TÜRK FEN EĞİTİMİ DERGİSİ
Yıl 16, Sayı 1, Mart 2019

Journal of
TURKISH SCIENCE EDUCATION
Volume 16, Issue 1, March 2019

http://www.tused.org

The Inquiry-based Teaching Instruction (IbTI) in Indonesian Secondary Education: What Makes Science Teachers Successful Enact the Curriculum?

Muhammad Haris EFFENDI-HASIBUAN [1], Harizon[2], Ngatijo[3], Amirul MUKMININ[4]

[1]PhD. Universitas Jambi, Jambi-INDONESIA
[2]Dr. Universitas Jambi, Jambi-INDONESIA
[3] Dr. Universitas Jambi, Jambi-INDONESIA
[4]PhD. Universitas Jambi, Jambi-INDONESIA

Received: 18.02.2017 **Revised:** 11.10.2018 **Accepted:** 17.11.2018

The original language of article is English (v.16, n.1, March 2019, pp.18-33, doi: 10.12973/tused.10263a)

Reference: Effendi-Hasibuan, M.H., Harizon, Ngatijo, & Mukminin, A. (2019). The Inquiry-based teaching instruction (IbTI) in Indonesian secondary education: What makes science teachers successful enact the curriculum? *Journal of Turkish Science Education, 16*(1), 18-33.

ABSTRACT

The inquiry-based teaching instruction (IbTI) has been practiced internationally to improve student competency in science. The implementation of this strategy has been recommended by the science curriculum in Indonesia since 2003. However, it is not still implemented successfully in schools. The implementation is likely unsuccessful to achieve its goals and this has been demonstrated by the results of an international assessment program called PISA in which the ranks of Indonesia have not increased since 2003. This study; thus, focused on this issue by assessing the implementation of IbTI in secondary schools in Jambi City, Indonesia. In addition, this study included constraints that interfered with the implementation. A researcher-designed questionnaire was sent out to 107 science teachers in Jambi city and 70 (65.4%) teachers returned the questionnaires. The results showed that most of the participants did not use IbTI in their science classrooms. They predominantly used the more traditional teaching strategies such as lecturing despite of the fact that the use of IbTI had been recommended by the curriculum. Four major perceived-constraints including the unsupportive educational settings and insufficient facilities and knowledge had been identified interfered with the implementation. These findings may provide a logical explanation to the low science scores of the Indonesian students as showed by PISA. This study thus highlighted the need of providing the science teachers with reasonable supports for replacing their traditional-type instructions with more student-centered ones such as IbTI. The findings of this study are also beneficial for those in other developing countries who are endeavoring to implement inquiry due to the similarity in their educational context.

Keywords: curriculum, inquiry-based teaching instruction, science teachers.

Corresponding author e-mail: amirul.mukminin@unja.ac.id © ISSN:1304-6020

INTRODUCTION

The inquiry-based teaching instruction (IbTI), in general, is a science teaching practice which is designed and implemented by a science teacher with a goal of involving students in carrying out an investigative learning activity to develop their critical thinking skills as well as their science skills. This approach is advocated because it is appropriate for the wide diversity of students' capabilities and existing knowledge (Hess & Trexler, 2005; Sewel, 2002; Trowbridge, Bybee, & Powell, 2004). In this practice, students are encouraged to pose questions and find their own answers by doing 'hands-on' activities in groups, sharing their ideas, and holding discussions with peers (NRC, 1996). Meanwhile, teachers are recommended to give students chance to work independently by carrying out their own investigations. Teachers can guide students by asking divergent questions (Alessandrini & Larson, 2002; Oliveira, 2010; Windschitl, 2002) which will help them to conduct their investigations, collect their own data, and reach their own conclusions (Baker & Leyva, 2003).

A vast array of studies over the years has provided evidence that IbTI is efficient for students' science achievement (e.g., Gallagher, 1987; Geier et al., 2008; Hmelo-Silver, Duncan, & Chinn, 2007; Hofstein & Lunetta, 1982; Hofstein, Navon, Kipnis, & Mamlok-Naaman, 2005; Lustick, 2009; Palmer, 2009; Sadeh & Zion, 2009; Zion, Cohen, & Amir, 2007). The benefits can be in the form of the developing students' critical thinking and conceptual understanding (Minner, Levy, & Century, 2010) as well as their science process skills in generating questions and writing hypothesis (Hofstein, Shore, & Kipnis, 2004), and increasing their engagement in science lessons (Sadeh & Zion, 2009).

Because of its numerous benefits, IbTI has become a worldwide strategy in science teaching. Some countries such as the United States (NRC, 1996, 2000), Australia (Education, 2007), the United Kingdom (IGCSE, 2009), China (MOE, 2001), and Indonesia (MoNE, 2003b) have mandated the use of this teaching strategy in their curriculum documents. Particularly in Indonesia, the use of IbTI was recommended firstly by the Indonesia government in 2003 in the science curriculum called the competency-based curriculum (*Kurikulum Berbasis Kompetensi* or KBK in *bahasa*). KBK had targeted goals to help students develop their scientific knowledge, (MoNE, 2003a), their process skills, and their ability to apply science in everyday life (MoNE, 2003b). These goals were parallel with the lifelong learning concept (or the need to learn throughout life) and the learning-society concept issued by The United Nations Educational Scientific and Cultural Organization (UNESCO) in 2002, in which all social science field areas should should meet goals to foster more-effective learning (UNESCO, 2001).

However, KBK was likely unsuccessful to achieve its goal developing the Indonesia students' science competency. The Indonesian students' competency in science remained low despite the recommendation of IbTI use within KBK. One of the evidence was obtained from the results of the Program for International Student Assessment (PISA) - an international assessment program which assesses 15 year-old students' performance on Mathematics and Scientific Literacy. The results of PISA shows that the Indonesian students' scientific skills had not been developed since 2003. In 2003, the Indonesian students were at the rank 38 out of 40 participant countries (OECD, 2003). In 2009, it was at the rank 57 out of 65 participant countries (OECD, 2009), and in 2012 it was at the rank 64 out of 65 countries (OECD, 2012). During that decade, the rank of Indonesian students were even lower than the rank of students from some other South East Asia Countries such as Malaysia and Thailand. It appeared that the implementation of IbTI was questionable, but unfortunately there was a lack of study investigating factors affecting the failure of KBK during that era.

Aiming at resolving the issue, thus, the Indonesian government in 2013 issued a reformed curriculum called the curriculum of 2013 (*kurikulum 2013* or K13 in *bahasa*). The

K13 also has a mission to develop the Indonesian student competency in science. To achieve its goal, K13 recommends teachers to involve students in science learning process. This involves students to do observations, post hypothesis, generate questions, design experiments, collect and analyze data, make conclusions, and share the results in classroom. To accommodate these approaches, teachers need to shift their teaching practices from traditional ones to student-centered strategies such as inquiry-based teaching (MoEC, 2014a, 2014b, 2016). In other words, the reformed curriculum recommends inquiry-based teaching instructions (IbTI) in Indonesian classrooms similar to the previous curriculum of the country.

Nevertheless, the Indonesian student competency in science is not noticeably developed despite of the recommendation. According to the latest PISA result in 2015, it was found that the rank of Indonesian student competency in science remains low which is at the rank 62 out of 70 participant countries (OECD, 2015) and remains below the rank of Thailand and Malaysia. It thus can be assumed that K13 is also not successful for the improvement of the Indonesia student competency in science.

Constraints may play a critical role in implementation of inquiry. For example, previous studies identified some challenges that include the external factors (Anderson, 2002) including curriculum structure, the availability of educational facilities (Coppola, 2008; Sundberg, Armstrong, Dini, & Wischusen, 2000; van den Berg & Lunetta, 1984; Zion et al., 2007), funding, technical support, classroom management (Thair & Treagust, 1999, 2003; van den Berg & Lunetta, 1984), and the assessment system (Chen, 1999; Cook & Taylor, 1994). In addition, internal factors or dilemmas (Anderson, 2002) that include teachers' knowledge and skills, and their experience in inquiry (Deters, 2004; Thair & Treagust, 1997) are also parts of the challenges in implementing inquiry. Some of these constraints look familiar in the Indonesia educational settings and thus their existence needs to be identified and their effect on the IbTI implementation needs to be understood.

Given the depiction above, it can be inferred that the enactment of science curriculum in Indonesia is problematic. The problems may be due to the quality of the implementation, the unsupportive educational settings, and some other factors. An assessment, therefore, needs to be performed to understand what factors affecting the unsuccessful enactment of the science curricula in Indonesia. The search includes about how well the IbTI was implemented in secondary schools by science teachers and what challenges that the science teachers faced in the IbTI implementation in Indonesia.

Purpose and Questions

The purpose of this study was to investigate the implementation of inquiry-based teaching instructions (IbTI) in Indonesia particularly in Jambi city and challenges that interfere with the implementation. To achieve the purpose of the study, the following questions guided this study:

1. What are the science teaching strategies predominantly used in Jambi city?
2. Have the inquiry-based teaching instructions (IbTI) been implemented in science teaching in Jambi city?
3. What challenges that the teachers face to implement the inquiry-based teaching instructions (IbTI) in Jambi city?

METHODOLOGY

a) Research Design and Participants

For this study, a survey research was used. Creswell (2012) defined survey as “research design as procedures in quantitative research in which investigators administer a survey to a sample or to the entire population of people to describe the attitudes, opinions, behavior or characteristics of the population” (p.376). In addition, Nunan (1992) defined survey “is the most commonly used descriptive method in educational research, and may vary in scope from large-scale governmental investigations through to small scale studies carried by a single researcher and the purpose of a survey is generally to obtain a snapshot of conditions, attitudes, and/ or events at a single point in time” (p.140). The purpose of using the survey research is to capture a broad picture of the IbTI implementation in Jambi city. This survey involved science teachers who were teaching in secondary schools in Jambi city, Indonesia. 107 science teachers from 40 public and private schools were invited into the survey.

Their involvements in the survey were based on their willingness and proven by their informed consent forms. 70 out of 107 (65.4%) science teachers who comprised of 20 chemistry teachers, 20 physics teachers and 30 biology teachers. These teachers included 37 male and 33 female as listed in Table 1. These teachers – further called respondents- were coded respondent 1 (R1), respondent 2 (R2), and so forth.

Table 1. *The demographic information of the science teachers*

No	Categories	Descriptions	Number of Teachers
1.	Education	a. Bachelor	55 (78.5%)
		b. Master Degree	15 (21.5%)
2.	The Institute/Faculty from where the teachers graduated	a. Teaching and Education Faculty	70 (100%)
		b. Other non-educational Faculty	0 (0%)
3.	Field of Study	a. Chemistry	20 (28.5%)
		b. Physics	20 (28.5%)
		c. Biology	30 (43%)
4.	Teaching Years	a. <5 years	10 (14.3%)
		b. 5-10 years	15 (21.4%)
		c. >10 years	45 (64.3%)
5.	Affiliated Schools	a. State Secondary School	44 (62.9%)
		b. Private Secondary School	26 (37.1%)
6.	Sex	a. Male	37 (52.9%)
		b. Female	33 (47.1%)

The demographic data in Table 1 shows that most of the teachers (78.5%) were holding bachelor degrees in science which is the requisite level of education to enter teaching job in secondary schools in Indonesia, while the remaining 21.5% of the teachers were holding master degrees; and all of them obtained their degrees from the Institute/Faculty of Teaching and Education in Indonesia. In addition, most of the teachers (62.9%) were teaching in public schools while 37.1% of the teachers were teaching in private schools. They had different teaching years; 64.3% had been working more than 10 years and the remaining 35.7% had been working less than 10 years. Based on the demographic data it can be assumed that the respondents who had returned the questionnaires had various backgrounds and they can be seen as the representation of the science teacher population in Jambi City.

b) Data Collection Tools and Analysis

To achieve the purpose of this study which was to investigate the implementation of inquiry-based teaching instructions (IbTI) in Indonesia particularly in Jambi city and challenges that the teachers faced with the implementation, three research questions guided this study: (1) What are the science teaching strategies predominantly used in Jambi city? (2) Have the inquiry-based teaching instructions (IbTI) been implemented in science teaching in Jambi city? And (3) What challenges that the teachers face to implement the inquiry-based teaching instructions (IbTI) in Jambi city? The questionnaire developed by the researchers was anonymous and sent to the teachers by mail. The questionnaire was written in *bahasa Indonesia* using clear sentences to avoid bias. The process was started by constructing the conceptual construct of the questionnaire (Table 1) that involved dimensions, definitions, indicators, items and description. The questionnaire involved questions about aspects such as the teachers' predominant teaching strategies in science teaching including their use of inquiry-based teaching instructions (IbTI), challenges that the teachers faced using IbTI in science teaching, their exposure to IbTI and their understanding about IbTI. The multiple response type items were applied in the questionnaire to provide the large scope of the teachers' responses on those questions.

Table 2. *The conceptual constructs of the questionnaire*

Dimensions	Definitions	Indicators	Items	Description
Teaching Practice and IbTI implementation	Teachers implement various teaching didactics/approaches span from the provision of contents to the investigative style (IbTI)	1. Lecturing 2. Conventional Experiment 3. Demonstration 4. Discussion 5. Drills/exercise 6. Question and answer activity 7. Inquiry-based Instruction (IbTI) 8. Problem-based Learning (PbL)	1. What strategies do you use to teach science on regular basis?	Multiple response item with 8 options
Constraints in IbTI	Some aspects are believed hamper the use of IbTI in science teaching	1. Time 2. Classroom population 3. Facilities 4. Teachers' knowledge and skill	2. What challenges that you faced when implementing the IbTI in science teaching?	Multiple response item with 4 options
Exposure to IbTI	Teachers are exposed to IbTI by diverse ways	1. From a university course 2. From books/internet 3. From workshops	3. How do you know IbTI?	Multiple response item with 3 options
Free response about constraints	Teachers' may have diverse feedback about constraints in using IbTI	1. Time 2. Classroom population 3. Facilities 4. Teachers' knowledge and skill	4. Please provide your feedback and reflection about the constraints you face.	Open response
IbTI understanding	Teachers may have diverse understanding about IbTI	Open	5. Please provide your understanding about IbTI.	Open response

As shown on the table above, the questionnaire consists of three items of multiple response questions that enable the teachers to cite more than one answer about their regular practices in chemistry teaching, challenges in using IbTI, and exposure to IbTI. The questionnaire also encouraged participants to share their open comments and reflections about the challenges they faced in using IbTI and their knowledge about IbTI. Having had the initial draft of the questionnaire (which was generated based on the conceptual construct), the process was followed by requesting two experts' opinions from the Department of Chemistry Education (bilingual) regarding the constructed questionnaire. The feedback of the two experts was used both to improve the constructed questionnaire in the context of Indonesia and to create a valid and reliable instrument. The data collected were analyzed directly by making tables and graphs and finally used to support the discussions. The data analysis process was also conducted in the light of trustworthiness involving the steps of member-checking process and discussions towards the data interpretation.

RESULTS and DISCUSSION

a) The science teaching strategies and the implementation of IbTI

This section is used to discuss the first and the second questions of this study that asked, "What are the science teaching strategies predominantly used in Jambi city?" and "Have the inquiry-based teaching instructions (IbTI) been implemented in science teaching in Jambi city?" Based on the data in Table 3, it is seen that the teacher-centered instruction approaches that featured by the minimal participation of students in the learning activities were the most used teaching strategies in Jambi city. These included lecturing which was used by all the 70 respondent teachers followed by the confirmation-type experiment or conventional experiment, demonstration, discussion, drill/exercise, and question and answer activity.

However, the results of the survey revealed an interesting phenomenon. It seemed that the student-centered learning strategies were not favored in Jambi city. The inquiry-based teaching instruction (IbTI) and the problem-based learning (PbL) were only used by one teacher. IbTI which was recommended by the K13 was likely neglected by almost all participant teachers in Jambi city.

Table 3. *The science teaching strategies*

No	Teaching strategies cited by the teachers	Number of teachers (total 70 teachers)
1.	Lecturing	70 /70
2.	Conventional Experiment	41/70
3.	Demonstration	22/70
4.	Discussion	9/70
5.	Drills/exercise	3/70
6.	Question and answer activity	2/70
7.	Inquiry-based Instruction (IbTI)	1/70
8.	Problem-based Learning (PbL)	1/70

The predominant use of teacher-centered strategies in Indonesia was actually not surprising as this had been noted by other two groups of researchers two decades ago. Mahady, Wardani, Irianto, Somerset, and Nielson (1996) had observed that teachers in Indonesia predominantly used a teacher-centered learning-approach such as lecturing in their teaching practices and provided little opportunity for students to actively learn. In their two studies, Thair and Treagust (1999, 2003) supported this finding and noted that science teaching activities in Indonesia is more teacher-oriented and not engaging students in the learning activities. These include the major use of lecturing, the conducting of experiments solely to finding a pre-determined answer, and the use of textbook activities. Hence, it suggests that the teacher-centered learning strategies such as lecturing is the most implemented teaching strategy in Indonesian secondary schools particularly in Jambi city which had not changed over decades.

The findings that show the minimal use of IbTI in secondary schools in Jambi city were absolutely not understandable for certain reasons. First, the use of IbTI in science teaching instructions had been recommended by K13 in 2013; however, the science teachers in Jambi city seemed to ignore the recommendation. The teachers left the inquiry-based instruction behind and preferred to use more traditional teaching strategies in classroom activities. Second, it is widely well-known that IbTI is beneficial to develop students' science competency. Nevertheless, the science teachers in Jambi city were likely not concerned about this fact. Many previous studies have shown that IbTI is beneficial for students in their learning outcomes (e.g., Gallagher, 1987; Geier et al., 2008; Hmelo-Silver et al., 2007; Hofstein & Lunetta, 1982; Hofstein et al., 2005; Lustick, 2009; Palmer, 2009; Sadeh & Zion, 2009; Zion et al., 2007). The benefits span from the development of students' critical thinking and conceptual understanding (Minner et al., 2010), students' process skills in generating questions and hypothesis (Hofstein et al., 2004), and enhancing students' performance in science (Sadeh & Zion, 2009). In IbTI, students experience outdoor experiences and interacting with nature that can promote students to carry out their own investigations by collect their own experimental data, and reach their own conclusions to create meaningful understanding in science (Baker & Leyva, 2003). Leonard (1980) argues that the more students are involved in practical activities, the more learning outcomes that they will achieve. Having these benefits in mind, we can state that it is not a good option to neglect IbTI in science instruction. The participants failed switching their teaching practices from more teacher-centered to more student-centered teaching practices. The failure in shifting the teaching practice is potential to bring failure developing Indonesian students' competency in science. Previous studies suggested swiching teaching practices from more traditional didactics such as lecturing to constructivism and active-learning approaches such as IbTI to be able to meet the goals of reformed Indonesian curriculum. (Kulm & Stuessy, 1991; Sawada et al., 2002; Shymansky & Kyle, 1992). Finally, these descriptions might explain why the rank of the Indonesia student competency in science assessed in the PISA program remains low since 2003.

b) Constraints in the IbTI Implementation

The third question of the study investigated the challenges that the teachers face to implement the inquiry-based teaching instructions (IbTI) in Jambi city. The data in Table 4 indicate that the science teachers responded differently to the four major constraints, which had influenced them in using IbTI. It seemed that the lack of time was the most cited constraint amongst the four. It was followed by the large number of students, the lack of equipment and facilities, and the lack of knowledge, skills and experience with practicing inquiry (Table 4).

Table 4. *Perceived constraints in the implementation of IbTI*

No	Constraints on use of IbTI cited by the teachers	Number of teachers (total 70 teachers)
1.	The lack of time	55/70
2.	The large number of students	50/70
3.	The lack of equipment and facilities	40/70
4.	The lack of knowledge, skill and experience	35/70

The four constraints cited by the teachers were not surprising as these are prevalent in Jambi city. These constraints are discussed below.

c) The lack of time

The lack of time was the first big constraint perceived by 55 out of 70 teachers in Jambi city. This constraint refers to the limited time for teachers to conduct inquiry investigations. According to the teachers, heavy teaching and curriculum load are the main reasons why they implement inquiry. The teachers were always rushing to cover the entire curricular contents. Some teachers posted the reasons about this constraint as below:

> 'I, hardly ever conducted experiments, due to the lack of time and equipment'. (R5)
> 'We [I] don't have much time to conduct many experiments; we are rushing to finish all the subjects'. (R7)
> 'We [I] do not conduct experiments for the unnecessary subjects, to be honest, because we are rushing'. (R15)
> 'Let us say in two x 45 minutes, students can only learn one concept in an experiment, but if we use the traditional method in the classroom, either by lecturing or discussion, we can accomplish more concepts within the same minutes. We are rushing'. (R20)
> 'Never… because I am forced to rush [to meet] my target'. (R31)
> "Inquiry needs a long time so we [I] do not do it'. (R45)

The teachers' perceptions about the insufficient time to conduct investigations particularly in the form of inquiry were understandable. It is widely known that the Indonesia curriculum is overloaded. The overloaded curriculum comes from the many subjects contained in the curriculum. For example, the Indonesia secondary-school curriculum contains around 17 subjects per semester during the compulsory three years of schooling (Abdullah, 2007). This has been done on the purpose for accommodating not only the science-content subjects (i.e., chemistry, physics, biology), the mathematics, the social-content subjects (such as language, economics, etc.) but also meeting the needs of diverse groups of the country by offering courses related to ethnicity, religion, national identity, and national resources (Hadi, 2002).

The problem of an overloaded curriculum is resulted in overlaps among contents covered in different subject matters. In other words, one scientific concept can be taught in two different subjects with insignificantly-different scopes. For example, radiochemistry is taught in chemistry and is also taught in physics as nuclear physics using similar concepts. Indonesian science teachers thus feel under pressure to meet all the curricular targets covering all the required science materials during the semester (Masdjudi, 1999). These overloaded science program then reduces the for the implementation of the inquiry-based teaching-activities. Previous studies have discussed how teachers felt pressure to cover curriculum that make them leave almost no time for practical lessons such as inquiry-investigations (Minner et al., 2010; Staer, Goodrum, & Hackling, 1998). This is why inquiry was not favored in Jambi city.

d) The large number of students

The large number of students was the second constraint discussed by 50 teachers. This refers to the number of students who are phenomenally large around 30 to 40 students in a classroom. This reduces teachers' eagerness to conduct an inquiry-based activity due to the classroom management and disciplinary issues as well as plenty of time spent for preparation of materials and arrangement of the classroom. Undoubtedly, the teachers thus prefer to employ a teacher-centered instruction method such as lecturing for their overcrowded classrooms (Thair & Treagust, 1999; van den Berg & Lunetta, 1984). Some teachers provided reasons why this had challenged them in implementing IbTI.

> 'There are almost 40 students in my classroom. I cannot conduct an inquiry learning because that will waste the time'. (R6)
> 'The number of students is very large. It is difficult to guide them'. (R29)
> 'It is hard for me to order them. It will produce big noise'. (R40)
> 'It will make the laboratory messy and disorder'. (R50)
> 'It is time consuming. I need 2 experiments for each topic to include all the students who are very large in number. Half of the classroom is for each experiment'. (R55)

A picture depicts a crowded situation of a classroom in one secondary school in Jambi city is presented in Figure 1.

Figure 1. A science classroom containing 40 students

e) The lack of equipment and facilities

The lack of equipment and facilities were the next constrain discussed by 40 respondent teachers in Jambi city. This refers to the lack of laboratory, science materials, and equipment such as glasses, balance, cables, etc. Some teachers further described the condition of their science laboratory and facilities in their schools and evaluated it as complete, inadequate or inadequate. It is presented in Figure 2 below. Data in Figure 2 shows that 48 teachers had reported that the equipment of their laboratory was inadequate, 18 teachers had stated that it was adequate, while 4 teachers had stated that it was complete.

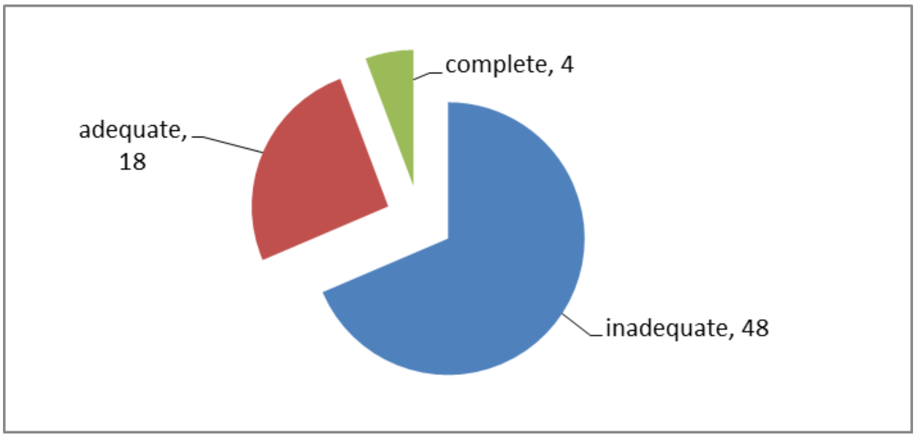

Figure 2. The inadequacy of equipment and facilities in the science laboratory secondary schools

The lack of equipment and facilities in the secondary schools in Indonesia including Jambi city actually is not a new issue. The past studies also discussed how some schools in Indonesia were lacking laboratories, basic equipment and materials. These studies also discussed the problems about restocking or replacing broken apparatus that are not taken cared of for years in the school laboratories. Teachers even find it difficult in purchasing electrical cables for practical work due to the lack of funding (Coppola, 2008). Furthermore, most of the laboratories are lacking assistants/technicians (Thair & Treagust, 1997); who would normally have the responsibility for helping the science teachers for preparing their experiments. Therefore, Walberg (1991) had criticized the suitability of inquiry-style experiments for developing countries due to the insufficiency of the laboratory facilities. This constraint thus undoubtedly causes science teachers to neglect inquiry-based laboratory investigations. Rather, they prefer to use those that are more teacher-centered ones.

f) The lack of teachers' knowledge, skills and experiences in IbTI

The final constraint was the lack of knowledge, skills, and experiences of science teachers to implement IbTI. This was cited by half (35) of the teachers out of 70 participant teachers in Jambi city (Table 5). The data were supported by other data showing that the respondent teachers held limited and miscellaneous knowledge about inquiry. It seemed that 35 teachers held anecdotal understanding about inquiry as an activity to find concepts, activity to make students more creative, etc., while the remaining half were blind about inquiry (Table 5). Some examples of the teachers' understanding are presented below.

'Inquiry is used to find concepts'. (R4).
'Students find something out of the experiment'. (R10)
'Students make conclusions'. (R11)
'Students to generate concepts'. (R17)
'To help students more creative'. (R19)
'Students solve problems'. (R22)
'Students make conclusion'. (R25)
'To prove concept '. (R34)
'To activate students'. (R41)
'Investigating type activity'. (R51)

Table 5. *Teachers' knowledge and experience in IbTI*

No	Descriptions	Number of Teachers (total 70 teachers)
1.	Knowledge of inquiry:	
	a. Anecdotal understanding:	
	- Inquiry aims to find concepts	25/70
	- Other understandings	10/70
	b. No understanding	35/70
2.	Exposure to inquiry:	
	a. Had been exposed to inquiry:	
	- in a university/faculty long time a go	21/70
	- from books	9/70
	- professional development (PD) programs about inquiry-based instruction (IbTI)	0/70
	b. No exposure to inquiry	40/70

The phenomenon about teachers' miscellaneous understanding about inquiry had been identified by previous authors. Windschitl (2004) had observed that inquiry was understood in many different ways. One of the commonly-held misconceptions about inquiry-learning activities is that they are activities 'to find something' out of practical activities. Then, French (2005) had also observed that some teachers may have understood inquiry in different ways. IbTI can be understood by teachers simply as similar to the prevalent traditional practical activity aimed at confirming/proving concepts. It can be done by simply involving students in a practical activity and by asking some questions for the students to answer, or by letting students investigate their own particular interests without clear steps and without appropriate guidance.

However, based on the literature, an inquiry activity is designed to help students develop their scientific knowledge and procedural skills. This should be designed with a clear purpose to answer specific questions that involve some steps and levels (Fay & Bretz, 2008; NRC, 2000) in which teachers use appropriate questions (Alessandrini & Larson, 2002; Colburn, 2000; Oliveira, 2010; Windschitl, 2002) and support students' learning (Davis, 2003; Edwards & Mercer, 1987; Hmelo-Silver et al., 2007) guide students to develop their explanations. Limited understanding about inquiry resulted in teachers' confusion in implementing IbTI such as having hard times in distinguishing their roles and students' roles in the inquiry-type instruction and deciding how much assistance they should provide for students to complete the inquiry activities (Bell, Smetana, & Binns, 2005; Blanchard et al., 2010; Colburn, 2000). It appears that teachers' knowledge about scientific inquiry is insufficient in Jambi city and that makes it unable for teachers to use this teaching strategy in their science teaching practices.

Professional development is, therefore, believed to be the key to meet the goals of teaching reform (Loucks-Horsley & Matsumoto, 1999). Such programs, which normally provide teachers with the knowledge, skills and experience, will enable teachers to further adopt it in their teaching practices. Unfortunately teachers had different experiences and exposures about learning and practicing inquiry. Data in Table 4 demonstrate that most of the teachers (40 teachers) had never been exposed to inquiry while 30 teachers had have inquiry-experiences from various resources. Nine teachers of the latter learned inquiry through books, 21 teachers had have experiences about inquiry during their college education few years/decades ago. However, none of the teachers had joined any professional development program or any kind of trainings to develop informed understanding about inquiry. This limited inquiry-exposure during the teachers' career might have the reasons of teachers' limited knowledge, skills and experience in inquiry as showed in Table 4. This assumption was supported by previous authors who discussed in their studies that teachers who have not been sufficiently exposed to student-centered methods such as inquiry, and/or teachers who have been exposed to professional-development courses excluding one related to inquiry, both of these type of teachers (Roehrig & Luft, 2004) could end up having lack of knowledge and skills for implementing IbTI teaching-activities (Herrington, Yezierski, Luxford, & Luxford, 2011; Luft, 2001; Smerdon, Burkam, & Lee, 1999; Thair & Treagust, 2003).

CONCLUSION

This study showed that secondary science teachers in Jambi City either do not use or minimally use inquiry-based teaching instruction (IbTI) in their science classroom. The results showed that the IbTI was surprisingly neglected by most of the participant teachers. They predominantly used the more traditional teaching strategies such as lecturing to teach science, despite of the fact that the use of IbTI had been recommended by the national curriculum. This study has provided a new insight about the need for providing teachers with opportunities in which they can learn to implement inquiry properly. While the curriculum has mandated the use of the inquiry-approaches in Indonesia, teachers were not supported to adopt and implement this strategy.

This study provides insight into the reasons for scare use of inquiry in Indonesian science classrooms will potentially contribute to the science education literature in this regard. However, there might be some limitations. For example, there may be differences of the use of the inquiry-based teaching instruction (IbTI) between teachers in secondary schools and teachers in junior high schools, and between teachers in cities and those in rural areas. Future studies thus may focus on diverse groups of teachers. Future studies may look at the implementation of the inquiry-based teaching instruction (IbTI) by science teachers and by non-science teachers. Future studies may also look at the necessary strategies, skills and scaffolding steps that teachers may use in successfully implementing inquiry by minimizing the constraints.

This study provided information for policy makers, school leaders, researchers, and teacher educators to understand the implementation of the inquiry-based teaching instruction (IbTI) in science classrooms. The findings of the study revealed four major perceived-constraints that prevented teachers from using inquiry in theior classrooms. These constraints included the ill-fit curriculum and lack of facilities and inadequate knowledge of teachers' about inquiry. Some recommendations can be drawn from the findings of this study. The Indonesian Government should provide teachers with supports including the provision of sufficient time, rational number of students, adequate scientific equipment and tools, appropriate workshops and trainings, and any other supports that are necessarily important to encourage teachers to adopt and implement the strategy. The findings of this study could also be beneficial for other teachers in developing countries who are endeavoring in using inquiry in their science teaching practices. Ignoring these constraints will produce only a short term success for this curriculum-reform process (Jonathan, 1998). Finally, the minimal rankings in the PISA results from 2003 to 2015 might be attributable to the limited implementation of inquiry strategies in science classrooms in Indonesia.

REFERENCES

Abdullah, A. (2007). Kurikulum pendidikan di Indonesia sepanjang sejarah (Educational curriculum in Indonesia history). *Jurnal Pendidikan dan Kebudayaan (Journal of Education and Culture), 13*(66), 340-361.

Alessandrini, K., & Larson, L. (2002). Teachers bridge to constructivism. *Clearing House, 75*, 118-121.

Anderson, R. D. (2002). Reforming science teaching: What research says about inquiry. *Journal of Science Teacher Education*, *13*(1), 1-12.

Baker, W. P., & Leyva, K. (2003). What variables affect solubility? *Science Activities, 40*, 23-26.

Bell, R. L., Smetana, L., & Binns, I. (2005). Simplifying inquiry instruction: Assessing the inquiry level of classroom activities. *The science teacher, 72*(7), 30-33.

Blanchard, M. R., Southerland, S. A., Osborne, J. W., Sampson, V. D., Annetta, L. A., & Granger, E. M. (2010). Is inquiry possible in light of accountability?: A quantitative comparison of the relative effectiveness of guided inquiry and verification laboratory instruction. *Science Education, 94*(4), 577-616.

Chen, Y. (1999). Tradition and innovation in the Chinese school curriculum. *Research in Education* (61), 16-28.

Colburn, A. (2000). An Inquiry Primer. *Science Scope, 23*(6), 42-44.

Cook, A., & Taylor, N. (1994). Robust adaptive processes: The case for laboratory assistants in Fiji high schools *Journal of Science and Mathematics Education in South East Asia, 17*(2), 7-15.

Coppola, B. P. (2008). Selamat datang di Indonesia: Learning about chemistry and chemistry education in Indonesia. *Journal of Chemical Education. , 85*(9), 1204-1209.

Creswell. J.W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson: Pearson Education Incorporate.

Davis, E. A. (2003). Prompting middle school science students for productive reflection: Generic and directed prompts. *Journal of the Learning Sciences, 12*, 91-142.

Deters, K. (2004). Inquiry in the chemistry classroom. *The Science Teacher, 71*(10), 42-45.

Education. (2007). *Senior syllabus chemistry 2007*. Brisbane: Queensland studies authoritiy Retrieved from http://www.qsa.qld.edu.au/learning/1952.html.

Edwards, D., & Mercer, N. (1987). *Common knowledge: The development of understanding in the classroom*. London: Routledge.

Fay, M. E., & Bretz, S. L. (2008). Structuring the level of inquiry in your classroom. *The science teacher, 75*(5), 38-42.

French, D. P. (2005). Was inquiry a mistake? *Journal of College Science Teaching, 35*(1), 60-62.

Gallagher, J. J. (1987). A summary of research in sience education. *Science Education, 71*(3), 277-384.

Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E., & Clay-Chambers, J. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. *Journal of Research in Science Teaching*, *45*(8), 922-939.

Hadi, S. (2002). *Effective teacher professional development for the implementation of realistic mathematics education in Indonesia.* (Thesis), University of Twente, Enschede.

Herrington, D. G., Yezierski, E. J., Luxford, K. M., & Luxford, C. J. (2011). Target inquiry: Changing chemistry high school teachers' classroom practices and knowledge and beliefs about inquiry instruction *Chemistry Education Research Practice, 12*, 74-84.

Hess, A. J., & Trexler, C. J. (2005). Constructivist teaching: Developing constructivist approaches to the agricultural education class. *Agricultural Education Magazine, 77*, 12-13.

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in PBL and IL: A response to Kirschner et all. *Educational Psychologist, 42*(2), 99-107.

Hofstein, A., & Lunetta, V. N. (1982). The role of the laboratory in science teaching: Neglected aspects of research. *Review of Educational Research, 52*(2), 201-217.

Hofstein, A., Navon, O., Kipnis, M., & Mamlok-Naaman, R. (2005). Developing students' ability to ask more and better questions resulting from inquiry-type chemistry laboratories. *Journal of Research in Science Teaching, 42*(7), 791-806.

Hofstein, A., Shore, R., & Kipnis, M. (2004). Providing high school chemistry students with opportunities to develop learning skills in an inquiry-type laboratory: A case study. *International Journal of Science Education, 26*(1), 47-62.

IGCSE. (2009). United Kingdom Chemistry Syllabus 0620. Retrieved from www.cie.org.uk/docs/dynamic/5140.pdf

Jonathan, D. J. (1998). Curriculum reform in South Africa: A critical analysis of outcome-based education. *Cambridge Journal of Education 28*(3), 321-331.

Kulm, G., & Stuessy, C. (1991). Assessment in science and mathematics education reform. In G. Kulm & S. Malcolm (Eds.), *Science assessment in the service of reform*. Washington, DC: American Association for the Advancement of Science.

Leonard, W. H. (1980). Using an extended discretion approach in biology laboratory investigations *The American Biology Teacher, 42*(6), 338-348.

Loucks-Horsley, S., & Matsumoto, C. (1999). Research on professional development for teachers of mathematics and science: The state of the scene. *School Science and Mathematics, 99*(5), 258-271.

Luft, J. A. (2001). Changing inquiry practices and beliefs: the impact of an inquiry-based professional development programme on beginning and experienced secondary science teachers. *International Journal of Science Education, 23*(5), 517 - 534.

Lustick, D. (2009). The failure of inquiry : Preparing science teachers with an authentic investigation. *Journal of Science Teacher Education 20*, 583-604.

Mahady, R., Wardani, I. G. A. K., Irianto, B., Somerset, H. C. A., & Nielson, D. (1996). *Secondary education in Indonesia:Strengthening teacher competency and student learning*. Report for the Ministry of Education and Culture, Jakarta Indonesia. Jakarta Indonesia.

Masdjudi. (1999). Menggusur kurikulum padat (Changing the overloaded curriculum). *Jurnal Pendidikan dan Kebudayaan (Journal of Education and Culture), 5*(18), 1-9.

Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—what is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching, 47*(4), 474-496.

MOE. (2001). Guidelines on curriculum reform of basic education (experimental) (Jichu jiaoyu kecheng gaige gangyao (Shixing). Beijing: Ministry of Education.

MoEC. (2014a). Peraturan Menteri Pendidikan dan Kebudayaan of Republic of Indonesia No 103/2014 Tentang Pembelajaran Pada Pendidikan Dasar dan Menengah (The Rule of Ministry of Education and Culture of the Republic of Indonesia No 103/2014 regarding Teaching Practice in the Primary and Secondary Schools). Retrieved 16 January 2017, from Ministry of Education and Culture https://akhmadsudrajat.files.wordpress.com/2014/11/permendikbud-no-103-tahun-2014.pdf

MoEC. (2014b). Salinan Lampiran Peraturan Menteri Pendidikan dan Kebudayaan of Republic of Indonesia No 103/2014 Tentang Pembelajaran Pada Pendidikan Dasar dan

Menengah (The Excerpt of the Rule of Ministry of Education and Culture of the Republic of Indonesia No 103/2014 regarding Teaching Practice in the Primary and Secondary Schools). Retrieved 16 January 2017, from Ministry of Education and Culture https://akhmadsudrajat.files.wordpress.com/2014/11/permendikbud-no-103-tahun-2014.pdf

MoEC. (2016). Salinan Lampiran Peraturan Menteri Pendidikan dan Kebudayaan No 22/2016 Tentang Standar Proses Pendidikan Dasar dan Menengah (The Excerpt of the Rule of Ministry of Education and Culture No 22/2016 Regarding Standard Process of Education). Retrieved 16 Januari 2017, from Ministry of Education and Culture http://bsnp-indonesia.org/wp-content/uploads/2009/06/Permendikbud_Tahun2016_Nomor022_Lampiran.pdf

MoNE. (2003a). Undang-undang Republik Indonesia No.20 tahun 2003 tentang sistem pendidikan nasional (Law no 20 2003 regarding the National Education System). Retrieved 22 nopember 2009, from Ministry of National Education http://www.inherent-dikti.net/files/sisdiknas.pdf

MoNE. (2003b). Kurikulum 2004 standar kompetensi (Curriculum 2004 standard for competency). Retrieved 22 Nopember 2009, from Pusat kurikulum Balitbang Depdiknas http://www.smantas.net/Kimia.pdf

Nunan, D. (1992). *Research methods in language learning*. Cambridge : Cambridge University Press.

NRC. (1996). *National Science Education Standards*. Washington, DC: National academy press.

NRC. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. Washington, DC: National Academy Press.

OECD. (2003). Student performance in reading, mathematics and science. Retrieved 27 July 2012, from OECD http://www.oecd.org/education/preschoolandschool/programmeforinternationalstudentassessmentpisa/34002454.pdf

OECD. (2009). Student performance in reading, mathematics and science. Retrieved 27 July 2012, from http://www.pisa.oecd.org/dataoecd/54/12/46643496.pdf http://www.cmec.ca/Publications/Lists/Publications/Attachments/254/PISA2009-can-report.pdf

OECD. (2012). PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know. Retrieved 9 Juni 2015, from OECD http://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf

OECD. (2015). PISA 2015: Results in Focus. Retrieved 10 January 2017, from OECD https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

Oliveira, A. W. (2010). Improving teacher questioning in science inquiry discussions through professional development. *Journal of Research in Science Teaching, 47*(4), 422-453.

Palmer, D. H. (2009). Student interest generated during an inquiry skills lesson. *Journal of Research in Science Teaching, 46*(2), 147-165.

Roehrig, G. H., & Luft, J. A. (2004). Inquiry teaching in high school chemistry classrooms: The role of knowledge and beliefs *Journal of Chemical Education, 81*(10), 1510-1516.

Sadeh, I., & Zion, M. (2009). The development of dynamic inquiry performances within an open inquiry setting: A comparison to guided inquiry setting. *Journal of Research in Science Teaching*, *46*(10), 1137-1160.

Sawada, D., Piburn, M. D., Judson, E., Turley, J., Falconer, K., Benford, R., & Bloom, I. (2002). Measuring reform practices in science and mathematics classrooms: The reform teaching observation protocol. *School Science and Mathematics, 102*(6), 245-253.

Sewel, A. (2002). Constructivism and student misconception: Why every teacher needs to know about them. *Australian Science Teachers Journal, 48*, 24-28.

Shymansky, J. A., & Kyle, W. C. (1992). Establishing a research agenda: Critical issues of science curriculum reform. *Journal of Research in Science Teaching, 29*(8), 749-778.

Smerdon, B., Burkam, D., & Lee, V. (1999). Access to constructivist and didactic teaching: Who gets it? Where is it practiced? *Teachers college record, 101*(1), 5-34.

Staer, H., Goodrum, D., & Hackling, M. (1998). High school laboratory work in western Australia: Opennes to inquiry. *Research in Science Education, 28*(2), 219-228.

Sundberg, M. D., Armstrong, J. E., Dini, M. L., & Wischusen, E. W. (2000). Some practical tips for instituting investigative biology laboratories. *Journal of College Science Teaching, 29*(5), 353 - 359.

Thair, M., & Treagust, D. F. (1997). A review of teacher development reforms in Indonesian secondary science: The effectiveness of practical work in biology. *Research in Science Education, 27*(4), 581-597.

Thair, M., & Treagust, D. F. (1999). Teacher training reforms in Indonesian secondary science: The importance of practical work in physics. *Journal of Research in Science Teaching, 36*(3), 357-371.

Thair, M., & Treagust, D. F. (2003). A brief history of a science teacher professional development initiative in Indonesia.. *International Journal of Education Development, 23*, 201-213.

Trowbridge, L. W., Bybee, R. W., & Powell, J. C. (2004). *Teaching Secondary School Science* (8 ed.). New Jersey: Pearson Education Inc.

UNESCO. (2001). Reflecting on lifelong learning discourses and practices across the world Retrieved 7 September 2012, from UNESCO Institute for Education http://unesdoc.unesco.org/images/0012/001265/126555eo.pdf

Van den Berg, E., & Lunetta, V. N. (1984). Science teacher diploma programs in Indonesia. *Science Education, 68*(2), 195-203.

Walberg, H. J. (1991). Improving school science in advanced and developing countries. *Review of Educational Research, 61*(1), 25-69.

Windschitl, M. (2002). Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural, and political challenges facing teachers. *Review of Educational Research, 72*, 131-175.

Windschitl, M. (2004). Folk theories of ‘‘Inquiry:’’ How preservice teachers reproduce the discourse and practices of an atheoretical scientific method. *Journal of Research in Science Teaching, 41*(5), 481-512.

Zion, M., Cohen, S., & Amir, R. (2007). The spectrum of dynamic inquiry teaching practices. *Res Sci Educ, 37*, 423-447.