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Building an indigenous learning community through lesson study: challenges of secondary school science teachers

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ABSTRACT

Universalists believe that indigenous knowledge should not be studied since it excludes non-indigenous people. A qualitative method was used to explore the impact of lesson study on a science teacher at a secondary school. The research indicated that lesson study has positive impacts on teachers professionally by improving their science content knowledge, developing their teaching strategy and skill, enhancing their interest in working collaboratively, and creating a sense of an indigenous paradigm. The four categories of impact are interrelated and mutually influential. Through a lesson study, a relationship of mutual trust is well established in an indigenous learning community.

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Indigenous learning community; indigenous science; lesson study; science teachers; secondary school

1. Introduction

Lots of local wisdom is marginalised since it is not considered to be in accordance with the demands and development of this era. Indigenous knowledge is ignored because it is considered strange and contrary to scientific knowledge (Baquete, Grayson, & Mutimucuio, 2016). Some people also believe that indigenous knowledge should not be shared and studied as it excludes non-indigenous people. Universalists have also argued that indigenous science has inferior explanatory powers for understanding the natural world as compared to Western science, which has been successful in producing knowledge that is testable, predictive, and explanatory (Aikenhead & Ogawa, 2007; le Grange, 2004). This can create imbalances in society where cultural values and local wisdom are abandoned and people even become alienated from the knowledge itself. The effort to regain traditional wisdom becomes an inspirational theme as a form of reversal against the beginning of the perceived decline of modern society.

One of the most effective ways to strengthen and maintain the balance of the social fabric of society in the context of education is to integrate indigenous knowledge through learning in the science classroom (McKinley & Stewart, 2012; Regmi & Fleming, 2012). Integration is a way for local knowledge to get better space and to make science more accessible for indigenous students whose worldviews and ways of knowing are different while validating a local

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community's understanding of nature (Aikenhead & Ogawa, 2007; Glasson, Mhango, Phiri, & Lanier, 2010). According to Ogawa (1995), each culture has its own science, which is known as its indigenous science. Indigenous science is found in specific cultural groups and taught by one generation to the next, not to the individual. The use of folklore and mythology is precious in the learning process, especially education based on cultural uniqueness (McKinley & Stewart, 2012).

In the learning process, students bring many ideas to the classroom based on their experience and different backgrounds, including ideas that interpret different science concepts. Science teaching should emphasize starting a lesson based on the knowledge and experience that learners already have and helping them to develop their understanding. Everything that the student has experienced or believed can be a source of scientific knowledge. Now, however, what happens in classrooms is that the learners have two different explanations of the same natural and social phenomena (Moyo & Kizito, 2014). There is a cultural mismatch between students' home culture and the school culture, which hold conflicting expectations. This conflict gives a poor understanding of indigenous students' behaviour. Teachers who are not fully aware of this, preferring instead to argue about ability and equity, are ill-equipped to build on their students' knowledge and experiences. The teachers' explanation is given as a legitimate way of explaining the phenomenon (Ogunniyi, 2006, 2007): They fear integrating indigenous knowledge into science since indigenous knowledge has not proven scientifically (De Beer & Whitlock, 2009). This is why there is a need to adopt new approaches to teaching sciences that respect the epistemological, ontological, axiological and pedagogical experiences of the student. One of the ways to integrate indigenous science into the science classroom is through lesson study (LS).

Lesson study is a familiar research topic around the world. LS refers to a process in which teachers progressively strive to improve their teaching professionalism by working together to examine each other's teaching technique. LS involves a small team working together to design, teach, study, and refine a class lesson (Cajkler & Wood, 2016; Cerbin & Kopp, 2006; Lewis & Perry, 2015). LS is a means of enabling teachers to develop their knowledge and study their teaching practices (Panbanlame, Sangaroon, & Inprasitha, 2014; Thinwiangthong, Inprasitha, & Loipha, 2012). This method has been proven to facilitate the improvement of teachers' competencies (Lewis & Tsuchida, 1999).

2. Theoretical framework

2.1. Lesson study

Lesson study is a form of practical guidance for educators to expand their teaching skill through collaborative learning and assessment and is justifiable based on the principles of collegiality and mutual learning in a learning community. Lesson study involves carrying out various steps: Lewis (2002) stated there are four steps in LS, and Fernandez and Yoshida (2004) explicitly declared six stages, while Stigler and Hiebert (2009) posited eight steps of LS. The number of stages of lesson study may be different, but it has the same goal: to facilitate collaboration (Kanauan & Inprasitha, 2014).

In lesson study, the teachers with a common goal continually meet together and plan lessons that may focus on either developing teaching skills or understanding subject

matter (Doig & Groves, 2011). The research lesson is taught in a regular classroom, and all the members of the lesson-study group observe as the lesson unfolds in the actual teaching-learning context. Through the lesson-study process, participants are given opportunities to reflect on the teaching process as well as on student learning (Takahashi & Yoshida, 2004). The activities follow a cycle involving collaborative goal-setting and planning the study lesson, implementing and observing the study lesson, debriefing and reflecting on the observed study lesson, revising the study lesson, and sharing thoughts about the outcomes (Fernandez, 2002; Fernandez & Yoshida, 2004; Lieberman, 2009).

Lesson study captures the idea of evidence-based learning and social constructivism, which claim that learning and professional growth are fostered by collaboration, sharing, exploration, and formulating new ideas (Dadds, 2014; Gutierez, 2016; Kriewaldt, 2012). The central part of lesson study is collaborative lesson planning, which builds the idea to develop a community of learners (Sims & Walsh, 2009). Lesson study embraces the idea that social interaction is enhanced when learning and intellectual functioning work together to develop personal expertise and improved instructional practice (Gutierez, 2016; Sims & Walsh, 2009).

2.2. Indigenous science

Ogawa (1995) posited that the science contained in a society's culture is known as indigenous science. It is a knowledge inherent in society that has been passed down from generation to generation, integrated into the culture, as well as the scientific knowledge of all those involved in the culture (Snively & Corsiglia, 2001). Indigenous science is closely related to the cumulative reflection on a place based on natural phenomena that include humans and non-humans and the belief that human beings are part of nature (Alessa et al., 2016). It contains components such as traditional beliefs that are considered inadmissible in classroom scientific discourse (Zinyeka, 2013). All persons involved in indigenous science from low to high levels within a community are experts. Indigenous science represents how the local world works according to a particular culture through a scientific process that involves systematic observation of natural events, classifying them, and solving problems threaded in all aspects of indigenous culture (Snively & Corsiglia, 2001). Characteristics of indigenous science include the development and application of science in local places, such as testing hypotheses and using systematic experiments and errors to solve problems related to the ability to compare actual sociocultural dynamics.

Epistemologically, school science is part of an empirical positivism that focuses on scientifically measured, rational thinking ability and expresses the truth (Abd-El-Khalick & Lederman, 2000; Aikenhead & Ogawa, 2007; Sandoval & Reiser, 2004). Positivists consider their scientific thinking to be the ultimate measure of rationality (Holton, 1978), and therefore, positivists' knowledge singularly represents the fidelity of the actual world (Aikenhead & Ogawa, 2007). In contrast, according to Zinyeka (2013), indigenous science cannot be proven precisely because it is local and based on the knowledge and culture in the community, which is unique. Below is a table of differences between school science and indigenous science in terms of epistemology (Table 1).

It is noted here that the difference between school science and indigenous science is one major challenge that remains to be faced. However, it should be underlined that both types

Table 1. Epistemological differences between school science and indigenous science.

School science	Indigenous science
Validation of knowledge is attached to the philosophy of positivism and empirical epistemology (Aikenhead & Ogawa, 2007; Cronje, de Beer, & Ankiewicz, 2015; Sandoval & Millwood, 2007).	The epistemologies of native science are not explicitly declared; better study and investigation are needed (Ogunniyi, 2011; Zinyeka, Onwu, & Braun, 2016).
School science is frequently based on mechanistic, experimental, and reductionistic scientific methods focusing on the generation of information and scientific literacy (Ogunniyi, 2011; Porsanger, 2004; Zinyeka, 2013).	Native science is based on a holistic worldview and the human mind, where empiricism and logic are used in the production of knowledge (Cronje et al., 2015; Porsanger, 2004).
Science is universal and objective, based on empirical data (Sithole, 2016). The dilemma of subjectivism in the creation of knowledge can be addressed by assuring inter-subjective validation (Zinyeka, 2013).	Indigenous science is unique, local, relative, subjective, multicultural, and contextual knowledge based on the accumulation of spiritual experiences, informal experiments, and understanding the signs of nature (Abah, Mashebe, & Denuga, 2015). The validation of indigenous knowledge is based on multi-theories of truth (Zinyeka, 2013).

of knowledge also have similarities, and this resemblance needs to be developed to produce a synergistic and comprehensive systematic body of knowledge that can engage students without causing conflict.

3. Methodology

3.1. Research question

The aim of this study was to explore the impact of lesson study as a way to build an indigenous learning community at a secondary school. This study explored the impact of the lesson study on the science teachers at a secondary school, creating a framework for thinking about teacher learning that draws on social constructivism with an emphasis on how learning is influenced by social interaction among science teachers and indigenous elders.

3.2. Setting and participants

The setting of this research is the secondary school in the Special Region of Yogyakarta, Indonesia. The participants comprised six Indonesian science teachers, two indigenous elders from Javanese ethnic, and one lesson study expert. The role of researchers in this research was to create and guide the indigenous learning community who cares about the sustainability and existence of indigenous knowledge in Javanese society. Each grade in the school was represented by two science teachers. The teachers had an average of 10.76 years of experience teaching science, and their cultural background was from the Javanese ethnic, one of the tribes in Indonesia with a strong tradition that still survives today. The Javanese culture has rich indigenous values and knowledge that is the basis of epistemology and cultural thought and history, using many symbols to convey messages since prehistoric times (Kartodirdjo, 1982; Raffles, 1817). As an indigenous learning community, the participants collaborated to facilitate goal setting, lesson planning, observation, revision, and finalisation of the research lessons as follows in Figure 1.

First, an indigenous learning community (ILC) was established by researchers. ILC is a small group consisting of participants who have a concern to preserve indigenous

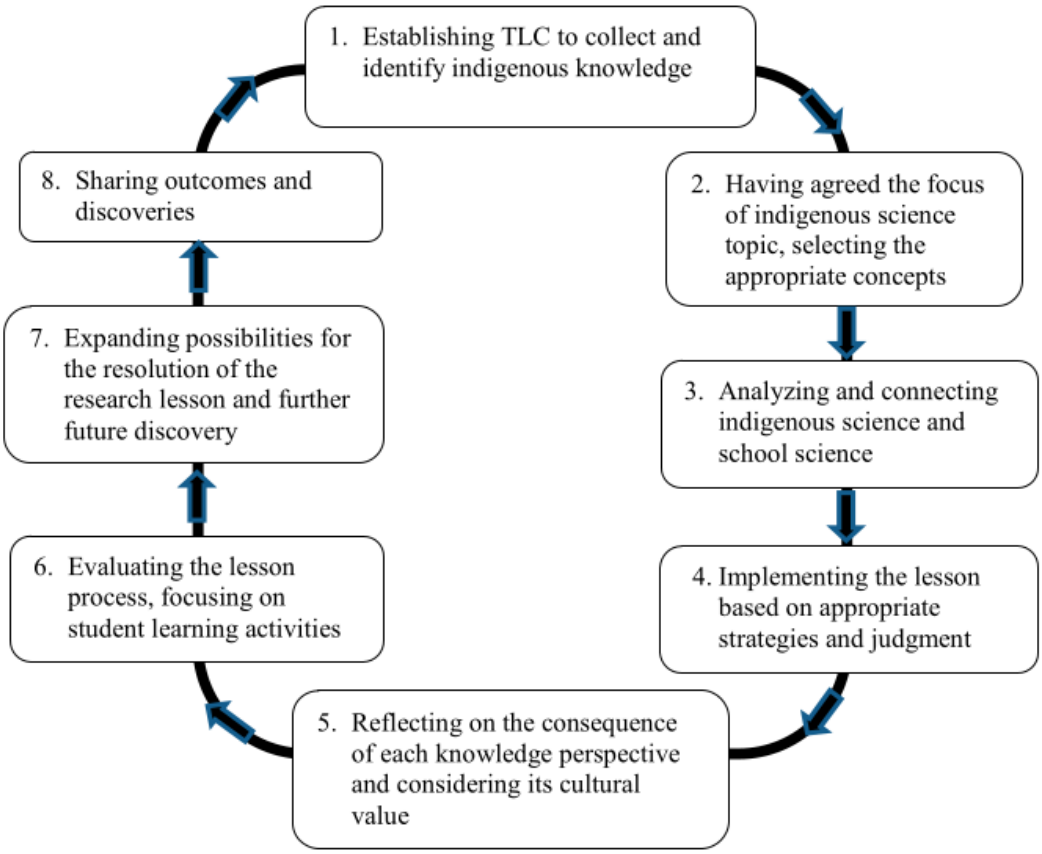

Figure 1. Lesson study cycle among secondary school science teachers.

knowledge in Java. The formation of the ILC considers several aspects, namely the school situation, the students social and cultural background, the abilities and cultural background of the teacher, and the relationship with the Javanese community. ILC met regularly to discuss indigenous science in formal or informal arrangements, collecting and identifying examples of indigenous science in Javanese society. As a second step, they decided to choose one science topic of interest. The selection of interest was aimed at making the group's study more focused and in-depth. Having chosen a concept, they then examined its suitability within the curriculum and classroom science (step 3). All the results of the analysis were organised as a basis for constructing lesson plan. The learning designs produced in the third stage were then implemented in the classroom according to the scheduled time during the term and based on appropriate strategies and judgments (step 4). Soon after the lesson, the team held a debriefing meeting to reflect on their experiences during the lesson's implementation and observation, which were the consequences of both knowledge perspectives (stage 5). Emphasized at this stage were the design and structure of the research lesson constructed by the group. After reflecting, the group members evaluated the implementation in the classroom related to the student learning process (step 6). ILC discussed the student activities during the lesson, ensuring that students could compare both perspectives. The results obtained from steps five and six were then used as the basis for determining further improvements (step 7) to expand the possibilities for future discovery. At the end of the steps, the group shared the outcome and new discovery (step 8).

3.3. Data collection

The impact of lesson study cannot be measured with only one or two cycles of lesson implementation. In this research, the cycle was implemented six times. The data were gathered over four months and collected by interview and observation involving field notes and video recording. These are the main components of the research, and all the data helped the researchers to answer the research question. Participants were interviewed individually before and after engaging in LS. They answered open-ended questions about the lesson study implementation and the collaboration with the indigenous elders. The interviews were used explicitly to explore more deeply teachers' feelings during the research. Field notes were recorded throughout the study: Remarks were taken down throughout group interactive sessions and during observation of the LS implementation. Audiovisual data were collected from whole stages of LS implementation using a digital camera recorder. Video recording of lessons was viewed by researchers to compare the content of a lesson with that in the planning, evaluation meeting, and field notes.

3.4. Data analysis

Qualitative data were analysed through six stages: organising data, exploring and sorting data, encoding for constructing themes, descriptive analysis, sustainability analysis and invention interpretation, and validation. First, all data were encoded in Microsoft Excel to come up with a segmented transcript of participants' interviews. The transcript was organised and grouped into broad themes, and labels of inference showing ideas with ordinary meaning were assigned. This was followed by exploring and sorting based on appropriately shown ideas. The next step was encoded creation to construct themes or categories. Categories were noted descriptively, analysed, assessed, and recorded in each iteration (Corbin & Strauss, 2015). The segmented data or categories were initially interpreted by the authors and verified or validated by two experts. Validation of the data and research findings was executed by the triangulation method. Triangulation method according to Johnson and Christensen (2013, p. 299), is to make the research process more systematic by mutually crosschecking information so that conclusions taken through various procedures or sources are trustworthy. The consistency of the data is achieved when the research steps can be verified through examination of raw data, data reduction results, and notes on the research process (Campbell, 1997).

4. Finding

In this research, lesson study's effects on the science teachers were categorised into four lesson aspects: improving teacher science content knowledge, developing teaching strategy and teaching skill, enhancing a stronger sense of working collaboratively, and creating a sense of an indigenous paradigm. Table 2 presents the categorised positive impacts of lesson study on the science teachers.

The four categories interrelated and mutually influenced one another (Figure 2). From a sociocultural view, learning frequently occurs in any community. Having a strong community challenges teachers to reconstruct their traditional behaviours and share a distinctive culture for redeveloping teachers' identities (Lieberman, 2009). In the indigenous

Table 2. Categorised positive impacts of lesson study.

Impact categories	Explanation from the transcript
Improving teacher science content knowledge	Teachers acknowledged the improvement of their science content knowledge by the indigenous learning community. ILC gave the opportunity to explore and share teacher knowledge and check the truth of information from each member with the textbook, internet, and journals. They explored the original information from the native elders.
Developing teaching strategy and teaching skill	Teachers expressed that their teaching strategy was enhanced through lesson study. Becoming an observer enhanced teacher classroom management skills and raised new perspectives that learning was not only for students but also for teachers.
Enhancing the sense of working collaboratively	Teachers had an opportunity to develop their social interaction through collaborative work. Teachers in ILC learned that doors were open – everything could be discussed, such as sharing their experience and teaching methods, giving feedback and critique, discussing a problem, and developing problem solutions.
Creating a sense of an indigenous paradigm	Teachers had a new perspective that an indigenous paradigm is essential to understanding and carrying out research from a previously marginalised perspective to be placed in accordance with culture as a unified whole in the methodology: rational accountable, respectful, reciprocal appropriation, and rights and regulation. Teachers viewed the four principles as serving essential purposes to give them the ethical responsibility for the indigenous research.

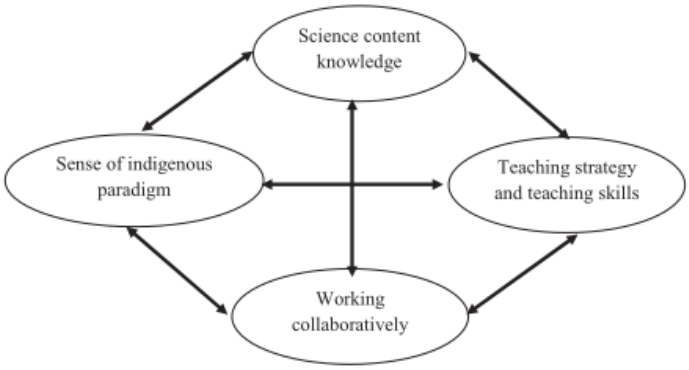

Figure 2. Interrelation of four categories of impact of lesson study on ILC.

learning community, the relationship of mutual trust and collaboration between indigenous people and secondary science teachers was well established. Science teachers and indigenous elders discussed, communicated, and exchanged information to produce a learning design appropriate to the science syllabus and student needs. Collaboration between two practitioners of these different types of knowledge can minimise the gap between indigenous science and science in the classroom.

4.1. Improving teacher science content knowledge

In the ILC, teachers and Javanese elders discussed, investigated, compared, and sought conformity between both knowledges – school science and indigenous science. Science teachers gained much knowledge from Javanese elders on indigenous science, realising that indigenous science can be integrated into science content in schools. Javanese elders provided information known as Javanese mythology. Javanese mythology is one of the roots of Javanese culture from which the Javanese seek solutions and answers to the problems they face (Zaidan, Tasai, Suyatno, & Suyono, 2002). Javanese mythology

contains local wisdom that often underlies the attitudes and behaviours in Javanese life (Endraswara, 2006). Javanese mythology is a way of thinking about the problems of life as a result of Javanese cultural contact with nature in the form of universal knowledge and moral values. Javanese mythological knowledge is obtained through a series of activities to understand the signs of nature, which are known as *titen*. *Titen* educates Javanese like scientists, instructing them to observe, record, analyze, and test hypotheses based on their knowledge. The term *titen* is the essence of indigenous science for Javanese people, which includes a body of knowledge, a way of thinking, and a way of investigation. Here is an example of integration of indigenous science and school science that was implemented in the first cycle of lesson study:

> In seventh-grade natural science, the subject is measurement. In the non-standard unit concepts, the Javanese society has the terms *sepasar* and *selapan*. The term *sepasar* is a five-day time measure, while *selapan* is the term to interpret a time measure as long as 35 days. Both the terms of *sepasar* and *selapan* can be introduced as nonstandard units of time in school science.

At the lesson study stage, each member was given the opportunity to explore and share his or her knowledge and check the truth of information with the textbook, internet, and journals. What the community accomplished is greater than the sum of individual contributions and is a part of broader cultural efforts. The implementation of lesson study provides much additional knowledge for teachers and improves understanding of indigenous science. One of the teachers explained,

> I have been teaching for more than 10 years, but it was unthinkable that a lot of Javanese knowledge is scientific and can be integrated into the science classroom. Through lesson study, I got valuable information about native science and its relevance to school science. ILC helped me to complete my knowledge of science content knowledge.

Through collegial interaction or collaborative work, teachers can develop and redevelop their knowledge, skills, beliefs, and philosophies of teaching and learning that directly influence their identities as teachers (Lieberman, 2009; Popp & Goldman, 2016).

4.2. Developing variety teaching strategy and teaching a skill

Most of the teachers the in the secondary school taught monotonously and required long preparation. Lesson study gave a new perspective that planning together is essential for the teachers as it saves time. One teacher noted,

> Planning together brings up a variety of ideas, approaches, methods, with one goal: students learn. Personally, I acknowledge that the collaboration has a positive impact on my classroom comprehension skills.

The experience of being a model presented a challenge for teachers to do their best in their teaching, leading teachers to think about using a variety of strategies in class and try out new approaches. Becoming an observer had a positive impact on the science teachers, particularly their classroom management skills. Observing students during a lesson helped teachers to understand how students were thinking about the lesson. Teachers got a new perspective on learning: that it is not only for students but also for teachers. They understood what the students were thinking and what confused them, thus generating a self-reflection on how to teach in class. One of the teachers stated that

> I learned a lot when I became an observer. I placed myself as a student as well as a teacher. I understand what a student feels when they are confused, when they are bored, how students think about problems differently. This makes me think more openly and dynamically, to use more varied teaching strategies to keep students learning.

Being an observer gives teachers a lot of information about student activities and the real learning processes. Bandura (2000) claimed that when teachers are dynamically engaged during professional learning sessions, they are likely to implement their acquired skills and knowledge in their classrooms. Fernandez (2005) showed that lesson study can improve teachers' teaching ability and skill. Another factor that enriches and elevates the work of lesson study is the common practice of involving an advisor in the lesson study process. In this research, the lesson study advisor was one of the lecturers who participated in LS and gave inputs ranging from planning to reflection. The advisor could serve as a vehicle for helping the indigenous learning community and a bridge connecting practitioners in schools with policymakers through a research study.

4.3. Enhancing the sense of working collaboratively

The existence of the community makes teachers less lonely, as there are colleagues with whom to share and discuss the obstacles and issues in the classroom, the condition of students, content knowledge, teaching strategies, new teaching approaches, etc. Teachers in ILC learned that the doors are open: Everything can be discussed. Through their participation, teachers learned the value of the process of collaboration. In a learning community, teachers think about their broader purposes and practices (communicating, giving colleagues access to learning, giving feedback, sharing experiences, etc.) to support long-term goals (McLaughlin & Talbert, 2006). When teachers interact routinely, they refer to their long-term goals and beliefs. One teacher explained,

> I usually work individually, rarely discuss with colleagues. As long as I have been a teacher, other teachers have never observed me or given feedback to me about my teaching in the class. The teachers here are Javanese, who still have a culture of *unggah-ungguh* (manners), *tepo sliro* (mutual respect); they remain silent if they disagree with my teaching method. Through lesson study, we shared knowledge about the subject matter, the needs of students, the obstacles faced by students, the teaching method, etc.

The idea of lesson study is simple: collaborating with fellow teachers to plan, observe, and reflect on lessons, revise and redesign them, and share their outcomes. Teachers have an opportunity to develop their social interaction through working collaboratively to formulate long-term goals for student learning; planning, conducting, and observing a 'research lesson' in the classroom; revising the lesson and the approach to instruction based on the observations; and sharing their discoveries. The product of this collaborative work is a written lesson plan that describes in detail the design of the lessons. Through lesson study, teachers have an opportunity to develop professional communities of inquiry with ownership of the improvement effort, a commitment to inquiry, shared goals, and a sense of responsibility to their colleagues and students (Lewis, Perry, & Hurd, 2009).

4.4. Creating a sense of an indigenous paradigm

A paradigm is a series of beliefs about the world and about receiving knowledge together to guide people in action (Wilson, 2001). The indigenous research paradigm is not

interpreted as being in opposition to the current method of research, but the understanding and carrying of research from a previously marginalised perspective to be placed in accordance with cultural and value protocols as a unified whole in the methodology. An indigenous paradigm views relationships at the centre of the research process, where knowledge and people are not seen as objects. The involvement of indigenous elders in the learning community gives teachers a different view that knowledge in the community is not just exploratory, but there is a reciprocal relationship with the direct involvement of the community in the learning activities. Teachers articulated the importance of building community relations and establishing positive home–school partnerships (Acton, Salter, Lenoy, & Stevenson, 2017). Science teachers explore and learn to understand the indigenous knowledge that is related to the school science. The ILC brainstorms the indigenous knowledge, identifies each members' ideas and opinions, reconfirms the chosen subject, takes turns invalidating science content, and checks information accuracy using content-based textbooks. The team seeks the essential correlation between indigenous knowledge and school science by looking for similarities and differences of both perspectives. They seek and sort out the knowledge accordance with scientific competence and then discuss it and implement it based on the eight stages of lesson study. Through lesson study, mutual respect emerged among teachers and the indigenous community. One of the teachers posited,

> The existence of indigenous elders opens my mind to the fact that they are marginalized. The indigenous learning community really needs to be socialized for communication between practitioners in schools and the community. It is a cultural richness that must be preserved.

Louis (2007) stated that there are four principles that must be considered in indigenous research: rational accountability, respect, reciprocal appropriation, and rights and regulation. Rational accountability describes the network of relationships indigenous peoples have with both their social and their physical worlds (Khupe, 2014). Indigenous peoples share their dependence on everything and everyone around them. Teachers describe relationships within an indigenous community as a way of sharing their own knowledge, giving ideas, and exploring indigenous knowledge. Teachers are not only responsible for developing relationships but are accountable for all relations. In the principle of a respectful perspective, teachers act as part of an indigenous society, digging for information from the indigenous elders by placing themselves as part of the community. Respecting in this regard is not only about saying 'thank you' or 'please' but about listening well to all thoughts and knowledge in an indigenous society. Respectful acknowledgment of highly situated knowledge is linked to the necessity of embedding plural ways of knowing (Acton et al., 2017). The focus principle of reciprocal appropriation considers the appropriateness of including indigenous science with school science. ILC provided a primary and integrated experience that both types of knowledge have their own advantages in explaining social and natural phenomena. Teaching in this paradigm values the personalised knowledge of learners, is inclusive of various understandings and perspectives of the world, and ideally provides a safe space to develop and refine this knowledge in an iterative process of collaboration, consensus building, and constructive conflict to challenge a narrow view (Maclean, Robinson, & Natcher, 2015). There is reciprocity between indigenous researchers and those studied, which implies the need for continual feedback to stakeholders and consulting with them on how to make the process beneficial for

everyone. The teachers understand that the study of indigenous people should be collaborative, proceeding in a manner reflective of a balance between teachers in schools and the indigenous community.

5. Discussion

Lesson study is a meaningful and manageable level of analysis for investigating, constructing, teaching, and learning. During the lesson study process, an indigenous learning community was established to assess indigenous science and integrate it into school science. In indigenous learning communities, science teachers gain new experiences showing them that indigenous science needs to be explored to strengthen scientific knowledge. Teachers can learn specific classroom practices from each other, that teaching means collaborating as well as discussion, observing colleagues, and having them observe you through collegial interaction (Lieberman, 2009). The science teachers found that they were more enthusiastically involved in scheming and sustaining the experience, even though it was challenging to increase their competencies.

The result of this study indicates that the four impact categories of lesson study interrelated and mutually influenced one another. A sense of caring for the indigenous paradigm fosters the sense of working collaboratively with other teachers and indigenous practitioners, which improves teacher knowledge and the development of learning strategies. The awareness to respect indigenous research paradigm made the teachers serious in assessing indigenous knowledge, placing themselves as part of indigenous society. They collected and identified indigenous science in Javanese society and brainstormed the topic such as *Pranata Mangsa*, *Palintangan*, and *Pawukon*. The choice of topic is based on several considerations: relevance, advantages, and disadvantages to indigenous knowledge, social influence, the cultural value contained in the knowledge, students' abilities, resources, timetabling, school infrastructure, and conformity with the school science curricula. The results are then organised as a basis for constructing a lesson plan. Lesson plans are arranged collaboratively in consideration of various aspects such as essential competencies, learning objectives, learning achievements, teaching methods, challenges in learning, assessment, student character, media, and culture in schools. The community discussion also predicts how the student is likely to respond to the lesson? What is the learning objective? How does it correlate with school science? What are the advantages and disadvantages of combining both perspectives of indigenous and school sciences? What is the response of the students in the learning process?

According to Hargreaves and Fullan (2012), three elements make up a teacher's professional capital: human capital, social capital, and decisional capital. As human capital, teachers need to develop themselves as skilled individuals with expertise. As to the element of social capital, teachers must interact and work collaboratively with their social community. This process of collaboration is characterised by authentic decision-making within the group, thus providing opportunities for the development of decisional capital. As decisional capital, teachers build their professionalism through opportunities to decide on significant changes in their practice. Participating in a learning community allows teachers to develop their identity as professional capital, which includes discussing and learning from other teachers. Lesson study is like a framework, where teachers can learn how to investigate the teaching and learning processes of planning, collaborating,

observing, researching, reflecting, and discussing, which leads to professional growth that has lasting impact on improving teachers' science content knowledge, develops their teaching strategy and teaching skill, enhances their sense of working collaboratively, and creates a sense of an indigenous paradigm.

Hung and Yeh (2013) were convinced that the design of teacher study groups plays a significant role in shaping various sequences of teacher change. Lesson study is evidence of teaching improvement, where science teachers got an essential insight that their collegial and mutual relationship with each other and the knowledgeable indigenous leaders was integral in the formation of an indigenous learning community. Their interactions not only minimised the gaps between both types of knowledge, but also kept them in balance and harmony with respect to independent coexisting ways of knowing. Valuing a localised and nuanced understanding of indigenousness and indigenous knowledge is essential to ensuring cultural sustainability (Acton et al., 2017). The lesson study experience of science teachers created a professional community built upon a collegial and constructive foundation to achieve a common goal. Building an indigenous learning community means establishing a learning goal with the support of experts as an essential aspect. Gutierez (2016) noted that establishing a learning goal with the support of other knowledgeable people is an important aspect of building a professional learning community.

The finding of this research is limited to categorising and recognising the impact of lesson study on the science teachers at the secondary school. The finding may serve as a benchmark for future studies about science teachers in an indigenous learning community. Teachers should be implemented Interesting and meaningful learning in the class. They have to explore the linkage between school science and indigenous knowledge. This is a challenge for the teacher in the secondary school to provide students with the knowledge, attitude, and skills to care and preserve local knowledge and cultural values. The school is an agent of the society that works to simplify, purify and balance so that individuals can participate in social life. Teachers who have qualified content knowledge, varied teaching skills, work collaboratively, and a sense of indigenous paradigm is expected to raise the student awareness about the global and cultural sustainability.

There are two challenges in this study: The first is the fact that the teachers have been schooled in Western science and hence are more familiar with that worldview than with that of indigenous knowledge. The second is the top-down approach in the Indonesian curriculum, which was implemented outside the teachers' role in curriculum planning and implementation.

This study is self-governing, which considers the indigenous knowledge sustainability in Javanese society. Researchers attempt to introduce indigenous knowledge to the teacher working group (KKG) and subject teacher meeting (MGMP). According to the Directorate General of Quality Improvement of Educators and Education Personnel of the Republic of Indonesia, KKG and MGMP aim to broaden teachers' horizons and knowledge in various matters, especially the mastery of the subject content knowledge, learning preparation, and provide opportunities for working group members to share experiences and feedback. This group provides opportunities for researchers to build indigenous learning communities that consider the cultural sustainability and local values. Nonetheless, it is hoped that the experiences of the teachers involved in this study are to be implemented in their future actual classroom practices.

6. Conclusion

This study indicates that lesson study can be a bridge to building an indigenous learning community. Science teachers can interact with indigenous elders in a community to explore the compatibility and integration of indigenous science and science in schools. Collaboration builds a harmonious relationship between teachers and indigenous practitioners. There are four categories of impacts of lesson study: improving teacher science content knowledge, developing teaching strategy and teaching skill, enhancing a sense of working collaboratively and creating a sense of an indigenous paradigm. The four impact categories of the lesson study are interrelated. A sense of caring for the indigenous research paradigm fostered a sense of working collaboratively with other teachers and indigenous practitioners, which had an impact on improving teacher knowledge and the development of learning strategies. Teachers were expected to share their knowledge with another teacher to widen the impact of this study. In summary, the long-term sustainability of ILC remains to be investigated.

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