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ADDENDUM TO THE PHD THESIS

THE IMPACT OF IMPLEMENTING PROBLEM-BASED LEARNING

IN A THAI UNIVERSITY

BY

PRARTHANA COFFIN

December, 2014

Conclusion and recommendation for addendum, from the assessment committee

1. In relation to the methodological approach a stronger theoretical/methodological discussion is needed to justify the modified framework of DBR phases, the needs analysis and the methods chosen.
2. A theoretically informed, coherent and stable discussion of the ‘central PBL principles at MFU’, and how theory, the different studies (papers, empirical data) have informed the designs of the ideal and actual models of courses and the staff development program.
3. A stronger discussion of how “the study can be generalized to a global scale” e.g. what are the more general theoretical/methodological contributions, or design principles and design artifacts other researchers could adopt/adapt or learn from. Also, a more reflexive, critical discussion of the candidate’s own role as a researcher, change agent, and management agent would be interesting.
4. Finally, there are a number of concepts which are introduced but not clearly defined. We would like to see a stronger discussion and definition (grounded in the literature) of the following terms: “active learning”, “studentcenteredness”, “interdisciplinarity”, and “communities of practice”.

Addendum 1

Clarification and discussion on the justification of the modified framework of DBR phases

Comments from the committee:

In relation to the methodological approach a stronger theoretical/methodological discussion is needed to justify the modified framework of DBR phases, the needs analysis and the methods chosen.

1.1. Introduction

This PhD research project has been developed based on the worldview of pragmatism which focuses on the practical implication of the research. According to Creswell (2007), the pragmatism worldview focuses on the outcomes of research concerned with applications or solutions to problems. Similarly, real life educational problems were the departure points of this study and applications to ‘what works’ in order to solve the problems are the objectives of the study. Because of the existing educational problems, the researcher has been searching for methodologies that are able to link educational research and educational practice. Design based research (DBR) and action research can be characterized as methods under a pragmatism paradigm. The reasons why design-based research was considered to be utilized with this PhD research project over action research is explained in the following section.

Through literature review on educational research, DBR appears to be the most suitable research methodology to approach the educational problems of the study context. Design-based research was developed in the early 1990s due to criticism of disparity between objectivity in social sciences research, particularly educational research, and the relevance of the outcomes (Rodrigues, 2008). During the 1960s -1970s, participatory research and action research were applied to provide teachers the opportunity to address teaching problems, study them, and improve their own teaching practice (Newton & Burgess, 2008; Cornwell & Jewkes, 1995; Koshy et al., 2010). According to Newton & Burgess (2008), action research encountered criticism because the disparity between the practical problems identified and the use of emancipatory ends. In particular, Nooffke (1997) has raised caution that “instrumental uses of action research are considered problematic” (as cited in Newton & Burgess, 2008, p.20). The development of DBR therefore aims to improve the quality of educational research results, which impacts the utilization of the research result (Anderson & Shattuck, 2012).

What also differentiates DBR from action research is that DBR takes its departure in theory and research and must contribute to research which is normally not a criterion for action research.

In the literature on the development of designed- based research (DBR), it is stressed that the terminology ‘DBR’ is not just a method of data collection. Reimann (2011); Anderson & Shattuck, (2012); and the Designed-Based Research Collective (2003) explain that DBR is a practical research methodology and a framework that orients the use of many different methods and techniques to help researchers and educators to understand the relationships between educational theories, designed artifacts, and practices. Since the early 1990s, DBR has also been identified by other names such as design experiments, design research, and development research (Collin et al, 2004; Reimann, 2011; Parker, 2011). Throughout the development of DBR, many different scholars and researchers have proposed that DBR is an interactive research process, which involves different phases in a range of 3- 6 phrases. The following table presents phases of DBR proposed by different scholars.

Table 1: Different DBR phases proposed by different scholars

Phases of DBR	Reeves (2006): 4 phases	Cobb and Gravemeijer (2008) : 3 phases	Kolmos (2014): 4 phases	The Design-based Research Collective (2003): 5 phases (steps)	Collins et al. (2004): 6 phases
Phase 1	Analysis of practical problems	Preparation phase	Design phase	Addressing theories of learning	Implementing a design
Phase 2	Development of solutions	Experimentation phase	Implementation phase	Identifying constraints and needs of the local context	Modifying a design
Phase 3	Interactive cycles of testing and refinement of solutions in practice	Retrospective analysis phase	Data collection and analyses phase	Constructing cumulative design knowledge and designed artifacts	Multiple ways of analyzing the design
Phase 4	Reflection to produce design principles	-	Findings and conclusion phase	Enacting interactions in local practice	Measuring dependent variables
Phase 5	-	-	-	Reflecting on and evaluating the produced designs	Measuring independent variables
Phase 6	-	-	-	-	Reporting on design research

Even though many different scholars have varied phases and reordered the details or parameters of each phase to suit their contexts, it can be seen from the table that those variations of DBR phases contain similar activities, ranging from 1) identifying problems and

needs for change to PBL as well as identifying the possibilities for the change, 2) developing the prototype of the design, 3) utilizing the design prototype, and 4) assessing the utilization of the design.

This section of the addendum explains the rationale behind the re-formulation of DBR phases and parameters used in the PhD research project. Developing the DBR phases and the parameters within each phase used with this research project emerged from a combination of comparing and synthesizing the existing literature about DBR phases and reflections based on needs analysis from interview data from two empirical studies: 1) interviewed students and teachers in the preliminary research to the PhD study by Coffin (2011; see appendix N) and 2) interviewed PBL experts, a study by Coffin (2013; see appendix P).

1.2. The influences of existing literatures, needs analysis, and the methods chosen on the modified framework of DBR phases

This PhD research project focuses on two major goals: 1) educational development which more or less depicts the phases of design experiment of Cobb and Gravemeijer and 2) research perspective which depicts the phases of DBR of Reeves. The descriptions of DBR phases and the parameters of each phase proposed by Cobb and Gravemeijer (2008, see figure 4 in the thesis p. 39) and Reeves (2006, see figure 5 in the thesis p. 39) were seen to be most suitable to the needs of the study or research protocol of this PhD research project. This PhD research project originates from a practical perspective; that is to develop strategies for change to the PBL in the classroom. The objective of changing learning and teaching practices at MFU in this case is bigger than doing just an experiment with one class and one teacher. The researcher aims to achieve the change of practice across the subject area and further across disciplines. Therefore, working on changing of attitudes and perceptions of both teachers and students on learning is the starting point. Reflections and analyses from the two empirical studies by Coffin, mentioned earlier, suggested that sufficient preparation which involves identifying constraints and possibilities for change of the particular context and training teachers to cope with change are significantly necessary for designing educational intervention and eventually putting the designs into action. The PBL implementation in this PhD study context involves a vast amount of students and teachers from different subjects and disciplines. Therefore, the design process is quite complex. The designs were not designed and utilized by the researcher alone. The process involved many other teachers as well. The method chosen in developing a modified framework of DBR phases should be straightforward in its outlook and easy to follow for the development

purpose, but the parameters of each phase can be complex and must cover both development and research purposes. In short, phases and parameters within the DBR phases used in this PhD research project must align and fall into logical orders of both development mode and research mode. Consequently, the three major phases of DBR proposed by Cobb and Gravemeijer (2008) were used as the core structure, but the parameters of each phase were mainly based on Reeves (2006) and Cobb & Gravemeijer (2008). The phases were redefined and re-ordered to serve 1) the logical protocol of the PBL implementation development in MFU context and 2) the research design components of this PhD study. In this case, it can be emphasized that there is a necessity in re-organizing the order of parameters of each DBR phase because to just take one of the existing models of DBR phases cannot completely serve the purposes of this implementation project. According to the Design-Based Collective (2003), DBR must account for how designs function in authentic setting. This indicates that DBR has to be contextualized which means the practice within the particular context can influence the organization of phases or steps of DBR, so that the designs and the practices function in that particular context. It may appear that the three phases of DBR that are used with this study are minimal when compared to the works of some other scholars. However, when taking a close look at the modified phases and parameters, no activity required for conducting design based research aiming to improve the educational or instructional designs and to develop theory of design principles is missing. The three phases of DBR and the parameters within each phase used in this PhD research aim to bridge between development (pragmatic) and research (theory), as present in the following table.

Table 2: Modified DBR phases applied with the PhD research project

DBR phases utilized in the PhD research project	Position in the PhD research according to research process	Modified parameters of DBR utilized with the PhD research project
Phase 1: Preparation Phase (+ conceptual framework of the designs)	Background of the study Statement of problems Rationale of the study Research questions Literature review	1. Identifying local needs and possibilities of the interventions : a preliminary case study at the local context, empirical study (see appendix N) 2. Studying the existing PBL model and its effects theoretically and empirically in the form of a case study of the original model context, and interviewing experts (see appendix O and P)
	Theoretical framework of the study Designs of research instruments (tools)	3. Output 1: designs of framework of programs and syllabus for the local context (see Chapter 4), a handbook of practice, and a master plan in establishing a community of practice
Phase 2: Implementation Phase (redesigning the practical)	Data collection Data analysis	1. Enactment of PBL staff training workshops
		2. Redesigning the negotiated curriculum designs (collaboration with other practitioners)

collaborative designs)		3.Enactment of the two modes of PBL practice in the local context (conducting case studies)
		4.On-going consultancy for involved practitioners
Phase 3: Retrospective analysis (findings, analyses, and reflections)	Findings and conclusion -Findings based on questionnaire and reflection notes to assess the success rate of the workshops -Findings based on triangulated data analysis of actual practices of students and teachers from the two cohorts	Assessing the complete cycle of the implementation of the designs in the local context
		Reflection and redesigning for the next round of implementation Design principles as output 2

Being a DBR researcher has allowed me to have different roles which are important and necessary because these can bring together the theory and practice for an educational development purpose. The following section explains what takes place in each phase of DBR utilized with this PhD research project.

Phase 1 of DBR (the preparation phase) proposed for this study contains both theoretical and empirical work executed by the researcher alone. This preparation phase aims to: 1) identify problems and possibilities of the intervention, 2) compare the existing exemplary practices and to inspire new designs and to seek advice and insights from experts to shape the new designs, 3) eventually come up with a conceptual framework of the design, or what is called a visionary design in this thesis. In identifying problems and possibilities of the intervention, the preliminary case study of a trial integrating PBL principles and characteristics with two subjects taught in tandem was the starting point in analyzing problems and needs as well as possibilities to further develop and implement PBL at MFU. According to the case study (see appendix N, pp. 191-200), data analysis from questionnaire and interview indicated that meaningful content learning, collaborative learning, and self-directed learning were highly valued by most students and teachers. They could see the benefits of integrating PBL principles into their discipline. However, both students and teachers had a common concern about assessment, as well as quality and standard of the supervision because teachers were not trained before the actual implementation. Furthermore, an article by Borhan et al. (2012) identifies constraints and possibilities in developing and implementing PBL in an Asian context. MFU context, one of the three locations, shows the potential to implement PBL at the institutional level, but PBL staff development (training) must be one of the top priorities. The finding of preliminary case study conducted at the local context combined with the finding of empirical studies and theoretical studies have helped the researcher draw a conclusion and develop the designs for the MFU context. The first

round of designs are called visionary designs (see Chapter 4) which cannot be put in practice right away because it is developed based only on the studies of the researcher and the purpose of the framework is defined broadly, so that there is room for revisions and collaborative design by the involved agents and the researcher. These collaborative designs are expected to be more practical and suitable for the particular context and eventually can be put in practice. The functions of the visionary designs acted as a guideline to the involved agents and the researcher working together to develop a more suitable design with specific details to be implemented for each particular context (the English cohort and the IT cohort). In short, the preparation phase of DBR in this study involves only the work of the researcher's own aims to achieve the conceptual designs (at the abstract level). The researcher has complete control over the visionary designs, and the decision making regarding all elements included in the designs.

Phase 2 of DBR (the implementation phase) proposed for this study contains studies of the actual actions of teachers, students, and the researcher. There are four activities occur in phase 2, as shown in Table 2. This phase is moving beyond the visionary designs; it moves into the practical collaborative designs and systematic actions. This round involves redesigning the details of the syllabus and the program is considered in the implementation phase of this study rather than in the preparation phase of visionary designs, because it involves the actions of other agents, as well as actions of the researcher. However, the redesigned syllabus and program are still based on the same framework of the visionary designs proposed by the researcher. At this point, the researcher has become one of the participants in the process of implementing the designs and had less control in redesigning the syllabus and program. The process started with hosting PBL workshops for staff in which the details of the workshops were modified and adjusted according to the request of the staff. The same staff members continued to take part in designing the two practical designs to be used with both cohorts. While the implementation of the practical collaborative designs or the negotiated designs continued throughout a semester, details of the designs such as the facilitation process and peer assessment continued to be revised or adjusted, as the involved agents met once a month to reflect on the designs and practices. During the same time period, data collection for research purposes was running simultaneously and this part was done by the researcher alone. During the phase 2 of DBR, there actually were many smaller details in revision, adjusting the designs while in practice throughout the semester. Therefore, it can be

pointed out that the implementation phase of DBR (phase 2) here also includes on-going adjustment and redesigning elements of the syllabus and the programs.

Phrase 3 of DBR (the retrospective analysis phase) proposed for this study can be viewed from two perspectives. First, from the educational development perspective, both summative and formative evaluations of PBL staff training, syllabus design, and program design were done as planned in this phase. Evaluation of PBL staff development programs and activities were divided into two major parts. The first part is that both closed and open-ended questionnaires were used to evaluate participants' perspective with respect to the provided activities, see findings in Chapter 7. The second part is that of formative evaluation based on suggestions by the teachers who were involved in redesigned the practical collaborative syllabus and program (from both the English cohort and the IT cohort). Monthly meetings and discussions among these people resulted in an ongoing adjustment of their PBL practice. A significant impact of PBL staff development in this context is that besides regular monthly discussions with the teachers who were PBL practitioners and also the participants of the PhD research project at that time, there was also a formation of PBL admirers who have practiced and wanted to practice PBL in their classroom under the support of the Teaching and Learning Development Center. This can be an example of the PBL community of practice at MFU, which was formed informally by practitioners. This type of community formation is a bottom-up approach to change. Therefore, in the perspective of educational development, it can be concluded that the retrospective analysis phase (evaluation) yielded a quite positive outputs, but continues to need an on-going adjustment on some small elements of the designs when new situations emerge. The design prototypes, which had gone through the refinement of design process, have achieved the set educational development goals for these particular situations. Even though the design principles emerged during these phases, it does not mean these prototypes can be used in a new situation without any adjustment. The on-going adjustments for each particular situation need retrospective analysis. Furthermore, from the research perspective, this retrospective analysis phase of DBR is quite complex and continues to be an on-going process. Retrospective analysis has begun once data collections and data analyses are completed. The findings and the reflections of the three different PBL implementations (with staff training, the English cohort, and the IT cohort) helped the researcher to reflect on the entire research project and generated the design principles. Also it helped to further disseminate the insights from the research to the broader educational community. This retrospective analysis requires a systematic approach in order to deal with

longitudinal data sets, so the design principles can be generated. From the research perspective, the findings of this PhD research project must be generalized to produce new knowledge and theoretical contributions of course recognizing the limitation of the study.

This PhD research project aims to achieve multiple goals (research and educational development) and the researcher also functions in multiple roles combining theory and practice to improve educational practice. DBR is chosen as the most suitable research methodology for this study. Based on the discussion on the needs to modify DBR phases to suit this PhD research project, it is explained that the method chosen to determine phases of DBR and the parameters within each phase derived from a combination between the reflections from the literature and the empirical studies. The synergy of DBR phases defined by the scholars of experimental designs (Cobb & Gravemeijer, 2008;) and the scholars of design research and design-based research (Brown, 1992; Collins, 1992; Cobb et al., 2003; Design-based Research Collective, 2003; Reeves, 2006) resulted in the three DBR phases and the parameters to serve both the development elements and research elements of the PhD research project.

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Addendum 2

Clarification and discussion of the theoretical coherence of PBL principles at MFU

Suggestions from the committee:

A theoretically informed, coherent and stable discussion of the ‘central PBL principles at MFU’, and how theory, the different studies (papers, empirical data) have informed the designs of the ideal and actual models of courses and the staff development program.

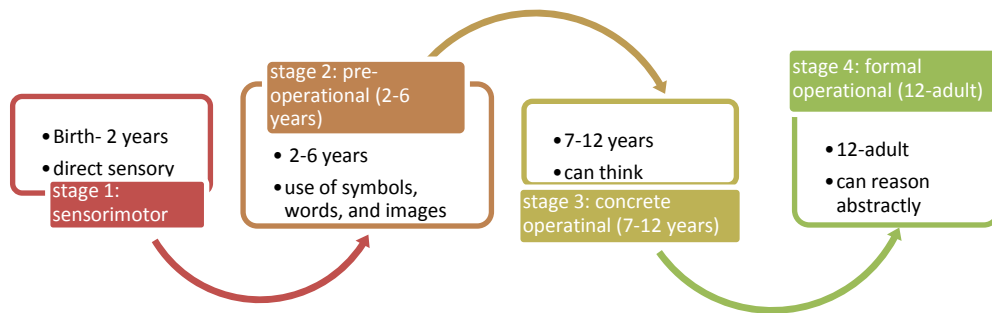
2.1. Introduction

In developing and designing any educational model or educational intervention, analyzing theories of learning principles are essential departure points. One of the objectives of this PhD project is to develop a PBL educational model for a Thai university context; therefore, analyzing learning principles and redefining PBL learning principles first are necessary. Kolmos et al. (2009) support this point by stating that defining PBL learning principles allows variation in developing PBL educational models to be adjustable and suitable for each local context. This addendum explains how PBL learning principles at MFU emerge through a combination of analyses of existing theories of learning principles, PBL principles and practices, and supported by the empirical studies of this project. Furthermore, the paper continues to present a logical connection of how the existing PBL principles, the emergent PBL principles at MFU, and the empirical studies derive the designs of the ideal and the actual PBL models (collaborative practical models) of specific PBL courses and the staff development program that is needed to prepare the teachers for their new roles.

2.2. Learning theories that influence the central PBL principles at MFU

The three learning theories that influence the PBL principles at MFU are cognitive development of Piaget, social development of Vygotsky, and experiential learning of Dewey and Kolb. Each of these three learning theories derives from constructivist theory, which stands at the core of PBL development. Piaget’s cognitive development theory focuses on the development of human’s mental processes. The way the human mind processes encountered information can be described by the four stage model defined by Piaget: the sensorimotor stage, the pre-operational stage, the concrete operations stage, and the formal operational stage, as presented in the following figure.

Figure 1: Piaget's theory of cognitive development



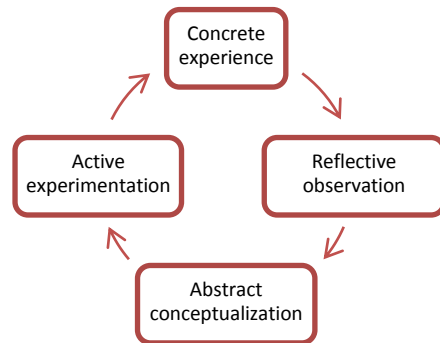
Within this theoretical framework, humans are considered to be rationale beings and they learn through active participation. Consequently, their actions reflect their thinking. From this perspective, humans are seen as information processors, requiring input, process, and output (Huitt & Hummel, 2003; Learning–Theories.com, 2014). In the relation to the influence on the central PBL principles at MFU, the formal operational stage of Piaget's theory is highly relevant. The social development theory of Vygotsky compliments the cognitive development theory by focusing on how humans learn and evolve in a social context. The social development theory, which focuses on human interactions, is viewed as the connecting link between human cognition and behavior, allowing us to reflect on how humans learn. Social interaction, in particular through language, is one of the crucial components of cognitive development (Alpay, 2003). Through the lens of these theories, the process of learning occurs through experience or by doing of the individuals and the associated surroundings. Knowledge in this sense is therefore constructed rather transferred or transmitted by teachers (Alpay, 2003). The social development theory strongly interrelates to the experiential learning theory. The works of John Dewey and David Kolb on experience and education and experiential learning are one of the inspiration sources that influence the PBL principles and models practiced at MFU. According to Dewey there is a relationship between experience, learning, and education as he states that:

To learn from experience is to make backward and forward connection between what we do to things and what we enjoy or suffer from things in consequence. Under such conditions, doing become trying: an experiment with the world to find out what it is like; the undergoing become instruction discovery of the connection of things. (as cited in Berding, 1997, p. 26)

Like Vygotsky, Dewey also emphasizes that in the process of learning through experience language is an important tool enabling us to share and develop meaning and to help humans to achieve educational goals (Berding, 1997). In addition to Dewey's

conceptualization of experience and education, Kolb also proposes that learning is a process in which knowledge is created on the basis of experience. He further proposes a four-stage model of experiential learning: concrete experience, reflective observations, abstract conceptualization, and active experimentation, as presented in the following figure (Lewis & Williams, 1994; Miettinen, 2000).

Figure 2: Kolb's experiential learning theory



Summarizing, the three presented learning theories are interrelated and aim for one common goal that is to understand educational practices from a perspective of students' thinking, aiming to raise students' critical awareness to achieve meaningful learning. These three learning theories are the basis of the constructivist theory, which has become one of the most influential aspects of the principles of problem based learning. Consequently, a combination of these learning principles has also become the inspiration and the foundation in developing PBL learning principles at MFU.

2.3. Existing PBL principles that influence the central PBL principles at MFU

Besides synthesis of the three learning theories, the PBL principles as defined by Barrows, Graaff and Kolmos, and Savin-Baden and Major were also synthesized to derive PBL principles and PBL characteristics at MFU. Since the 1960s, PBL has evolved and diversified resulting in a multitude in variations in models and practices. In spite of variations of PBL, there is a common core of PBL principles which has become the foundation of new PBL designs for many different educational contexts. The PBL principles that are synthesized to develop the foundation for the PBL model at MFU come from three sources. First, the PBL principles as it was originally developed at Mc Master are: 1) learning is student-centered 2) learning occurs in small students groups 3) teachers are facilitators or guides 4) problems form the organizing focus and stimulus for learning 5) problems are a vehicle for the development of clinical problem-solving skills and 6) new information is acquired through

self-directed learning. These principles lead to a practice, which expects students to learn the existing knowledge and expertise through their involvement in the group process. This means students must practice self-directed learning and collaborative learning by discussing, comparing, reviewing, and debating of what they have learned (Barrows, 1996). Second, the PBL principles developed at Aalborg and Roskilde, the PBL universities in Denmark, underpinned the characteristics of problem-based and project organized learning (project work) which supported by the theories of learning by doing and experiential learning. In the relation to the Aalborg PBL model, Graaff & Kolmos (2003 and 2007) categorize PBL principles in this context as follows: 1) Problem orientation 2) Project organization through teams or group work 3) Participant-directed 4) Experience learning 5) Activity-based learning 6) Interdisciplinary learning and 7) Exemplary practice. Another source of the inspirations in forming PBL principles at MFU is the work of Savin-Baden and Major. They have outlined eight modes of PBL curriculum practice and four of those, which most fit the needs and the possibilities of the context, were selected to form PBL principles at MFU. These four modes are: 1) Students, in teams, engage with one problem at a time and meet 2-3 times with a tutor over the course of each problem. Lecture is used but infrequently 2) Problem used is discipline-based. 3) PBL is gradually integrated throughout 3-4 year programs, which use a cohesive framework where problems are built upon one another. 4) The problems are sequential and cross-disciplinary boundaries (Savin-Baden & Major, 2004). These existing PBL principles all relate back to the three learning principles presented in the previous section, stipulating how humans learn and evolve in a meaningful way. The PBL learning principles and PBL characteristics at MFU are grounded in these learning principles and the PBL principles presented in this paper. It should be noted that the development of PBL at MFU consists of diverse designs from a single subject model inspired by the McMaster model, the Maastricht model, and the Singapore model. These models are well suited for the designs that are integrated into the existing courses. Furthermore, a more advanced design which involves multiple subjects and disciplines for the institution level was inspired by the AAU model.

2.4. Findings of the empirical studies that influence the central PBL principles at MFU

Findings of three empirical studies conducted by the research during the preparation phase of DBR made a substantial contribution to the designs of both ideal and actual PBL models practiced at MFU. This section discusses the connections between the findings of the three empirical studies and the PBL models and practices at MFU. The first study was titled

‘Integrating PBL pedagogy with EFL courses taught in tandem: Reflections on benefits and challenges’ (see appendix N, pp. 191-200) which aims to 1) identify needs, constraints, and possibilities to implement PBL in a larger scale and in a more systematic approach at MFU; 2) detect the perceptions of students and teachers toward integrating PBL with the existing courses. The findings indicated that practicing PBL enhances the following learning outcomes: communication skill, self-directed learning skill, collaborative skill, and a good quality final product. These variables (learning outcomes) can be traced back to learning principles of social development, cognitive theory, and experiential learning theory. As for the PBL principles, small team learning (collaborative learning) and self directed learning were the focus of this study. Another strong evidence of this study was the integration of the content of the two subjects, which can be done through PBL activities and practice evoking interdisciplinary learning. Therefore it can be also concluded that interdisciplinary learning is one of the PBL principles that applies to the MFU context. PBL has brought in desirable learning outcomes to the English as a foreign language study areas. However, the issues of supervision quality and assessment must be further developed.

The second study was titled ‘Reflections on Problem-Based Learning Practice at Aalborg University’(see full paper in Appendix O, pp. 201-213). This study aims to make an understanding of how PBL is practiced at the PBL institution in Europe and consequently inspires a new development of PBL curriculum design for a local Thai context. Findings of the study gave insights in a range of differences in practicing PBL at Aalborg University (AAU) and these insights have shaped the principles and designs of PBL for MFU context. The concepts of diversity and flexibility of PBL models and practice supported by Barrows (1996) and Savin-Baden (2000) have become very influential in forming PBL learning principles and designing PBL models to be utilized at MFU. The study showed that PBL practices at different faculties at AAU are different with respect to the type of problems, the project work, and the facilitation process depending on the nature of study domains or disciplines. In spite of variations of PBL models and practices, the study also indicates that the core principles of PBL of each different model and the impact on learning outcomes were similar: motivation, self-directed learning skill, collaborative skill, and communicative skill. Based on the findings of the study, what can be applied with the principles and the designs for MFU context is that PBL curriculum design for this particular context should be grounded in learning principles that synergize with the common core of PBL principles, but must be in

a flexible frame to accommodate diverse practices depending on the needs, the possibilities, and the limitations of each educational context.

The third study was titled ‘Identifying needs to develop a PBL staff development program’ (see full paper in Appendix P, pp. 215-130). This study emphasizes the importance to PBL staff development and aims to answer the following questions: 1) How can university academic staff be assisted to acquire pedagogical competences for an initiative of the implementation of PBL curriculum? ; 2) What kinds of support do university academic staff need in order to maintain PBL implementation? The study helped the research reflected on the importance of preparing staff for the change to PBL and further inspired the design of PBL staff development program. Through a combination of literature review and interviews with PBL experts, it can be concluded that in order to implement and sustain PBL practice, it is necessary to first equip academic staff through a sequential PBL staff training activities and through the PBL community of practice. According to Savin-Baden (personal interview, 2011) preparing, training, and building a PBL community of practice takes time, but it is crucial and must be done in order to make the implementation of PBL works and sustains. PBL principles were also applied in designing and running the PBL staff development program at MFU. The activities of the program are sequential which aims to help staff to 1) design their PBL syllabi, activities, problem cases and 2) strengthen their facilitation skills. These sequential activities start with problem formulation by the staff themselves which they worked on together in a small team to identified learning problems in their context and continued to work through the problems to come up with a possible solution for the problem and then they reported back and shared their finding with others in the training session. Moreover, the theory of community of practice (Wenger, 2014) has become quite influential to the design and practice of PBL staff development program at MFU because the staff started to collaborate and develop their own practice. In short, the existing learning principles, PBL principles, and empirical studies not only informed PBL principles models and practices at MFU, they also informed the design of PBL staff development at MFU as well.

2.5. How the existing theories of learning principles, PBL principles, and the empirical studies have informed the ideal and the actual PBL models of the courses and the staff development program practiced at MFU.

The development of central PBL principles at MFU has emerged from a combination of the existing theories of learning principles, PBL principles, and different empirical studies conducted by the researcher. This section demonstrates the synergy of the composing elements in developing new PBL principles and models implemented at MFU (see figure 3).

Figure 3: The emergence of PBL principles and models implemented at MFU

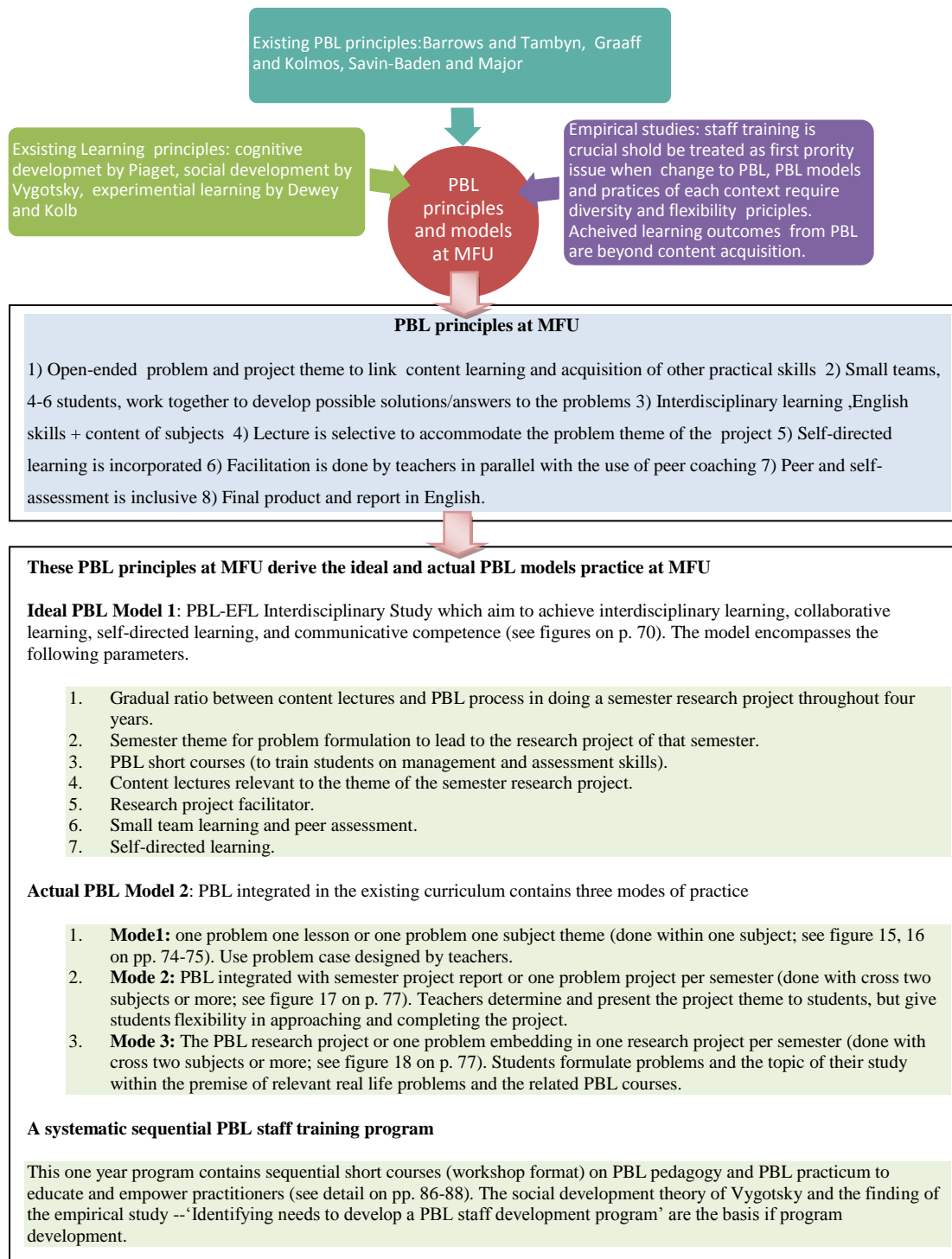


Figure 3 depicts how the PBL curriculum models and PBL staff-training program at MFU have their roots in the learning theories and PBL principles, and the combined findings from three different empirical studies. The existing learning theories namely cognitive theory, social development theory, experiential learning theory constitute the foundation of the PBL principles. Existing PBL principles and practices from different North America and European context were also synthesized to underpin the common core principles of PBL to inform new principles and practice of PBL in MFU. One of the most valuable insights that make PBL designs and practice at MFU possible is the concept of diversity and flexibility in which many prominent PBL scholars have also supported, such as Barrows, Kolmos, and Savin-Baden. Dealing with educational change at MFU is equal to dealing with uncertainty. Therefore the frameworks of the designs and practices of PBL require the flexibility concept which will allow a more suitable redesigning for each particular context or even a sub-context. Changing to PBL at MFU cannot be done drastically because the existing educational forms and practices at MFU which asks for a compromise of being strategic and flexible designs. The use of DBR as a research methodology has allowed such a process to derive the new principles and designs to be implanted at MFU. In spite of the differences within PBL models and practices, they all are grounded under the common core PBL learning principles and all aim to achieve the same learning outcomes. PBL practiced at MFU does not exclude lecture, but it is selective and minimized. Problem formulation is related to content learning of single subject or multiple subjects and can be done by either teachers or students depending on the modes of practice. Problem formulation and PBL facilitation allows for the process collaborative and self-directed learning. The existing theories and practices of PBL combined with empirical studies have inspired the designs of PBL at MFU. The designs and practices of PBL as a part this PhD research project are the exemplary models, which continue to be an interaction between theory and practice. Hopefully, this exemplary PBL practice through this PhD project may encourage MFU to be more confident to implement PBL further at a larger scale.

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Addendum 3

Reflection on the generalization of the study on a global scale

Comments from the committee:

A stronger discussion of how “the study can be generalized to a global scale” e.g. what are the more general theoretical/methodological contributions, or design principles and design artifacts other researchers could adopt/adapt or learn from. Also, a more reflexive, critical discussion of the candidate’s own role as a researcher, change agent, and management agent would be interesting.

3.1. Introduction

This PhD research project was conducted following the steps of the design-based research paradigm (DBR), aiming to fulfill the conditions of both scientific research and educational development. DBR was employed as a research methodology to address problems and needs in designing and implementing PBL in a Thai university. How the design of PBL for a local Thai context as well as the implementation of PBL and its result can be generalized to a global scale will be presented in the following section. This part of the addendum explains how the research project generates theoretical contributions of design principles and design syllabus and curriculum. Furthermore, the second part of this addendum presents a reflective and critical discussion of the multi-roles that the researcher performed throughout the process of design development and research.

3.2. The generalization of the study on a global scale

Starting from the very beginning of this research project, a pragmatic world view was the basis of developing the project together with scientific insights aiming to generate theory. The inquiry to develop a learning and teaching model for a Thai university in order to prepare students to become active and lifelong learners has roots in the concept of problem-based learning. Several PBL scholars point out that taking the existing and successful PBL models from North America and Europe to practice with other different educational contexts will most likely result in failure. Redefining the term PBL as well as modifying PBL practice for each particular context is necessary for a successful PBL implementation (Barrows, 1996; Savin-Baden, 2000; Kolmos et al, 2009). A crucial question for the researcher at the start of the project was how to initiate the design process of a PBL model at the local Thai

University? In the course of the research project it was discovered from the literature that the DBR framework would allow such a process because DBR allows 1) the potential to bridge the gap between educational practice and educational theory, and 2) researcher to function multi-roles, as designer, researcher, teacher, and change agent. Through these different roles and functions, this research project thus produces useful products (designs) and scientific insights (Bakker & Eerde, 2013). In a practical sense this means that this PhD research project has interwoven the designs of learning model with testing the designs and developing theory. The impact of this study to worldwide knowledge about PBL implementation will be highlighted in the next section.

3.2.1 Generalization of the study and the impact of the implementation

Generalization of this study is manifest at several levels: 1) big samples (students) with intensive and complex data collection show that PBL improve motivation and learning ; 2) triangulation data which involves the combination of two different case studies that encompass multiple sources and multiple instruments of data collection and data analysis (Mayring, 2007) indicates that PBL designs could work in the MFU context and perhaps can be transferred to other similar contexts; 3) DBR methodology can be applied globally as it introduced in the Western educational context, but this research project applies DBR methodology in the Eastern context. Generalization of the study through triangulation of data is considered a strength of this study. The results and analysis of all case studies conducted to answer the research questions of this project allowed triangulated information; particularly, data triangulation is from two different cohorts of participant and resulted in the generalization of designs and practice of PBL at MFU and well as learning outcomes. Case studies were employed under the umbrella of the PhD research project, which aimed to design a PBL model for a Thai university testing the designs through practice. Data from the two case studies were from multiple sources (students and teachers) and multiple instruments (questionnaire, interview, and observation) have confirmed similar results on the impact of the implementation of the designs. The generalization based on cross-findings was that PBL practice based on the final collaborative prototype designs (see collaborative prototypes on pages 95 and 111 in the thesis) helped students improve the following: motivation, collaboration skills, communication skills, problem solving skills, self-directed or autonomous learning skills, and critical thinking skills. This means the prototype designs (see design models in chapter 4 pages 73-79 and pages 95 and 111 in the thesis) as well as the expected learning outcome from these prototypes practiced at MFU context can be

transferred to other similar contexts such as higher institutions in Asia where use English as the medium of instruction.

Furthermore, there was one very interesting finding based on comparing data from students' grades during five year period (same subject, same teacher, different teaching approaches) which showed that PBL helped weak students to improve their learning outcomes and consequently to achieve better grades, please see the analysis on page 106 of the thesis. The analysis of these data sets may add to the claim that PBL students do not learn or acquire less content compared to traditional approach students, but they gained more on motivation and other practical skills (Kolmos, 2010). The analysis of students' grades indicates that not only PBL enhanced students' motivation and practical skills, PBL with proper designs and emphasizing but that collaborative learning also improves learning outcomes of weak students. This generalization is based on 1) big samples (grades of 166 PBL students comparing to grades of total 514 non-PBL students, from other 4 semesters studying the same subject); 2) triangulation data which are teacher interview, student questionnaire, and student interview. The results are expected to generalize outside the specific context of the study.

3.2.2 Theoretical contribution to DBR

The strength of the theoretical contribution of this PhD research project is that it underlines the important role of the preparation phase of DBR. This research project has demonstrated that the preparation phase of DBR is crucial because it takes substantial time (50% of the whole project time) and it also can take a substantial effort from the researcher, in the role of developer, to develop the first round of prototype designs. Before developing the first prototype design, it is necessary for the researcher first to identify constraints and possibilities to utilize the principles of PBL as educational intervention within the local context. Both from a theoretical and an empirical perspective, the prototype designs embraced the principles of diversity and flexibility of PBL practice to make PBL implementation in the Thai context possible. Therefore, it can be concluded that the first prototype designs of PBL are grounded in the theoretical framework of learning principles and PBL principles combine with empirical studies. These first prototype designs allow room and flexibility for design adjustments when the actual collaborative designs must be put in place and ready for the implementation phase. The prototype design used as a basis in developing the collaborative design (after negotiating with involved teachers) was the

framework of 'PBL in EFL Interdisciplinary Curriculum Model 1: PBL integrated in the existing curriculum'; please see the figure and detail of the design on page 69 of the thesis. This first prototype design of PBL curriculum model is then further divided into 3 modes of practice from a range of one PBL subject to multiple PBL subjects, see figures of designs and the explanations on page 72-79 of the thesis. These three modes of practice design offer more explicit steps and activities of PBL to be implemented. These are the activities, studies, and developments that must be done in the preparation phase of DBR which took up 50% of time (18 months) of the entire PhD research project. Therefore, what can be generalized from this study is that when there is a need to implement PBL effectively at any local context, at any level, DBR is considered a sound research methodology to be utilized with the emphasis that the preparation phase which requires sufficient attention, effort, and time from the researcher. Based on the DBR process utilized with this study, it can also be concluded that a PBL curriculum is always in a constant process of negotiating among staff and student learning experience and it does not have a fixed form.

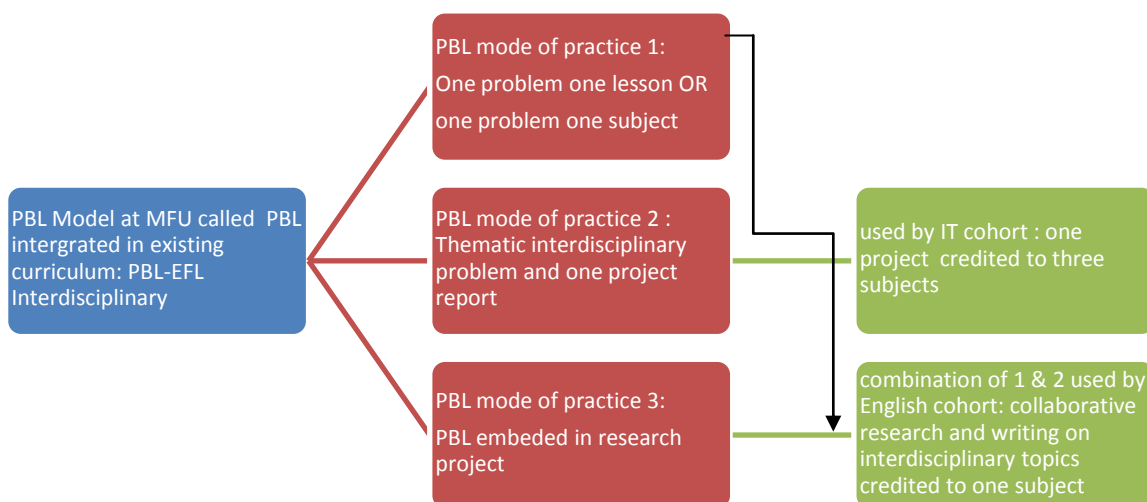
In addition to developing the first design prototypes of curricula or programs, getting staff prepared for the implementation is also included in the preparation phase. A good preparation will lead to a successful implementation even with some adjustment along the way. Preparing PBL staff was done through sequential workshops and a community of practice. Preparing sequential workshops and establishing a PBL community of practice at MFU also took substantial time and effort. Once again the preparation phase of DBR played a significant role in getting PBL staff development to be implemented and sustained. A combination of literature review and drawing insights from PBL experts led to a design of sequential workshops and the formation of a PBL community of practice. Refinement and adjustment of the PBL staff development design continue to occur throughout the implementation period. For example, there is still on-going adjustment on PBL staff development activities such as format and content of PBL workshops and on-going consultation sessions. According to the DBR literature, a constant adjustment of prototype designs is considered a regular practice of a DBR researcher. This study, therefore, has confirmed that one of the key characteristics of DBR (which is adjustment to the original design) often occurs during the implementation period. This is called the prospective and reflective component that must not be separated from a teaching experiment (Bakker & Eerde, 2013). According to the study, every month the researcher and the involved staff members met to reflect on their practice and in order to readjust the designs. Each reflection session contained a reflective analysis and thus led to

some change to some elements of the original designs. For example, due to some limitations of the existing syllabus and condition of the subject and the faculty, the collaborative design cannot just adopt the three proposed modes of practice. What we did was to combine features of the mode of practice 1 and the mode of practice 3. Activities of this one course (for the English cohort) were designed and ran completely in PBL fashion, which required problem formulation by students and high collaboration among students and teachers. The number of lectures was minimized; workshops about PBL process and technical writing were integrated, and PBL facilitation and peer assessment were emphasized. Even though the core PBL activities were laid out, details of the in-class activities, workshops, facilitation, and assessment were reflected monthly in order to readjust for a better practice. In short, The PBL designs at MFU, for both curriculum design and staff development design, support the theory of changes to the original plan or design often occurs during the implementation period.

3.2.3 Theoretical contribution to design principles (of PBL at MFU)

The general framework of the PBL model designed to be implemented with the existing course and curriculum at MFU allowed for both single subject and multiple subjects. Based on this model, PBL activities gradually gained space and importance throughout the semester while content was selected and lecture was minimized. The following figure demonstrates the emergence of the final designs implemented with both English and IT cohorts.

Figure 4: The emergence of the final design of PBL at MFU



The PBL model at MFU allows sequential activities and gradual practice. This model provides three alternatives of PBL practice modes from the range of single subject to multiple subjects. At MFU, gradual change to PBL is likely to receive a positive response from all involved parties namely students, teachers, and executive managers of the institute. Whether using the model of one subject or multiple subjects, the core principles of PBL learning principles must be grounded: problem formulation (cognitive aspect), team work and collaborative learning (social aspect), and discipline learning (content aspect). Due to the circumstance of having to deal with the existing curriculum which is determined by Thai Qualification Framework for Higher Education, the PBL model and the three modes of practice utilized at MFU must be creative in formulating problems because the content aspect continues to dominate the designs. In other words, it can be concluded that in designing PBL activities based on PBL model at MFU, content of the involved subject(s) must be designed around the predetermined course description by carefully readjusting learning objectives. Once the learning objectives were revised to align with PBL, the rest of the course and curriculum elements such as contents and materials, facilitation and learning process, and assessment would follow. In short, the design principle that emerged in this case is that 1) learning objective is taken as the first element to look into whether or not the course or the program can be revised to PBL; 2) problem formulation, whether done by students or teacher, must raise or intertwine learning concepts relevant to the selected content (similar to the work of Savery & Duffy, 1995). The problem intertwined with the selected content is the starting point in leading students to execute their cognitive and social learning and consequently allow them to achieve the set forth PBL learning outcomes.

In conclusion, this PhD research project which utilized the pragmatic approach to research has produced theoretical insights related to DBR and design principles which are: 1) the significant role of the preparation phase of DBR; 2) one of the key characteristics of DBR in which changes or revision to original plan or design often occurs during the implementation period that serves the local practice; 3) PBL curriculum design requires problem formulation (cognitive aspect), team work and collaborative learning (social aspect), and discipline learning (content aspect); 4) learning objective are the first element to be tackled when revising the existing curriculum to be PBL; 5) problem formulation in the existing curriculum context must raise interest in learning concepts relevant to the selected content; and 6) PBL staff development must be treated as priority in making educational change to PBL. The prototype designs and the results of the implementation of this study have provided

an insight into PBL is possible for most disciplines and works best in the interdisciplinary learning context, but diversity, flexibility, and adaptability must be considered when designing PBL for different local contexts.

3.3. A reflective and critical discussion of multiple-roles of the researcher

In a DBR design the researcher acts in multiples roles such as a curriculum designer, a teacher, a researcher, and sometimes as a change agent. In handling these multiple roles I have made the following efforts to separate my responsibilities as a designer from my commitment as a teacher working alongside my colleagues. From the very beginning it was not the intention that I should take on all these roles. However, during my stay at Aalborg University lasting for 1 year and 6 months, the situation at MFU had changed and I had to adjust accordingly. My first challenge is to minimize research bias because of my multiple roles. During the first phase that was basically carried out at Aalborg University, the roles were straight. I was the researcher and designing the curriculum process for colleagues. After returning to MFU, the roles got much more mixed up – and I have constantly reflecting on how to balance my actions of being a designer and a teacher, who has the possibility to influence the action or behavior of the participants, in parallel with being an objective researcher has become a part of my regular practice. Dealing with random and cross faculty members and students who became PBL practitioners and participants of my study minimized my control and manipulation over them. There was no pre-selecting of teachers, students, and subjects that implemented the PBL model and modes of practice I designed. The registration system generated body of teachers and students who would become my participants. Even though these teachers later worked with me on the details of the designs and practice, they all were independent and strong individuals who would like to try something new and possibly make a difference. My role as a teacher was that I co-taught some classes with the English cohort (of course not with the IT cohort). In addition to balance the process of getting participants, the process of data collection was also done in various ways in order to reduce potential bias of the data. For instance, data collected through questionnaires was not done by me, but by assistants.

My second challenge was handling the roles of being a change agent and a PBL consultant to the practitioners at MFU. These two roles demand substantial time, patience, and intellectual contribution to bring together people who share a common vision, interests, and goals about education. I have always tried to go out of my way to be supportive of those

who want to know and want to try their PBL version and sometimes feel discouraged. I have always taken part in any projects that involve PBL or active learning and have tried to create an incentive for PBL practitioners at MFU. I found myself become political in dealing with the bottom-up and top-down groups at the same time. It is difficult to find a balance between these two opposing views. Despite uncertainty about PBL policy at MFU, I realized that PBL practitioners at MFU need encouragement through a community of practice to empower them to practice and sustain PBL. I saw the necessity to establish a PBL community of practice because it is the platform for these practitioners to identify themselves and show their solidarity. As for the challenge of being a PBL consultant, it is difficult to make decisions on how to act toward some of my colleagues. When to encourage them and keep them practicing PBL despite some flaws and when to say 'this is not PBL' to some of them has been difficult. Then, what to do next with those who were told 'this is not PBL'. How humans think, know, act, and learn is so complicated. I have become quite sensitive on this issue in the process of acting as a change agent. A change agent has to deal with the following challenges: 1) establishing a supportive environment for the practitioners who share the similar vision and goal regarding learning and education; 2) persuading the executive managers to support the mission. A strategy of win-win outcomes from implementing PBL for all parties (students, teacher, and the institute) has always been my strong proposal. It can be concluded that the advantages of combining these multiple roles in one person are 1) the progression of PBL development , especially, at the institutional scale, are in a continuation process; 2) collaborative research between the designer and the other teachers on educational intervention can be easily encouraged which will improve professional development of the involved parties.

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Addendum 4

Definition and discussion of concepts and terms used in the thesis

Suggestions from the committee:

4. Finally, there are a number of concepts which are introduced but not clearly defined. We would like to see a stronger discussion and definition (grounded in the literature) of the following terms: “active learning”, “studentcenteredness”, “interdisciplinarity”, and “communities of practice”.

4.1. Introduction

There educational terms used to describe different educational practice and formats in this thesis sometimes may cause confusion. The following section discusses definitions of some key concepts, customary usage of the terms, and the interrelations among them. The first section of addendum 4 focuses on the definitions and the inter-relations of the following terms: student-centered approaches to learning, active leaning, collaborative learning, and PBL. In general, theories and principles of learning approaches can be divided into two major categories, which are teacher-centered approaches and student-centered approaches. Under the umbrella of student-centered approaches to learning terms like active learning, problem-based learning, and collaborative learning are being used. Even though these terms are considered as different in their interpretations and practices, there are some common characteristics. This paper will discuss the links between those terms. Furthermore, the last part of sections continues to define and discuss the other two terms, interdisciplinarity and community of practice, and their relationship to PBL principles and practice.

4.2. Definitions and usages of the terms active learning, student-centered approaches or student-centeredness, and collaborative learning

The terms student-centered approaches to learning or student-centeredness and active learning are popularly used in the literature on higher education, but there are no universally accepted definitions of these terms. The interpretations of the terms are different depending on authors and contexts of education (Prince, 2004). This paper aims once more to provide general definitions, which are used and accepted by educational scholars from different contexts. Prince & Felder (2006) suggest that these terms encompass a range of instructional methods, which requires students to take responsibility for their own learning. The instructional methods that give importance to students’ learning by involving students in

discussing questions and solving problems in class are considered active learning. Therefore, it can be concluded that student-centered approaches to learning and active learning focus more on learners and learning rather than teachers and teaching in which the activities used in classroom are learned and taught inductively.

Bonwell & Eison (1991) formulated some general characteristics of active learning which are commonly associated with the use of strategies promoting active learning in the classroom: 1) students must be involved more than listening; 2) transmitting information is minimized, but emphasizing on developing students' skills; 3) students must be involved in higher-order thinking which are analysis, synthesis, and evaluation; 4) students must be engaged in activities such as discussing, reading, and writing; 5) Students' exploration of their own attitudes and values must also be emphasized. In the other words, it can be summarized that through the given characteristics, Bonwell & Eison (1991) defined active learning as "anything that involves students in doing things and thinking about the things they are doing" (p. 2). Moreover, one of the most often quoted definition of active learning is proposed by Felder & Brent (2009), that is "Active learning is anything course-related that all students in a class session are called upon to do other than simply watching, listening, and taking notes." (p.2). Furthermore, Prince (2004, p. 223) proposed that "active learning is generally defined as any instructional method that engages students in the learning process which requires students to do meaningful learning activities and think about what they are doing". From his perspective on active learning, he also proposes some other terms associated with active learning which are collaborative learning and problem-based learning (PBL).

According to Prince (2004), collaborative learning refers to any instructional method that requires students to work together in a small group to achieve a common goal. Collaborative learning emphasizes student interaction, which eventually leads to learning as the common goal rather the end product as the common goal. In the other word, Prince (2004) concludes that collaborative learning (collaboration) enhances academic achievement, student attitudes, and student retention. In addition, collaborative learning also provides students with the opportunity to develop social skills or interpersonal skills in which they need to be successful in their future career. The concept of collaborative learning has been put into practice since the early 1900s applying principles based on the learning theories of John Dewey, Lev Vygotsky, and Benjamin Bloom (Wisconsin's guiding principles for teaching and learning, n.d.). Even though the term collaborative learning was not explicitly stated in their work then,

their concept of learning is that learning is a social act which cannot occur in isolation. The core of their learning principles has put students at the center of instruction which means students must be encouraged to be involved in the learning process. Therefore, this concept has become the principle foundation of collaborative learning. Dooley (2008) further proposes that collaborative learning aims at getting students to take full responsibility on working and learning for themselves and their peer which means together they build knowledge, change, evolve, and improve their understanding of the studied topic. Consequently, practicing collaborative learning also changes the student's role; they eventually become researchers and self-directed learners.

To demonstrate how the terms student-centered approaches to learning, active learning, collaborative learning, and problem-based learning are interrelated, a statement of Prince (2004) explains the correlation, as he states that "PBL is active, engages students, and is generally collaborative" (p. 228). Based on Price's statement, it can be summarized that the three terms: student-centered approaches to learning, active learning and collaborative learning, highly overlap and are interrelated in their features. Prince (2004) further deliberates what active learning is and he has put collaborative learning and problem-based learning under the umbrella of active learning. He points out that collaborative learning and problem-based learning are the common forms of active learning, but are considered different types. Furthermore, Walker (n.d.) points out that collaborative learning emphasizes activities that encourage people to learn from each other actively through thinking systematically to understand and improve the specific problem situation. According to the PBL literature, it is accepted that PBL practice has many variations, yet there are common characteristics which are also present in active learning (engage students in the learning process in class) and collaborative learning (team learning and group discussion), which affect positively on many learning outcomes (Prince, 2004). Hmelo-Silver, et al. (2007) also identify a strong interrelationship between PBL and collaborative learning, that is PBL emphasizes collaborative learning and activities in which students learn content, strategies, and self-directed learning skills through solving problems collaboratively. Similarly Schmidt, et al. (2007) point out that group discussion in PBL is essential (collaborative learning) because it encourages the activation and sharing of knowledge, experience, and expertise among group members, which enables them to deal with more complex tasks.

4.3. The definition of the term interdisciplinarity and discussion of the term in the relation to PBL

The central essence of the discussion of the term interdisciplinarity in this section is related to PBL, especially the Aalborg PBL model. In general, the definitions of the term interdisciplinarity focus on the integration and synthesis of disciplinary perspectives in crossing boundaries of knowledge and disciplines (Lattuca, 2003). The use of the terms interdisciplinarity, interdisciplinary learning, and interdisciplinary studies is interchangeable in this paper. Klein & Nowell (1998) defined the term interdisciplinary studies as “a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession” (as cited in Gould, n.d., p.4). To elaborate on the definition of Klein and Nowell, that is complexity has become the key reason for interdisciplinarity as well as generating new knowledge or new disciplines has become the result of interdisciplinary learning (Gould, n.d.; Choi & Pak, 2006). A summary of the definition of the term interdisciplinarity, based on definitions from several scholars, from the School of Interdisciplinary Arts at Ohio University conveys that interdisciplinarity is the employment of different disciplinary concepts and approaches in the examination of a specific topic for the purpose of new methodologies or new fields of inquiry (School of Interdisciplinary of arts, n.d).

Often the terms ‘multidisciplinary’ and the term ‘interdisciplinary’ are used interchangeably. Often these three terms have been seen as synonymous and consequently lead to confusion. Gould (2004) has made it clear that interdisciplinary is not multidisciplinary by referring to Joe Moran (2002) who explains that the term multidisciplinary refers to two or more disciplines simply juxtapose but “there is no real integration between them” (cited in Gould, p. 6). Choi and Pak (2006) conclude that these terms involve learning of multiple areas of study (several disciplines), but in vary degrees on the same continuum. Similar to Gould, Choi and Pak state that multidisciplinary is not interdisciplinary and they further point out that these terms should not be used interchangeably. Moreover, the term ‘cross-disciplinary’ also needs to be clarified for its definition and function in the relation to the term interdisciplinary and multidisciplinary. CTDL Brief (2006) explains that cross-disciplinary deals with “connections, interrelations, and interactions between different field of knowledge” (p.1). In this sense, it is suggested that cross-disciplinary is about making connections and understanding those connections of disciplines, but not to bend everything together like interdisciplinary.

The term interdisciplinarity in the context of the Aalborg PBL model is referred to as one of learning principles describing the Danish problem-based and project-organized model (Kolmos, Fink, & Krogh 2004). Graaff and Kolmos (2003) deliberate that the central theoretical learning principles of the Aalborg PBL model comprise three dimensions which are the problem (cognitive learning), the contents, and the team (social or collaborative learning). The content dimension is the one that is concerned with interdisciplinarity. According to the Aalborg PBL model, the term interdisciplinarity is also referred to as *inter-disciplinary learning* which is interpreted as “the dimension of knowledge as the solution to the problem formulation and may span across traditional subject-related boundaries and methods” (Kolmos, Fink, & Krogh, 2004, p. 12). To further define and deliberate the term interdisciplinarity in the relation to PBL practiced in Aalborg context Graaff and Kolmos (2003) explain that “inter-disciplinary learning relates to problem orientation and participant-directed processes, in that the solution of the problem can extend beyond traditional subject-related boundaries and methods” (p. 658). Based on the literature of interdisciplinarity, it can be concluded that interdisciplinarity or interdisciplinarity learning or interdisciplinarity studies asks complex questions which cannot be answered adequately within one discipline. In order to derive an answer or a solution to the asked questions students must reach out to other disciplines and integrate knowledge, tools and methodologies. Learning outcomes of interdisciplinarity learning therefore go beyond an answer or solution, but include new knowledge and new field of inquiry.

4.4. Definition of the term community of practice and discussion of the term in the relation to PBL staff development at MFU

The concept and the term community of practice (CoPs) emerged during a study of apprenticeship as a learning model by Wenger and Lave in the early 1990s. They coined the term to refer to the community of practice, which acts as a living curriculum for the apprentice. According to Wenger (2014), a community of practice encompasses three crucial characteristics: a domain (of interest), a community, and a practice. Wenger (2014) define the term community of practice in a nutshell as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (p.1). In 2002 Wenger, McDermott, and Snyder redefined the term community of practice as “groups of people who share a concern, a set of problem, or a passion about the topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis (as cited in Cox, 2005, p. 14.). Moreover, Kaplan and Suter (2005) further elaborate on the

concept and the definition of community of practice as “ a group of people who share a common concern, a set of problems, or interest in a topic and who come together to fulfill both individual and group goals” (p.1). They further point out that a community of practice is important because it connects people to enable their dialogues in order to share information by capturing or diffusing the existing knowledge and generate new knowledge. Consequently, these people are stimulated in their learning through the activities of collaborative learning. A community of practice therefore helps the involved people to organize around purposeful actions which deliver tangible results (Kaplan and Suter 2005).

How the concept of community of practice applies with PBL staff development movement at Mae Fah Luang University, the following discussion deliberates. In the attempt to change the practice of learning and teaching at MFU, it is realized that neither a top-down approach nor a bottom-up approach works in isolation. That is why PBL staff development took a substantially important function in approaching change. The concept of the community of practice is used in developing sequential activities of PBL staff development at MFU in order to allow PBL practitioners to share their best practices and to create new knowledge to advance the domain of their professional practice and development. The set forth activities are on-going and sequential which take time and sustained interactions among those PBL practitioners. They engage in joint activities and discussions to learn from one another and to help each other to achieve the common goals which are: to address the reoccurring educational problems, to change learning and teaching practices, and to establish new learning outcomes. As Wenger (2014) states that not everything called community is considered a community of practice; it is not just about a group of people who share the same interest only, but these people must share a common goal, interact, and learn together. They therefore imply the commitment to the domain of interest.

In 2012, the PBL sequential activities began and the community practice of PBL practitioners was also formed in MFU context. Since then the on-going workshops and discussions have always provided opportunities for PBL practitioners here to request information, seek and share experience, map knowledge and identify gaps, collaborate and discuss developments, reuse the assets, and document the process and the product of the practices. The existence of a community of practice at MFU affects its educational practices in three dimensions. First, the internal effect; this means through the support of the community, the members get to practice and share their educational experiences around the subject matters and beyond. Second, the external effect; this means through the support of the

community, the members connect their students' experiences to their practice and connect their own experience (through their participation) in broader communities beyond the classroom and university. Lastly, the third dimension, lifelong learning effect; this part involves a long term plan which aims to serve lifelong learning needs of students and the members (PBL practitioners) such as the topic of their professional development.

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