As Lave and Wenger (1991) argued that ‘learning involves the whole person’, learning indeed promotes the

transformation of learners' internal aspect, namely, their identities.

Figure 5-5 shows how learners go through the process of personal transformation. At the beginning, learners have a great deal of apprehension. Being surrounded by unfamiliar peers, they may have no idea about what is going to happen in this class. After instruction from a facilitator, they start exchanging ideas within a team. Learners engage in dialogue with their peers, and at the same time, they also conduct self-dialogue in their minds. That is, while they critically observe and analyse others, they consistently monitor their own thinking and behaviour. In this regard, this phase can be characterised as reflection of the self. Such dialogical interaction inspires each of them to the depths of their being.

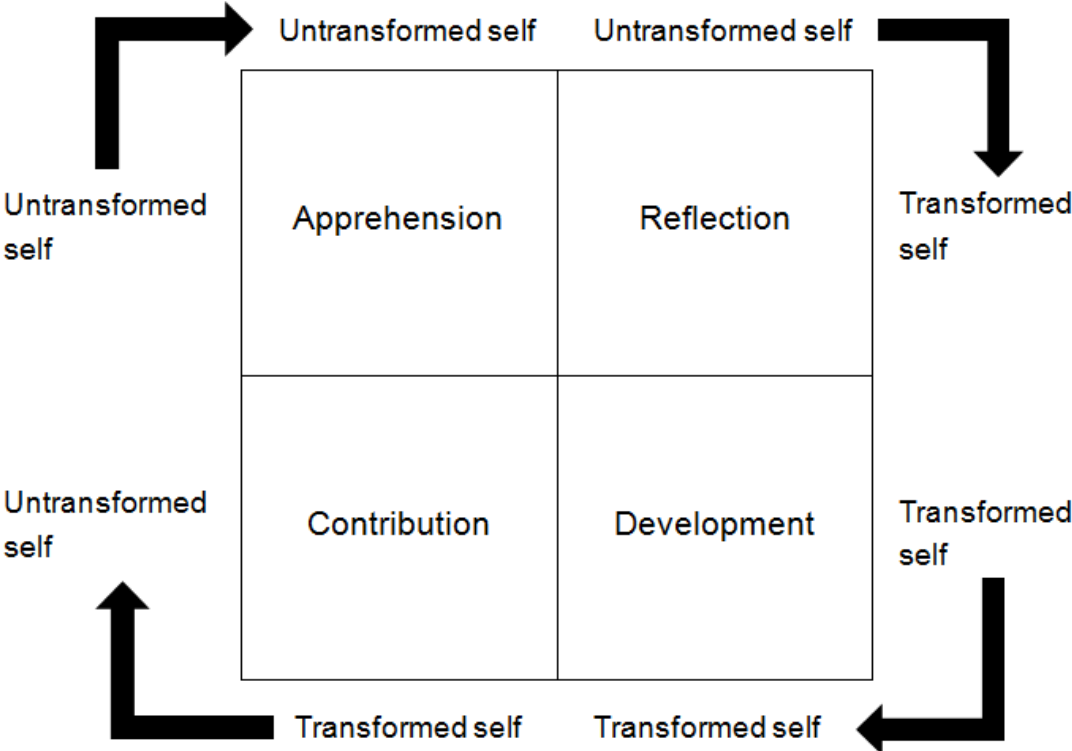


Figure 5-5. Sub-model of personal transformation in PBL (Internal aspect)

As learning becomes more relevant and meaningful, learners may develop a stronger sense of

respect and acknowledgment for their peers and wish to repay debts of gratitude to them. To this end, their motivation toward self-development seems to grow. However, their increased commitment does not stop at personal development. It continues propelling them to rise above the lesser self and to reveal the higher and greater self (Ikeda 1998). Then, beyond personal enlightenment and empowerment, learners are humanely awakened to their intrinsic mission to contribute more to society as a whole. This suggests that genuine personal transformation may go far beyond individual interests, concerns, and desires and reach deeper awareness of one's social mission and responsibility to selflessly serve others.

Nonaka and Takeuchi (1995) claimed that creating new knowledge is 'a highly individual process of personal and organisational self-renewal', but they fell short of expounding and visualising this process of innermost changes concurrently taking place in learners' minds. Figure 5-5 illustrates how the untransformed self is gradually cultivated through inner and outer dialogue and shifts into the transformed self. The self thus transformed continues to be the higher level of self in the recurrent upward spiral of personal transformation.

(4) Limitations of the Comprehensive Conceptual Model of PBL

The author has proposed the comprehensive conceptual model of learning that evolves through the process of PBL with regard to the cognitive, social and internal aspects. This model has been elaborated based on the case study evidence and theoretical analysis. However, its limitations and weaknesses need to be mentioned here to advance future studies.

First, the existence and terminology of each phase or conversion mode in the sub-models need more detailed investigation. This challenge derives from the fundamental defects of the SECI model. Gourley (2006) forcefully pointed out that Nonaka's work lacks creditable methodology and evidence, opining that it is largely based on intuition. In fact, a limited number of Nonaka's case studies contain solely success stories of Japanese companies, but

failures are not referred to at all. Therefore, the model presented by the author should also be minutely examined and rigidly tested by further qualitative, quantitative and theoretical analyses.

Second, through all the case studies, the author conducted PBL in university lessons that addressed world trade and development assistance. As discussed in Chapter 4, there might have been different results in the research if the author had taken up other issues. For example, students who tackle problems concerning international aid or cooperation may be more inclined to aspire for their personal development and social contribution compared to those who do not. In this sense, future research ought to illuminate how different subject areas may influence student learning, especially in the internal aspect.

Third, the author implemented PBL at university over the years, but he encountered new students every year. Consequently, no student continued to learn in PBL settings for more than one year. In addition, the students who participated in the PCM lessons conducted only two types of analyses (problems analysis and objectives analysis) in the planning stage of PCM, but not in the implementation and evaluation stages. In fact, students merely experienced the first cycle of learning generated through PBL as shown in Figure 5-3, 5-4, and 5-5. In this regard, the model needs to be reviewed and refined in the future based on the subsequent cycles of learning in PBL. Such longitudinal or follow-up studies may open up a new horizon for prospective research.

4. Implications for Future Research

As mentioned in the final part of Chapter 2, this study does not address the subject of teachers and educational institutions that implement PBL. Instead, it has elucidated the structure and mechanism of PBL that students may experience. However, what this study has discussed regarding student learning may perhaps hold true for teacher learning that can be termed as

teacher professional growth.

Sykes (1999) and Sato (2009) stated that teaching, in essence, is the learning profession. Sandel (2011) claimed in his co-authored book that two-way classes that engage both a teacher and students may often put a teacher in an unexpected and uncontrollable situation, but therefore a teacher can grow as a professional by acquiring participatory teaching and learning techniques. This implies that, compared to one-way lecturing, teachers may have more opportunities through which they can develop their capacities in PBL classes via interaction between a teacher and students and also among students. If so, PBL can provide positive effects not only on the cognitive, social, and internal aspects of student learning, but also on those of teacher professional development. This means that a similar three-layer structure of teacher learning may also be formed in tandem with that of student learning. PBL may contribute to promoting the professional growth of teachers by enhancing their expertise, sociality, and reflective capacity, as illustrated by Takahashi and Ishii (2013) (see Figure 5-6). They also claimed that these three qualities are essentially commensurate with the ‘technical skill’, ‘human skill’, and ‘conceptual skill’ that Katz (1974) identified as the three skills necessary for an effective manager. Indeed, like other professions, teachers employing PBL ought to be reflective practitioners (Schön 1987) because they must handle complex and unpredictable problems one after another in the real world of teaching and learning.

Despite all that, no evidence was shown through the case studies in this paper. Consequently, one of the next research issues in this line of inquiry is teacher professional growth in PBL. The three-layer conceptual model proposed by this study can also be elaborated with regard to teachers. Both short-term and long-term practices can be scrutinised with a particular focus on teachers who are essential agents of PBL.

Additionally, as students and teachers comprise a university, various changes that take place in students and teachers seem to inevitably affect an entire institution. Lantz and Chaves

(2001) averred that the concept of Vygotsky’s zone of proximal development works not only for individuals but also for institutions. In this respect, organisational endeavours and consequent changes may also be a subject for future research, and findings or lessons learnt can be shared among the same-minded yet struggling institutions around the globe. Revealing such institutional interventions may hold the key to mainstream PBL in higher education that is expected to prepare students for a borderless society that requires multi-faceted skills as well as empathy and compassion for others.

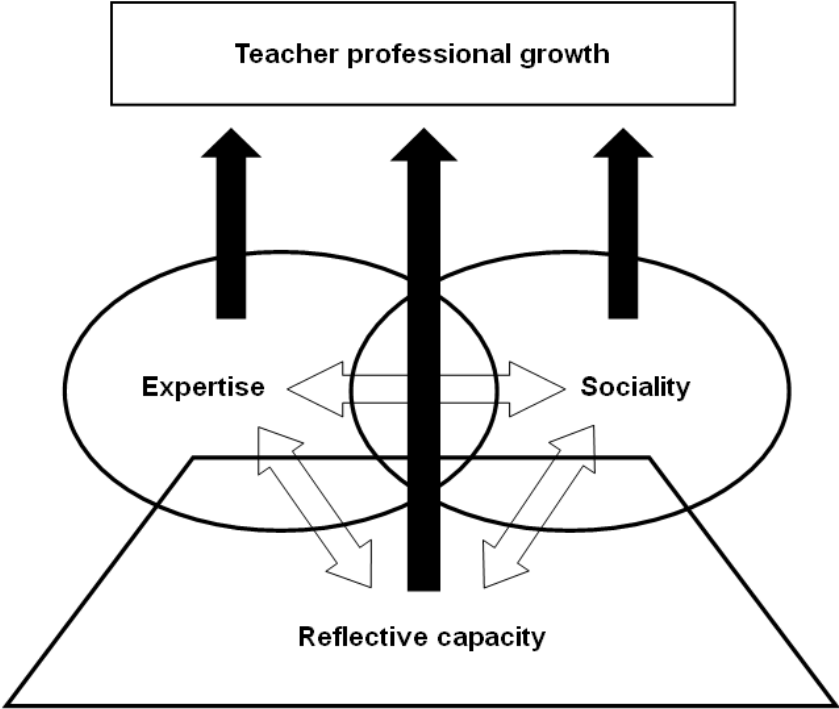


Figure 5-6. Structural outline of teacher professional growth. *Source* Takahashi and Ishii (2013)

Chapter 6 Summary and Conclusion

1. Summary as Statement of Contribution

The main potential contributions of the present study are sevenfold. First, the author conducted a comprehensive review and critique of the existing literature and identified the following deficiencies in PBL research: (1) in non-medical disciplines, (2) on the internal aspect of learners, (3) on the teacher, (4) on the education institution, (5) on the comprehensive conceptual framework, and (6) in the non-English-speaking world.

Second, the study demystified the structure, process and meaning of PBL experiences that university students may undergo from a holistic viewpoint, more specifically from the perspectives of cognitive, social, and internal aspects.

Third, this paper added to a new definition of PBL, describing it as learning that can generate rich and varied emotions in learners concurrently as they face problems, enable them to acquire subject matter knowledge and relational skills through dialogue, and eventually guide them to the threshold of personal transformation. Yet, genuine personal transformation may go beyond egoistic concerns and desires and reach deeper awareness of one's altruistic responsibility to contribute to people and society in a disinterested manner.

Fourth, the author affirmed the positive effects of PBL on students' perceptions with regard to the understanding of subject matter, communication with peers, and self-reflection through qualitative and quantitative case analyses.

Fifth, the study compared individual PBL (with no discussion) and group PBL (with discussion). The results revealed that those who attempt to solve problems collaboratively with their peers are more likely to have academic, social, and internal stimuli, examine their

language and behaviour, and broaden their outlook. Such interaction with others may inspire them, positively influencing their thinking and attitude, and sparking a zest for personal development and social contribution.

Sixth, while drawing on the widely accepted model of knowledge creation (the SECI model) as a clue, the author analysed its limitations and flaws from an angle different from that of previous critiques, and finally created a hypothesised comprehensive conceptual model of PBL, which unravels the structure and mechanism of learning engendered through PBL.

Seventh, the author referred to the limitations and implications of the study itself. Since all the case lessons consistently dealt with an issue of international development conducted by a single facilitator, future research can change such impersonal and personal variables. Also, each conversion mode and its terminology of the three sub-models need to be more minutely examined and tested by additional qualitative, quantitative and theoretical analyses. Moreover, it was noted that PBL may propel not only student learning but also teacher learning that can also be termed as teacher professional growth. That is, PBL may contribute to promoting the professional growth of teachers by enhancing their expertise, sociality, and reflective capacity. However, the dimension regarding the teacher should be investigated through increased accumulation of case studies especially focusing on it. Further research may also shed light on organisational changes through the implementation of PBL over a certain period of time.

2. Conclusion as Outcome of Inquiry

This study deconstructed the multi-layered structure and mechanism of learning generated through PBL. It uncovered that small-group discussion is an essential component that makes PBL a unique pedagogical approach and such interaction may help students be inspired, give birth to deeper self-reflection, and have a growing sense of gratitude and responsibility of being more knowledgeable and skilled to return the favour they received from others during

class.

Then, beyond the acquisition of knowledge and skills, PBL may contribute to broadening learners' perspectives and promoting their personal transformation. However, genuine personal transformation does not end at the individual level. It may go far beyond personal interests, concerns, and desires and create stronger awareness of one's social mission and responsibility to selflessly serve others. In this regard, PBL seems to have potential to become a powerful philosophical construct, guiding principle, and practical approach in higher education institutions if they strongly aspire to provide a problem-laden globalised society with students who possess a solid knowledge base, multi-faceted skills, and empathy and compassion for others.

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Appendix A

Pre-class Questionnaire Art Education (January 28, 2014)

When you think about people and things, what kinds of beliefs and attitudes do you think are important?
Please circle the number in each item that best describes what you believe now.

(Feel free to answer truthfully; your responses will not affect your grade in the course.)

1 = Strongly Disagree; 2 = Disagree; 3 = Slightly Disagree; 4 = Neutral; 5 = Slightly Agree; 6 = Agree; 7 = Strongly Agree

Year : _____ Sex : M • F ID Number _____

1	I know of developing countries.	1 • 2 • 3 • 4 • 5 • 6 • 7
2	I feel familiar with developing countries.	1 • 2 • 3 • 4 • 5 • 6 • 7
3	I know of Japan's official development assistance.	1 • 2 • 3 • 4 • 5 • 6 • 7
4	I feel familiar with Japan's official development assistance.	1 • 2 • 3 • 4 • 5 • 6 • 7
5	I feel like that I will be of use to people and society.	1 • 2 • 3 • 4 • 5 • 6 • 7
6	There are some things one can learn only by doing.	1 • 2 • 3 • 4 • 5 • 6 • 7
7	I am impressed by ideas I would never hit upon by myself.	1 • 2 • 3 • 4 • 5 • 6 • 7
8	There is more than one right answer or solution.	1 • 2 • 3 • 4 • 5 • 6 • 7
9	Concerning complex problems, I sort out the connections among them.	1 • 2 • 3 • 4 • 5 • 6 • 7
10	I realise and accept others who see things differently from me.	1 • 2 • 3 • 4 • 5 • 6 • 7
11	I gather ideas of mine and others and make better choices based on them.	1 • 2 • 3 • 4 • 5 • 6 • 7
12	I want to increase my knowledge of my major field of study.	1 • 2 • 3 • 4 • 5 • 6 • 7
13	I want to learn a lot by meeting many people with different ideas.	1 • 2 • 3 • 4 • 5 • 6 • 7
14	I want to acquire skills to solve problems of mine and those around me.	1 • 2 • 3 • 4 • 5 • 6 • 7
15	I examine myself to see whether I unknowingly have a biased view.	1 • 2 • 3 • 4 • 5 • 6 • 7
16	I examine things from as many perspectives as possible.	1 • 2 • 3 • 4 • 5 • 6 • 7
17	I make a judgment based on as many facts as possible.	1 • 2 • 3 • 4 • 5 • 6 • 7
18	I pay attention to others' ideas and opinions.	1 • 2 • 3 • 4 • 5 • 6 • 7
19	I put myself in someone's shoes.	1 • 2 • 3 • 4 • 5 • 6 • 7
20	I express my ideas and opinions clearly.	1 • 2 • 3 • 4 • 5 • 6 • 7
21	I express my feelings honestly.	1 • 2 • 3 • 4 • 5 • 6 • 7
22	I want to study a lot during my college years.	1 • 2 • 3 • 4 • 5 • 6 • 7
23	I want to have a lot of different experiences during my college years.	1 • 2 • 3 • 4 • 5 • 6 • 7
24	I want to conduct myself to be of use to people and society.	1 • 2 • 3 • 4 • 5 • 6 • 7
25	I want to be a person who has empathy for developing countries.	1 • 2 • 3 • 4 • 5 • 6 • 7
26	I want to be a person who has empathy for troubled people around me.	1 • 2 • 3 • 4 • 5 • 6 • 7
27	I want to be a teacher who has empathy for troubled students.	1 • 2 • 3 • 4 • 5 • 6 • 7

<Lastly>

28	I prefer to discuss with others rather than think alone.	1 • 2 • 3 • 4 • 5 • 6 • 7
29	I have had more practicums than lectures in in college classes.	1 • 2 • 3 • 4 • 5 • 6 • 7
30	I have had more group work than individual work in college classes.	1 • 2 • 3 • 4 • 5 • 6 • 7

Thank you for your cooperation.

Appendix B

Post-class Questionnaire Art Education (January 28, 2014)

When you think about people and things, what kinds of beliefs and attitudes do you think are important?
Please circle the number in each item that best describes what you believe now.

(Feel free to answer truthfully; your responses will not affect your grade in the course.)

1 = Strongly Disagree; 2 = Disagree; 3 = Slightly Disagree; 4 = Neutral; 5 = Slightly Agree; 6 = Agree; 7 = Strongly Agree

Year : _____ Sex : M • F ID Number _____

1	I know of developing countries.	1 • 2 • 3 • 4 • 5 • 6 • 7
2	I feel familiar with developing countries.	1 • 2 • 3 • 4 • 5 • 6 • 7
3	I know of Japan's official development assistance.	1 • 2 • 3 • 4 • 5 • 6 • 7
4	I feel familiar with Japan's official development assistance.	1 • 2 • 3 • 4 • 5 • 6 • 7
5	I feel like that I will be of use to people and society.	1 • 2 • 3 • 4 • 5 • 6 • 7
6	There are some things one can learn only by doing.	1 • 2 • 3 • 4 • 5 • 6 • 7
7	I am impressed by ideas I would never hit upon by myself.	1 • 2 • 3 • 4 • 5 • 6 • 7
8	There is more than one right answer or solution.	1 • 2 • 3 • 4 • 5 • 6 • 7
9	Concerning complex problems, I sort out the connections among them.	1 • 2 • 3 • 4 • 5 • 6 • 7
10	I realise and accept others who see things differently from me.	1 • 2 • 3 • 4 • 5 • 6 • 7
11	I gather ideas of mine and others and make better choices based on them.	1 • 2 • 3 • 4 • 5 • 6 • 7
12	I want to increase my knowledge of my major field of study.	1 • 2 • 3 • 4 • 5 • 6 • 7
13	I want to learn a lot by meeting many people with different ideas.	1 • 2 • 3 • 4 • 5 • 6 • 7
14	I want to acquire skills to solve problems of mine and those around me.	1 • 2 • 3 • 4 • 5 • 6 • 7
15	I examine myself to see whether I unknowingly have a biased view.	1 • 2 • 3 • 4 • 5 • 6 • 7
16	I examine things from as many perspectives as possible.	1 • 2 • 3 • 4 • 5 • 6 • 7
17	I make a judgment based on as many facts as possible.	1 • 2 • 3 • 4 • 5 • 6 • 7
18	I pay attention to others' ideas and opinions.	1 • 2 • 3 • 4 • 5 • 6 • 7
19	I put myself in someone's shoes.	1 • 2 • 3 • 4 • 5 • 6 • 7
20	I express my ideas and opinions clearly.	1 • 2 • 3 • 4 • 5 • 6 • 7
21	I express my feelings honestly.	1 • 2 • 3 • 4 • 5 • 6 • 7
22	I want to study a lot during my college years.	1 • 2 • 3 • 4 • 5 • 6 • 7
23	I want to have a lot of different experiences during my college years.	1 • 2 • 3 • 4 • 5 • 6 • 7
24	I want to conduct myself to be of use to people and society.	1 • 2 • 3 • 4 • 5 • 6 • 7
25	I want to be a person who has empathy for developing countries.	1 • 2 • 3 • 4 • 5 • 6 • 7
26	I want to be a person who has empathy for troubled people around me.	1 • 2 • 3 • 4 • 5 • 6 • 7
27	I want to be a teacher who has empathy for troubled students.	1 • 2 • 3 • 4 • 5 • 6 • 7

<Please make any comments or observation on today's class, if any>

Thank you for your cooperation.

Appendix C

Problem statement offered to students

In Country B, which is in the Caribbean, no art education was offered in school for years. It has been offered only recently, but there are no teachers who had art education in school or who had majored in it at a teacher training institute. In primary education, four subjects—language (English), mathematics, science, and social studies—are highly valued. Some schools that do not provide humanities education programs including art education even today due to low motivation and lack of expertise and skills among teachers. Nevertheless, almost no parents or mass media point out this situation as a problem.

In general, learning materials and stationery products are expensive in Country B. However, pupils are supposed to bring them from home to school, and there is no stock of them kept at school. Such a bother undermines teachers' motivation toward the implementation of art education. On the other hand, some Japanese animation programs dubbed into the English language are televised in Country B, and children's and youth's interest in them is quite strong.

To promote art education, the Ministry of Education and Culture in Country B requested that the Government of Japan dispatch a group of Japan Overseas Cooperation Volunteers. As a result of a screening, you were selected to be assigned to the education board of Rakusa District of Mataisa Province in Country B. The chairperson of the board is very nice and friendly, and he has encouraged you to do anything that you want to do. There are five primary schools in Rakusa District. You have been assigned to Country B for a period of two years. Now, let's think about how you can contribute to the local people there!

Appendix D

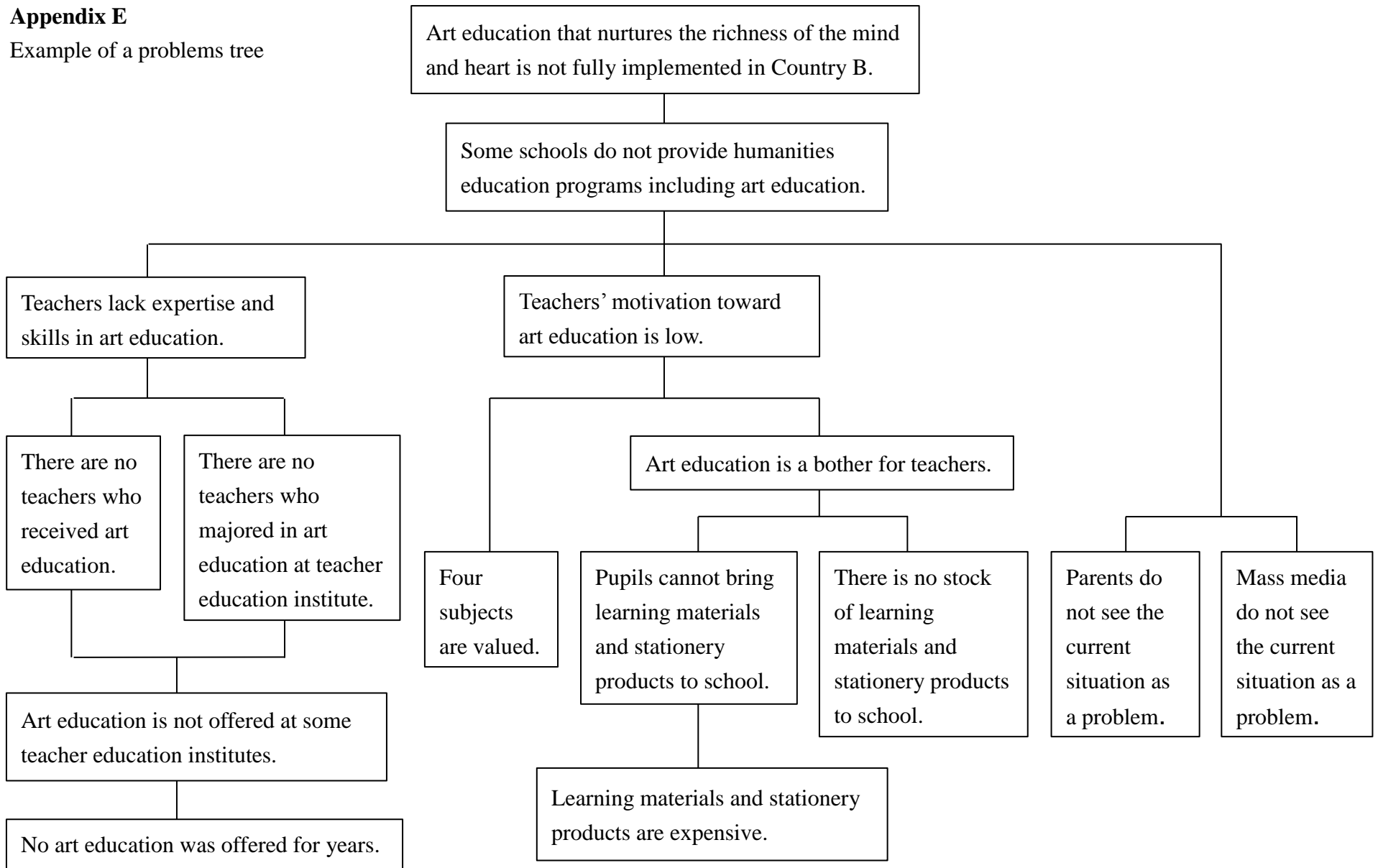
Content and time allocation in individual PBL and group PBL

Individual PBL (3rd period) with no discussion		
Start time	Duration (minutes)	Content
13:00	3	Lecturer: Introduction
13:03	4	Students: Answering pre-class assessment
13:07	21	Lecturer: Lecturing on international cooperation
13:28	4	Lecturer: Explaining the PCM method
13:32	4	Student: Silently reading a problem statement
13:36	4	Lecturer: Explaining the problem analysis
13:40	15	Students: Conducting the problem analysis
13:55	7	Lecturer: Summing up the problem analysis and explaining the objective analysis
14:02	15	Students: Conducting the objective analysis
14:17	7	Lecturer and students: Reflection and Synthesis
14:24	6	Students: Answering post-class assessment
Total	90	—

Group PBL (4th period) with discussion		
Start time	Duration (minutes)	Content
14:40	3	Lecturer: Introduction
14:43	4	Students: Answering pre-class assessment
14:47	17	Lecturer: Lecturing on international cooperation
15:04	4	Lecturer: Explaining the PCM method
15:08	4	Student: Silently reading a problem statement
15:12	4	Lecturer: Explaining the problem analysis
15:16	18	Students: Conducting the problem analysis
15:34	6	Lecturer: Summing up the problem analysis and explaining the objective analysis
15:40	17	Students: Conducting the objective analysis
15:57	7	Lecturer and students: Reflection and Synthesis
16:04	6	Students: Answering post-class assessment
Total	90	—

Appendix E

Example of a problems tree



Appendix F

Example of an objectives tree

