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When Vocational Teachers Improve Their TPACK Competencies ThroughLesson Study

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Abstract--- *Teachers at vocational schools may be more challenged than at public high schools since they aim to teach working skills that could be more complex than just knowledge. The paper aims to propose models of lesson study for vocational teachers. It is proposed that when vocational teachers utilizelesson study to improve pedagogic competencies, a strategy to implement it is required to minimize possible obstacles.Further, through a systemmatic review, the perspective of Technical Pedagogical and Content Knowledge (TPCK) is used to develop the model of the teacher professionalism.A lesson study strategy is choosen depending on the focus of the professionalism by identifying pedagogic and content competencies level of the involving teachers. Four types of teachers based on these dichotomies were developed, and therefore four models of lesson study could be derived. The models offer what specific competence to learn during the lesson study. Through the use of the lesson study model, vocational teachers in across different fields could decide the most relevant model of their professionalism, with regard to their competence in pedagogic, content, or technological knowledge. Eventually, the lesson study model becomes a strategic pathway to solve issues in vocational education.Improvement of the effectiveness lesson study practice when suitable model is applied can be achieved. This paper offers lesson study models that are developed based on teacher typology of competence, particularly for vocational teachers with wide-range of specialities.*

Keywords---*lesson study, vocational, teacher, pedagogic, content, technology, competence.*

I. INTRODUCTION

Lesson study (in Japanese,jugyō kenkyū), which makes possible dialectical relationships between pedagogic theory and classroom practice, has been globally known as a means of teacher continuous professional development program. This collegial activity has been introduced by Japanese since decades ago, before it is widely implemented in other Asian countries [1] and the North America [2]; [3]. Many teachers in technical areas, such as in mathematics [2]; [4], science [5], and in language [6]; [7] have used lesson study as part of their in-service professional development program, however it seems rare to find it by vocational teachers, taking Indonesia as an example[8].

[9] described the significant impact of lesson study for the development of teacher professionalism in Japan. The lesson study is essentially a professional development program where teachers are engaged in pedagogical activities from planning a lesson, and then conducting, analysing, and evaluating the results. During lesson study, teachers gather to plan a lesson including developing the instructional media, then study how the lesson is taught and reflect

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how the instruction can assist understanding. Lesson study is run in cycles continuously [4]. Once a lesson is studied, then they use the evaluation results to improve the subsequent lesson study. In Japan and the North America, lesson study is organized by the local government or an institute. Teachers collaborating with researchers [10] in lesson study are facilitated from lesson planning, developing worksheet, preparing learning tools, during observation, and the seminar at the end of the cycle. The sharing part at the end of each cycle that is focused on the student's learning used to improve the lesson which is studied in the following cycle. Obviously, the program turns to be sustainable and effective.

Teachers may develop their profesionalism by attending training, workshop, conference, or by self study, or being involved in curriculum analysis, conducting classroom action research, etc. Particular for vocational school teachers, however, least known who have been using lesson study for improving their profesionalism. While vocational schools have different curriculum structure than the others, it is not impossible to use lesson study as a platform of continuous professional development. A challenge of lesson study at vocational schools might be determining the content areaof the lesson study sincethere are many expertise programs or specified competences offered in vocational schools. The number of the teachers with the same vocational subject that may be grouped into a lesson study might also be limited. Such obstacle may arise causing a clumsy lesson study program.

[11]summarized that recruitment criteria of vocational teachers are varied among countries, with regards to the minimum teaching degree qualification or work experience. As such, level of professional skills of vocational teachers may be considered when allocating them into a professional development program. An issue may also emerge when the involving teachers in lesson study are diversed in terms of their teaching competences. This might occur in some pluralism countries like Indonesia, Thailand, or the others [12]. It might be assumed that the different level of professionalism among teachers might have impact to each individual achievement during the lesson learning phase.

Arguably, targetting a specific prefossionalism area might be more advantageous for vocational teachers in lesson study. Models that are developed mapping with the strategic area of profesionalism may provide a more sustainable yet achievable lesson study program. Accordingly, this paper attempts to systematically review previous studies on lesson study to propose four models of lesson study applicable for vocational school teachers. Analysing which model that can be used in order to run a strategic lesson study might be motivating vocational teachers to begin implementing the lesson study.

II. VOCATIONAL EDUCATION

Vocational education is often associated with technical education, or some others have named it technical and vocational education. [13]describes the subtle difference between these terms, indeed it often is used interchangeably. Vocational education is referred to an education to prepare for working, while technical education is meant for training of certain working skills. In general, vocational and technical education aims to prepare human resource with skills needed by workforce, factory or industry. This paper uses the terms vocational education thoroughly.

Vocational schools may be different compared to public schools. This is obvious since public schools emphasis on academic development, but vocational schools focuses on principles of accomplishing particular occupation [14];

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[15]; [13]. Public school graduates might enter workforce and get in-house training, but vocational graduates are more directed to be ready with required skills [16]. For this reason, teaching competence to be developed by vocational teachers might be specified on how students master principles of completing a job and the application into practice. This competence compromises the pedagogic competence, the job specific content competence, as well as the educational technological competence [17].

Curriculum and instruction at vocational schools is designed and aimed to build working skills. Subsequently, teachers must understand the most updated skills needed by workforce [18]. Vocational teachers are encouraged to have experience in the field to be able to design instruction using the appropriate media or tools [19]. Additionally, when school has resources that are factory like, students may be introduced with working experience as early as possible [20]. However,[21]asserted that students at vocational schools do not only learn skills but more importantly is working attitude. Attitude is a personal decision to behave in a context which may be impacted by their soft-skills. A study indicates that particular attitudes are of prioritised by educators, practitioners or employers [22]. Consequently, it could be argued that soft-skills must be included in the vocational curriculum since having soft-skills is also an ultimate competence for vocational graduates [23].

The number of vocational schools, in fact, has been increasing recently, not only in Indonesia [24]but also in many other countries [18]; [17]. Besides this occurs to fullfil the need of workforce, this also indicates that the government pays more attention to the need of skill-full human resources at a level. Secondly, this brings consequence that more professional vocational teachers are expected. Research says that the expected profession in vocational schools is varied among countries, they may be as a teacher, trainer, or instructor [14], however it is widely agreed that profesionalism is undoubtedly required to support the effectiveness of the vocational programs and the well-being of the teacher themselves.

Moreover, the demand for 21st century workforce leads to the growing culture of using technology as any means [15]. Undoubtedly, the fast development of digital technology has made changes in how people work. Similarly, vocational education is also greatly influenced by the technology. Noted that the aim of vocational education is to prepare graduants ready to work, integrating technology is important to cultivate their technological knowledge. The use of technology, such as computerized media of learning and communication therefore should be embedded in the curriculum. Consequently, the teacher, the school system, and the teacher professional development should adapt with the trending use of technology. Pre-service teachers are also expected to acquire this technology competencies [25] ; [26].Unfortunately, some vocational teachers in developing countries may have a lack of technology readiness [27]; [12]. This causes a minimum use of technology for classroom teaching, and therefore conventional teaching is preferred. This fact raises a critical question that how vocational students could follow the fast growing of technology when the teachers hardly use technology in the teaching.

Furthermore, when the vocational teacher is seen as the central role in the quality assurance of vocational education, it may be argued that their pedagogic competence is vital. Being competence means having the capacity and capability to perform in a sepcific occupation [28]. It is widely agreed that pedagogic competence is basic for all vocational teachers. However, teaching work competencies may urge vocational teachers to acquire content of skills.

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Some contries even recruit vocational teachers based on their work experience which means that having professional work oriented skills is as important as pedagogic skills. The following discussion details the three domains of teacher competences.

III. TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE

All teaching needs preparation to be efficient and effective. Arguably, being able to teach vocational classroom does not mean merely applying vocational pedagogic knowledge, but to deliver work oriented subject [20]. It means that vocational teachers should be advanced in performing work skills while assisting students to learn these skills. Pedagogy may be defined as the knowledge of teaching consisting of knowledge when and how to use an instructional strategy to deliver a content learning with the available resources,technology, curricular, and in accord with the characteristic of the lesson as well as the students [29].

Nowdays, the use of computerised media has been familiar in the classroom. This means that pedagogic knowledge should also be integrated with technology[17]; [30]. Nevertheless, the core of pedagogic knowledge might be our understanding of cognitive process that explains how learning occurs in student's mind since this could assist teachers in improving their instructional manipulation [31]; [32]. Comprehensive understanding into pedagogic knowledge will considerably be sufficient in supporting their teaching performance; consequently, pedagogic competence that is the skill of implementing pedagogic knowledge is basic for all teachers[33], including vocational teachers.

When instructional technology is hardly available, it might be argued further that a vocational teachers should at least perform pedagogic and content competences for designing the instruction. Pedagogic competence enables teachers to create learning environment for assisting students learning, while content competence shows teacher's understanding on knowledge or skills they teach. Based on pedagogic and content competences, teachers may be categorised into four, as can be seen in figure 1. This typology describes there could possibly be teachers who has lack of pedagogic or content competences, and vice versa. Well-trained teachers are depicted in the first quadrant representing teachers who has capability in designing instructions and also skills in performing the task.

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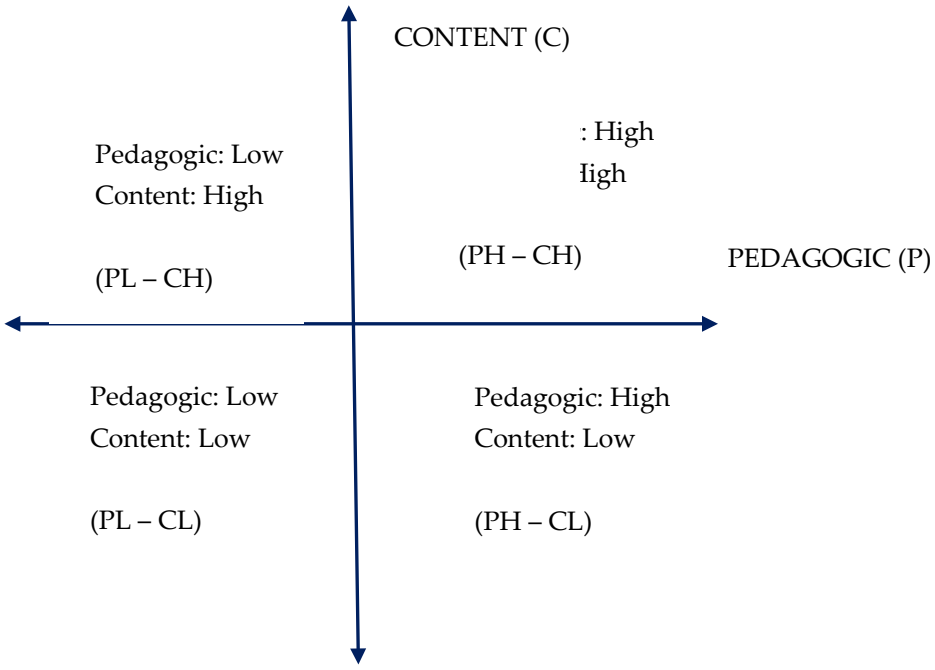

Figure 1. Typology of vocational teachers based on pedagogic and content competences

Learning is a process to be competent in a specific domain. For a teacher, learning pedagogic competences may occur using direct or indirect approach depending on the need of the learners [31]; [32]. Using a direct approach, learners may be provided a model or worked examples on the learning material. Learners may also learn in small groups to discuss or solve an issue. Subsequently, strategy used by pre-service and in-service teachers to might be different. Pre-service teachers may have limited experience of teaching practice since they study pedagogic knowledge in a course, literature review or simulation, therefore they need more direct instruction towards pedagogic knowledge[34]. Whereas in-service teachers may have some practical experience and hence, to improve their pedagogic competence they should be given more opportunities to reflect or criticise a classroom teaching practice.

Analogy to the other teachers, pedagogic knowledge for vocational teachers does not stand alone, but significantly contribute to the teaching performance when teachers also have sufficient pedagogical content knowledge, technological pedagogical knowledge, technological content knowledge, and more importantly is the technological pedagogical content knowledge (TPCK). TPCK is an integration between content, technology, and pedagogy [17], vocational teachers are not only required to understand content and pedagogy, but also are able to integrate technology in the content and to use technology in the teaching. Pedagogical content knowledge [35]is indicated having expertise in the content area and able to perform this expertise to students. Pedagogical technological knowledge may be informed as knowledge of teaching using advanced tools. Through the integration of these three aspects, vocational teachers are able to perform innovative instruction satisfying the need of 21st

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century. Innovative instruction is the one that can assist students to optimize their potential in order to meet the current development of working life.

[36]assert that vocational teachers need a model of vocational teacher development program where teachers can learn how to deliver an instruction for specific working competence. This also include for teachers who teach general knowledge in vocational schools, such as mathematics, physics, and language, their pedagogic knowledge should be contextualised within the set of competences to be learned by students [21]. In fact, there are many work orientations facilitated by vocational education. Further, the acquisition of knowledge during the study is specified to skills relevant to the work skills. Consequently, content knowledge that are acquired should be applicable to become relevant and motivating to students. Undoubtedly, the dynamic changes of industry and technology urge teachers to not withdraw from enriching their teaching content aiming to yield competent graduates in the field. Albeit challenging and vocational teachers may independently maintain their pedagogic knowledge by experiencing teaching, attending training or similar, there should be a more sustainable platform to facilitate vocational teachers developing their professionalism. The discussion follows suggest the implementation of lesson study.

IV. LESSON STUDY FOR VOCATIONAL TEACHERS

It is introduced in the beginning of this paper that lesson study is a kind of collaborative study about a lesson. During this activity, a group of teacher plans a lesson, and then conducts the lesson (by a selected teacher model, while the others observe), analyze, and evaluate the results focusing on how students learn during the lesson [9]; [2]; [10]. By studying the teaching model, in-service vocational teachers are given the chance to reflect their own teaching experience, and thus improve their teaching capability.

Taking the case in Indonesia (or in southeast asian countries), where the authors reside, lesson study program to develop continuous professionalism of educators has been conducted by the JICA Program under the name of the Strengthening in Teacher Training of Mathematics and Science Education at Junior Secondary Level (SISTTEMS) since early 2000 and has developed widely [37]. It was reported that many professional development programs are conducted [12], however it is apparently that the vocational education requires particular approach.

A little number of junior high school still implements this program until now. The sustainibility of this kind of professional development program seems depending on the funding or any available project, as well as the educational policy [1]. Institutional factors indeed can influence greatly how vocational teachers decide to improve their continuous profesionalism [38].

It might be said that professionalism of vocational school teachers is a dualism, these are their teaching competence and their competence related to a specific work procedure [38]. This can be illustrated that not all factory worker can teach their skills to the others without appropriate knowledge of how to present that to the other. For an instance, a chef may be skillfull in creating various dessert, however, it does not automatically mean that they can teach this skill or expertise to students. In addition, expertise is built by complex acquisition and automation of knowledge stored in both form of memory, explicit and implicit [31]. Skills learned at vocational schools are frequently procedural knowledge that is learning how and why to do particular things, hence this is categorised as part of implicit memory. Obviously, not all experts can transfer their expertise to students except they have some

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pedagogic capability compromising understanding of some knowledge on curriculum, characteristics of students, educational media, as well as the learning process.

Furthermore, previous research suggests that vocational teachers need collaborators from university, industry, or factory to involve in their professional development [39]. Collaborating with university academia or researchers may be useful for teachers in many ways, such as providing updated knowledge on how to improve pedagogic competence, facilitating training, involving in joint-research or classroom action research, curriculum advice or joint-publication. In other words, teachers might be focused on their teaching skills when they are attended by university partners. On the other hand, some companies may share to teachers regarding the most recent technical system used at work, such as modern machinaries, or practical sales management. Either succcessful or failure stories from the field-work may inform in-service teachers an updated content knowledge in the area.

The collegial system offered by lesson study [2]; [10]; [4]makes it possible to gather partners from university or industry, since a group of teachers is insufficient to evaluate teaching a very specialised subject as in vocational schools. In the lesson study, teachers may target on a narrowed competence to teach, presumably the lesson that is not easy to deliver. As was discussed above, the professionalism of vocational teachers should contend both pedagogical knowledge, pedagogical content knowledge, and technological content knowledge [17].

Lesson study has been identified to be effective to improve pedagogic competence [40]. It could also be said that the focus of lesson study may target on three things. Firstly, on how to design instruction that helps students efficiently construct understanding (pedagogical knowledge). If this is the focus, then the orientation of the lesson study would be more on how to prepare instruction and the associated learning media. Secondly, on how to master a specified job skill (content knowledge). In this case, observation during the lesson study is meant to see how student thinks to acquire certain procedure to accomplish a task. The reflective thinking devoted by the teachers after seeing the classroom practice enables them to justify whether the lesson has met the objective. Lastly, related to technology use in the classroom that just like developing pedagogy with the assistance of technology to deliver a learning content. In this lesson study, vocational teachers may focus their program on developing learning media such as video simulation.

According to the theoretical review above, this paper argues that there could be four strategies of lesson study for vocational teachers. These four strategies consider the teacher typology above, level of TPCK relevant to improve, and whom it collaborates with. The implementation of lesson study is to facilitate vocational teachers to create integrated technology in the classroom learning, not only as instructional media but also as the content of the learning.

Table 1. Models of lesson study for vocational schools

Model	Teacher typology	Teaching domain to develop	Description	Main collaborator
LS 1	PH-CH	TPCK	Improving teacher's ability in integrating technology, pedagogy, and mastery of working skills	University, company/factory
LS 2	PH-CL	TCK	Improving mastery of working skills through the integration of technology	Company/factory

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LS 3	PL-CH	TPK	Improving teacher's ability to teach using the integration of technology	University, company/factory
LS 4	PL-CL	PCK	Improving teaching skills and the mastery of working skills	University

There are vocational teachers who teach different competences but in the same occupational area. A vocational school majoring in cooking may have teachers who teach competencies on preparing specific entry food, main course, dessert, or on packaging, garnish and food handling. In this lesson study, teachers may develop their pedagogic knowledge, particularly for understanding the student's characteristic and may learn to contextualise the subject specific knowledge within the field. Teachers from within the same vocational school may organize this lesson study. To elaborate the pedagogical practice during the lesson study, the group may be benefited by the attendance of university partners.

Vocational teachers who teach the same specified subject matter organize the lesson study. This lesson study is focused on the study of a content area, accordingly teachers may be able to comprehend and explore deeply their understanding of a specific skill. By involving people who use the skill to accomplish their occupation, the lesson study may be advantageous to facilitate teachers with the most practical content knowledge in the field.

When pedagogy is the focus of development, collaborating with educational expert from university is suggested. Whether the first and the third model is used, vocational teachers in the same field could focus their lesson study on how to create lesson plan, demonstrate how to teach a job-skill, and identify strategies to improve skill performance.Through the use of the first and the third model of the lesson study, vocational teachers in across different fields could meet to discuss issues related general teaching, such as how to understand student needs for occupation, and the wider context of the learning material. Collaborating with factory or company employers could be advantageous since they can suggest various contextual cases or the application of recent technology at work. Moroever, the third and the fourth model might be organized for fresh graduate or new teachers since it facilitates learning of core component of teaching. On the other hand, the first and the second model might be seen as a more advanced lesson learning as it requires teachers to see and reflect on a more complex technology integration in teaching. Therefore, these models seem more suitable for knowledgeable teachers.

The availibility of specification of vocational teachers may be used to consider which model to select. Lesson study will require the involving teachers to meet and plan the lesson, therefore some administration and management should also be considered [1]. The sustainibility of the lesson study as a vocational teacher professional development that has been published by many other educational institutions might be seen as a promising policy. Policy recommendation may be formulated as follows. This paper suggests that to conduct lesson study as one of the efforts to foster and develop the teaching profession, the first step that needs to be done is to map teacher competencies, particularly in terms of competency typology which includes aspects of teaching ability (pedagogical) and the content knowledge[41]. Based on the typology, it can be determined an appropriate lesson study model so that the implementation of lesson study can be run more effectively. The next important step that needs to be taken is to strengthen technological literacy hence that TPCK can be implemented.

V. CONCLUSION

The lesson study is an essential professional development program where teachers are engaged in pedagogical activities from planning a lesson, and then conducting, analysing, and evaluation the results. Arguably, lesson study can be used as a strategy to improve pedagogic competence of vocational teachers. Vocational teachers with their capacity and

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capability to facilitate the acquisition of a specified working skill are encouraged to update their pedagogic knowledge by integrating with technology during lesson study. Vocational teachers in across different fields could meet to discuss issues related general teaching, such as how to understand student needs, variety of learning theory can be used, and the scope of the learning material. They may attempt to conduct lesson study in a model where vocational teachers in the same field could focus their lesson study on how to create lesson plan, demonstrate how to teach skills, and identify strategies to improve student skill learning. The implementation of all strategies may contribute to the continuation of their professionalism, however, situational factors should be considered, such as time allocation, grouping of teachers, university partners, factory partners, and resources.

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