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**DEVELOPING AN ONLINE SYSTEM FOR DIAGNOSING MATHEMATICS
LEARNING DIFFICULTIES BASED ON A COMPARATIVE STUDY BETWEEN
INDONESIA AND JAPAN**

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ABSTRACT

Developing an Online System for Diagnosing Mathematics Learning Difficulties Based on a Comparative Study Between Indonesia and Japan

The results of international assessment program such as PISA and TIMSS shows Indonesian students' low performance in mathematics. Nevertheless, these results and also the results of national and classroom assessments are not really used to improve educational practices. Diagnosing students' learning difficulties is also not really implemented as a follow-up step of assessment program. Therefore, the changes in educational practices might not fit students' need in their learning process. Considering this situation, this study is aimed to develop an online system for diagnosing students' learning difficulties as the basis to improve mathematic learning. The online system will be developed on the basis of a comparison of the learning difficulties experienced by Indonesian and Japanese students. The study employs research and development study. This is the first year of the study which is a phenomenological study to compare the process of diagnosing students' learning difficulties in Indonesia and Japan. The data was collected through a Focus Group Discussion (FGD) and a teachers questionnaire. The participants of this study were mathematics teachers consisted of 28 Indonesian and 10 Japanese. This first year of study found that teachers perceived that their students experience several difficulties in learning mathematics however they have not performed an in-depth diagnosis on it yet. They tend to focus on the mathematical issues rather than the process of students thinking. Therefore, teachers follow up this diagnosis results mainly focus on the remedial dan drill-practices. Based on the results of the first year study, in the second study the researchers will develop an online system for diagnosing students' learning difficulties.

CHAPTER I

INTRODUCTION

A. Background

Assessment should be positioned as an integral part of educational practices. The success of an education practice could be measured through and reflected by the results of an assessment. Furthermore, assessment is useful for making educational decisions in the level of students, teachers, schools, regions, and even countries. These decisions include developing lesson plan, classifying students' rank or learning achievement, evaluating learning progress and difficulties, implementing remedial, and determining learning effectiveness (Gronlund & Linn, 1990). The results of assessment can be used to measure students' learning progress and difficulties, which later on serves as an important basis to improve educational practices and students' achievement. Ideally, the implementation of assessment is integrated to the learning process. However, the results of our preliminary study shows that teachers still have difficulty to integrate assessment into learning process in a classroom and to use authentic assessment system. In fact, teachers tend to see and conduct assessment as a separate part of learning process. Another problem is that assessment and learning process are mainly positioned to prepare students for the national examination, instead of to develop students' conceptual understanding. Furthermore, the implementation of assessment and learning activities has not yet emphasized higher-order thinking skills.

In global level, there are international studies which assess and compare the performance of students in mathematics; for example Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA). The results of such international studies do not only report students' mathematics performance, but also could indicate the educational quality of a country. High mathematics performance resulted from these international studies is often associated with good educational practices. Regarding these international studies, Indonesia has regularly participated in PISA and TIMSS studies. However, the results of Indonesian students in these studies are always low.

For example, in PISA 2012 75,7 % of Indonesian students were low achievers and only 0,3% of Indonesian students who were top performers in mathematics (OECD, 2013). These results indicate a need to improve educational practices. However, to improve educational practices in accordance with the needs and situation of Indonesian students, we need more specific information about students' needs or difficulties in the learning process. With regard to the low performance of Indonesian students in PISA, Wijaya, Van den Heuvel-Panhuizen, Doorman, and Robitzsch (2014) conducted a study to investigate Indonesian students' difficulties in solving contextual mathematics problems as used in PISA. Their study showed that Indonesian students mainly experience difficulty in comprehending a contextual problem and in transforming it into a mathematical problem. Wijaya et al.'s study indicates the aspects to be considered in order to improve students' achievement. Furthermore, their study also shows the benefit of diagnosing students' difficulties.

Diagnosing students' learning difficulties is an important part of assessment. However, the results of our preliminary study show that most teachers have not yet diagnosed the learning difficulties of their students. Furthermore, many teachers also do not use the results of assessment as the basis to improve educational practices. A kind of activity which is conducted on the basis of assessment results is mainly in the form of re-examination. A reason for this situation is that teachers have tight schedules so they do not have enough time to diagnose students' learning difficulties and to use assessment results to design educational practices. Furthermore, there is a lack of system and guide that can assist teachers in analyzing students' learning difficulties and designing lesson based on assessment result. Therefore, one of possible solution to overcome these difficulties is by providing teachers with a system and a guide that can be used to analyze assessment results and to use them to develop instructional practices.

Developed countries have used diagnosis of learning difficulties and analysis of assessments results to improve learning quaity and students' learning achievements. For example, the United States of America has launched a program called No Child Left Behind (NCLB) (Nitko & Brookhart, 2007) to improve their

learning quality. Similar programs have also been implemented in some Asian countries, such Japan. Regarding this situation, it is important to investigate and compare the use of assessment results to diagnose students' learning difficulties which has been done in other countries. The results of such comparison and investigation can be used to improve the integration of teaching-learning process and assessment in Indonesia. Furthermore, the comparison should also include the system that has been developed and used in other countries to diagnose students' mathematic learning difficulties.

In this modern era, information and communication technology (ICT) has widely been used for educational purposes such as for developing computer-based manipulative, applet, or presentation media. ICT is not only useful for instructional activities in lessons, but also for assessment purpose. For example; Indonesia has started implementing Computer-Based Test for the National Examination (Ujian Nasional Berbasis Komputer). The use of ICT for assessment purpose can be extended to developing a system for diagnosing students' learning difficulties. This system can be presented as an online system embedded in a website so that teachers can use it flexibly and widely. With a good system, the results of an assessment or a diagnosis can be immediately analyzed so that it will be easier for teachers to use them to develop ways to improve instructional practices.

With regard to the aforementioned comparative study, it is important to collaborate and cooperate with researchers from other countries. Yogyakarta State University has already established a cooperation and The National University Corporation Aichi University of Education. The agreement includes the cooperation in the domain of joint research, cultural and other educational activities. This cooperation might be manifested by performing a shared research by researchers from both institutions. Therefore, the present study focuses on collaboration between researchers from Yogyakarta State University and Aichi University to develop an online system for diagnosing students' mathematic learning difficulties on the basis of a comparison between educational practices in Indonesia and Japan.

B. Objectives

The general objective of the study is to develop an online system for diagnosing students' learning difficulties in relation to the use of assessment results to improve mathematics learning. As the first step, this study will compare the use of assessment results for improving teachers' teaching practices and for diagnosing junior high school students' mathematic learning difficulties in Indonesia and Japan. The results of the comparison will be used as a basis to perform a needs assessment and to formulate and design an online system for diagnosing students' learning difficulties. In addition, another objective of this study is to valide the system for diagnosing learning difficulties in order to improve the learning quality.

C. Urgency

Along with the implementation of the 2013 Curriculum, schools encounter multiple problems (Retnawati, 2015; Retnawati, Hadi & Nugraha, 2016). In addition to the lack of teachers' preparation, teachers have problems in designing and implementing learning activities that activate students and the assessment technique that includes four aspects (i.e. spritual attitude, social attitude, knowledge and skills). Furthermore, teachers have insufficient time to prepare learning activities, to plan follow-up activity after assessment and to diagnose students' learning difficulties. Consequently, it is important to help teachers in diagnosing students' learning difficulties as a means to improve learning process.

Several studies have concerned educational assessment at schools. Some studies (Heri Retnawati, 2003; Heri Retnawati et al., 2006) focused on identifying the characteristics of test items which were developed by the Principals' Working Forum (Musyawarah Kerja Kepala Sekolah) or the Subject Teachers' Forum (Musyawarah Guru Mata Pelajaran) in which it was found that the items need to be revised in terms of construct, item composition and quantitative characteristics. Another study on item characteristics has also been conducted by Heri Retnawati and Kana Hidayati (2006) who found that the characteristics of test items which are used in schools' final examination varied across regions. Other studies on educational assessment concerned the development of test items. For example,

Pujiati Suyata, Djemari Mardapi, Badrun Kartowagiran and Heri Retnawati (2010) developed a collection of test items, which is often called as *bank soal*, for test summative at the end of school year without concordance test items. The system of *bank soal* for vocational high schools were also developed in 2012-2013 (Heri Retnawati & Samsul Hadi, 2012-2013). The change from centralization system to decentralization system in Indonesia has also led to several studies. Heri Retnawati, Samsul Hadi and Edi Prajitno (2010-2011) conducted a study on developing a model of final examination in the era of regional autonomy and decentralization.

Despite various studies in the field of assessment, there is no study that deals with developing an online system for diagnosing students' learning difficulties, which includes presenting students' learning difficulties and identifying efforts to overcome students' learning difficulties. Considering the absence of such study, the present study is therefore very urgent to conduct. This online system can improve the efficiency and effectivity of diagnosis process. Therefore, an online system for diagnosing mathematic learning difficulties is very urgent to develop because it is useful to identify students' learning difficulties and to assist teachers in reporting mathematic learning process. Furthermore, the assessment results obtained by this system provide important input to develop instructional activities.

CHAPTER II

LITERATURE REVIEW

A. Mathematics Learning

There are various definitions of mathematics. Mathematics could be defined according to its content (Gold, 2008) or its objects (Avigad, 2008). Reys et al. (1998) defined mathematics as a subject of pattern and relationship, a way of thinking, a consistent art, a language which uses specific terminologies and symbols, a tool to solve daily life problem, and a tool to develop other sciences. Mathematics might also be viewed as a structure of relationships that link the symbols. This view is based on the paradigm regarding the establishment of mathematics. Furthermore; mathematics could also be defined as a thinking process. Rus Effendi proposed that mathematics has been established as a result of human thinking that contains idea, process, and reasoning (Ismail, 1998:14).

The objects of mathematics are abstract and correlate from one to another and, in turn, constitute new concept that might be more complex (Skemp, 1971:37). Mathematics often deals with definitions and axiomas. Definition refers to the agreement of using an object as the replacement of other object, usually an expression saying that the object is too difficult to write easily (James & James, 1976). On the other hand, axioma refers to the statement that might be accepted without further evidence. Through the thinking process that has been termed as deductive logic, people attain the theorem (Allendoerfer, 1969:7). The theorem resulting from the thinking process becomes a general conclusion that might be proved (James & James, 1976). Definitions, axiomas and theorems become a unity that constitutes a mathematical concept. A mathematical concept is often built hierarchically for which one concept becomes the basis for the learning of subsequent concepts (Herman Hudoyo, 1988:3). Finally, the mathematical concept that has been found will be re-applied to the nature and human beings use mathematical concept to meet their daily needs. In relation to the implementation of mathematical concept for meeting daily needs, mathematics is often implemented as a language or as a tool for solving problems.

Mathematics is designed hierarchically (Herman Hudoyo, 1988:3); therefore what students could master in mathematics learning could be influenced by the mathematical concepts they have mastered in their previous learning. It means that junior high students' mathematics ability or capacity is influenced by their mastery of mathematical concept taught in the elementary schools and, simultaneously, will influence students' mathematic ability or capacity in senior high schools. This fact indicates the importance for measuring students' mathematics ability or capacity. Students' mathematics ability could be measured by means of assessment especially educational assessment.

B. Assessment

Improving instructional practices is incomplete without proper educational assessment. An educational assessment is performed to attain information regarding the aspects related to education, in particular as an attempt to ensure the quality of educational practices. The National Education Act Number 20 Year 2003 about the National Education System Article 11 Verse 1 mandates the central government and the regional government to ensure the implementation of well-qualified education for all citizens. Improving well-qualified education needs continuous efforts to improve learning practices. In order to measure the success of education and learning practices, there should be an educational assessment which is frequently referred to as educational evaluation. Educational assessment is an activity of gathering information for making decisions regarding students' learning (Popham, 1995) and the success of curriculum, educational programs and educational policy (Brookhart & Nitko, 2009). In addition, educational assessment is also intended to improve the quality of learning process (Reynold et al., 2010). Information that is obtained from an educational assessment can be used by students, teachers and even schools. This information can be used to measure whether students have mastered the topics taught by teachers. Furthermore, test results can be used to find part of materials in which students have not mastered so that students will strive to learn this part of materials. In other words, the results of test or examination could serve as a tool for diagnosing students' learning

difficulties, i.e. finding the part of learning materials in which students experience difficulty to master.

Based on its objectives, assessment is divided into three categories. The first category is assessment for learning which takes place during the learning process. When doing assessment for learning, a teacher does not necessarily score students' works because the main intention is the teacher checks whether students' understanding has been in the right path. Assessment for learning has specific characteristics which include: (a) containing preliminary or diagnostic phases, (b) using multiple information sources, (c) providing feedbacks for students both in oral and written descriptive, (d) emphasizing students' strength, (e) identifying challenges, and (f) being implemented to determine next steps of instructional practices. The second type of assessment is assessment as learning which takes place when students are aware of the objectives of instructions or performance criteria. In this type of assessment students set their learning objective, monitor their own progress, and reflect on their learning and results. The last type of assessment, i.e. assessment of learning, takes place at the end of learning process and is aimed to judge students' achievement or performance. In assessment of learning, students' works are scored or marked in order to compare students' learning results to a particular standard such as passing grade which is set by the government. The results of assessment of learning are informed to students and their parents as a kind of academic report.

Educational assessment holds an important key role in measuring the success of educational practices that has been implemented. According to Gronlund (1990:8), an educational assessment has the following objectives: a) to provide clarification toward the characteristics of the learning results that have been attained; b) to provide information regarding the achievement of short-term goals that have been defined; c) to provide feedback toward the learning progress; d) to provide information regarding the learning difficulties; and e) to select the learning approach in the future times. These objectives could be achieved after teachers report the assessment results to the principals, educational offices, students' parents, and stakeholders.

One of the benefits from implementing an educational assessment is that teachers could get information about students' learning difficulties. The process of attaining such information is referred to as diagnosis. Diagnosis process is different with the process of measuring students' learning achievements. In order to perform a diagnosis, teachers need to design special instrument and make special report regarding the improvement of students' understanding toward certain concepts and how it can be used to improve learning process. Although the diagnosis of learning difficulties is very necessary, most teachers have not conducted such diagnosis.

C. Learning Difficulties

Students' difficulties in mastering concept occur if students are not able to link the knowledge that they are studying and the previous knowledge that they have studied (Russell & O'Dwyer, 2009). Analyzing students' learning difficulties is seen as a crucial step to have access to students' reasoning (Brodie, 2014). Furthermore, such analysis can be a crucial preliminary step in the process of improving student performance because it sheds light on key aspects of students' learning process that need to be developed (Wijaya, 2014). For example, the study of Wijaya et al. suggests that improving the task comprehension of Indonesian students requires a focus not only on students' language competence, but also on the ability to select relevant information. Furthermore, the ability to identify the required procedure or concept was found to be another key competence that needs to be improved.

Understanding the learning difficulties – known as diagnosis – might be pursued by means of cognitive information on test participants' capacity on the basis of the results of an assessment (Gierl et al., 2007). These difficulties might be revealed by implementing a diagnostic test. Diagnostic test is an instrument which is different with test to measure students' achievement such as summative test (Corter, 1995). Diagnostic test has specific characteristics. The test items which are used in a diagnostic test can be used to detect learning difficulties. For this purpose, a diagnostic test is developed based on an analysis of possible causes for students' error, uses constructed response test items, and the report of diagnosis test is

supplemented with a follow-up plan (Depdiknas, 2007). The follow-up plan might be in the form of feedback that contains the concept that has been mastered (Robert & Gierl, 2010) and could also be understood easily (Gierl et al., 2007).

D. The Use of ICT for Assessment Purpose

Evaluation of learning results is mostly conducted by means of written test. Such evaluation is easy to conduct but has several limitations. For example, students with various capacities are given the same test items and, therefore, the test items become less efficient because the measurement scale of the test items does not consider different ability level. Such evaluation will generate less valid measurement and have enormous measurement errors. Similar situation also applies to the implementation of paper and pencil based diagnostic test.

An alternative that can be considered to overcome the limitations of written test is using Computer-Based Test (CBT). Through CBT, the implementation of the test could be distributed through internet and does not require printing so the test items could be distributed safely. The test items which are used in CBT could be adjusted to students' ability level so that the measurement errors will be smaller in comparison to paper and pencil test. In other words, the the use of information technology could be implemented to obtain an effective and efficient test (Chee & Wong, 2003:96; Towndrow & Vallence, 2004:44). To respond to the development of science and technology, Indonesian government has equipped schools with computer laboratory units to support students' learning process. The computer laboratory is also equipped with internet and intranet connection so that accessing and sharing information could be done easily. This facility could also be used for other purposes such as computer-based and internet-based test. Despite the potential of computer for educational purposes, computer has not been used optimally for education in Indonesia; for example computer is not used to conduct diagnostic test and to analyze the results of such test.

CHAPTER III

METHOD

A. Stages

The present study will be a research and development research by referring to Borg (1981). The study will be conducted in two consecutive years. The first year study will serve as a baseline study which is intended: (i) to portrait the problems in using assessment results for improving mathematics learning for junior high school students, (ii) to identify teachers' difficulties in diagnosing students' learning difficulties, and (iii) to formulate an online system model for diagnosing students' mathematics learning difficulties. In the second year, the model of the online system will be developed into full online system. The online system will be tried out through an experimental study in order to get feedback to revise the online system for diagnosing students' mathematics learning difficulties. The stages of the study is presented in Table 1.

Table 1. The Plan Research Activities

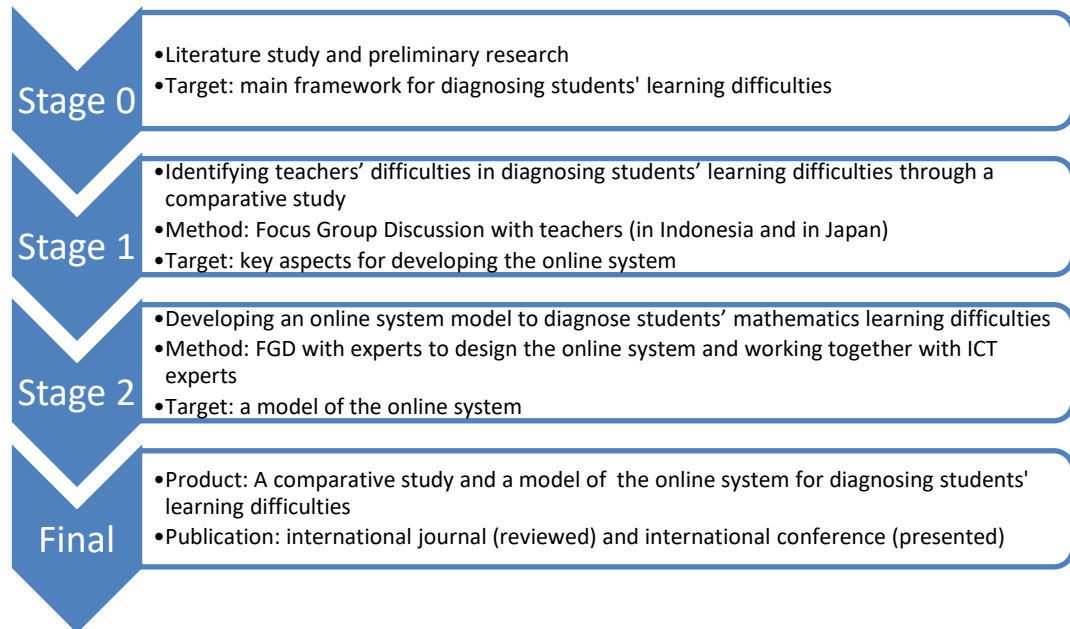
Year /Stage	Activity	Location	Approach	Data Gathering Method	Data Analysis Method	Output
2017 (1)	A comparative study between Indonesia and Japan to describe a needs assessment for developing an online system for diagnosing students' learning difficulties	Indonesia and Japan	Phenomenology	Documentation, In-depth interview, Focus Group Discussion, questionnaire distribution	Qualitative	Articles reviewed in an International Journal
2017 (2)	Formulating and designing the model of the online sysem for diagnosing students' learning difficulties	Indonesia	Synthesis based on the results of phenomenologic al study and literature review	-	Quantitative and qualitative	Draft of Online System

Year /Stage	Activity	Location	Approach	Data Gathering Method	Data Analysis Method	Output
2018 (1)	Developing the online system for diagnosing students' learning difficulties	Indonesia	Software development	-	Quantitative and qualitative	The first draft of Online System
	Writing manual book for the online system	Indonesia	Software development	-	Quantitative and qualitative	Manual book for the online system
2018 (2)	Validating and revising the online system for diagnosing learning difficulties	Indonesia and Japan	-	Assessment Sheet, Documentation, Interview		The second draft of Online System
	Conducting a small scale experiment, revising the online system, conducting a large scale experiment and doing final revision	Indonesia	Software development	Assessment Sheet, Documentation, Interview	Quantitative and qualitative	Final Online System, Final Manual, International Journal Article
2018 (3)	Applying the copyright and disseminating the online system	Indonesia	Community Service	-	-	Copyright

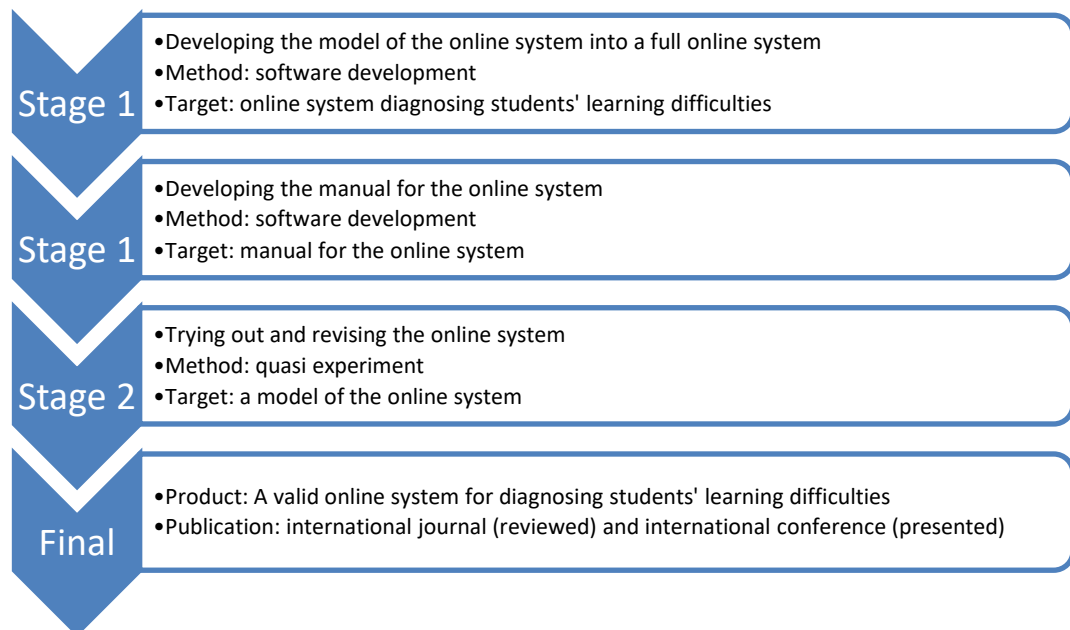
The study will generate an innovative and applicable online system for diagnosing students' mathematics learning difficulties. The online system will be used as a tool to assist teachers in performing diagnostic test and reporting the results which includes the description of students' difficulties. It is expected that the online system will help teachers in preparing and conducting lessons effectively. In addition, on the basis of assessment and diagnosis results teachers could design and implement a follow-up step to improve their teaching practices. These activities will lead to the improvement of students' mathematics learning achievements. The

activities that will be performed in each stage and the outputs of the study are presented in Figure 1.

Year 1:



Year 2:



The output of the study will be as follows:

1. An online system for diagnosing students' mathematics learning difficulties (Effective Technology)
2. Articles submitted/published in international journals
3. Articles presented in international conferences

B. Location

The majority of the study will take place in the Province of Yogyakarta. For the baseline study and the development stage, the study will be conducted in Indonesian and Japanese schools. This stage will be conducted by researchers from Yogyakarta State University Indonesia and Aichi University of Education Japan. In the experiment stage the study will be conducted in junior high schools in Yogyakarta, Indonesia. These locations are selected purposively and the researchers will select schools that have technology or computer that is supportive for diagnosing learning difficulties.

C. Data Collection Method

In general the data will be collected by using five complimentary methods as follows:

1. ***Participatory Observation*** will be conducted to identify the problems that occur during mathematics learning, particularly in relation to the assessment and its follow-up in both Indonesian and Japanese junior high schools.
2. ***Focus Group Discussion*** refers to the implementation of discussion forum in a group which members are limited by certain criteria and the discussion in the forum is limited to or focuses on certain topics without a target to have an agreement or final conclusion. The ideas that are shared in the forum will be used as the basis for developing the online system.
3. ***Survey or questionnaire*** will be used to get data from all respondents in order to identify the problems that respondents encounter in using the results of assessment for improving mathematics learning process, for diagnosing

students' learning difficulties and for defining the necessary aspects that might be needed to improve the quality of mathematics learning of junior high school students.

4. **Interview** will be conducted to several people in each group of teachers and students. The interview is intended to complete the data obtained from the survey or questionnaire and from the participatory observation. An in-depth interview will be done for key respondents, i.e. people who play role and have influence in implementing the integrated education within junior high schools. This people includes teachers, school principals, school supervisors, experts from the Department of National Education, and other related institutions.
5. **Documentation** will be done to measure the use of assessment results that has been conducted by schools.

D. Data Analysis

In the first stage, the study will use of phenomenological approach and descriptive-explorative approach. In relation to these two approaches, the research data will be analyzed altogether by means of descriptive-quantitative and descriptive-qualitative technique. In order to identify the problems in using assessment results for improving mathematics learning process and in diagnosing students' mathematics learning difficulties, the researchers use descriptive-qualitative and descriptive-quantitative analysis. In the needs assessment, the researchers use descriptive-qualitative and descriptive-quantitative data analysis. In the second stage the study will design the online system. For this stage the data will be analyzed through descriptive-qualitative technique.

CHAPTER IV RESULTS

A. RESULTS

This is two years study, the data form the first year of study are used as the baseline study to: (i) portrait the problems in using assessment results for improving mathematics learning for junior high school students, (ii) identify teachers' difficulties in diagnosing students' learning difficulties, and (iii) formulate an online system model for diagnosing students' mathematics learning difficulties. In order to fulfill this research purposes, focus group discussion (FGD) is conducted with twenty-nine mathematics teachers of Junior High School in Yogyakarta. Data obtained from the FGD shows that most of the teachers believe that their students experience difficulties in learning mathematics. On the other hand, they uncertain how to examine the difficulties. The assessment method teachers used to diagnose students' difficulties are observation, interview, and verbal or witten test (Tabel 2).

Tabel 2. Diagnostics methods used by teachers

Diagnostic Method	Percentage
Observation	28%
Interview	17%
Verbal or witten test	56%

More than half of the respondents (53%) said that they conducted the diagnostic assessment during the learning process in the classroom meanwhile, the other 42% conducted the assessment after and 5% before the learning process in the classroom. Teachers states that students faced many problems in learning mathematics. Based on their experiences in teaching, they named several students' obstacles in learning mathematics as summarized in Table 3.

Tabel 3. Students' difficulties in learning mathematics

Students' Difficulties	Percentage
General obstacles such as lazy, unfocus and careless	39%
Obstacles related to mathematics such as dealing with problem solving, logical and analytical thinking skills	61%

Based on the results above, teachers take some steps to help students overcome their problems. Most teachers (48%) choose remedial/re-teach as the way to help teachers facing their difficulties. Meanwhile, the other (31%) believes that drill and practices could minimize the difficulties. Other teachers (17%) try to find new teaching strategies to solve the obstacles students experienced. The remaining 4% of the teachers believe that the students' difficulties in learning mathematics could be resolved by developing media.

The data above implied that students experience difficulties in learning mathematics. Unfortunately, teachers state that they have problems in diagnosis students' difficulties. The data from FGD revealed that most of the teachers confused in creating the diagnostic instrument as they mixed up between diagnostic, evaluation and prediction test. Two teachers state that they even do not know how to make diagnostic instrument. Only one out of twenty-nine teachers felt that they can produce the assessment instrument easily. In addition, most of the teachers said that they have not use any software in the diagnostic assessment process. They are hoping to have software for the diagnosis process. Considering this findings, the second year study will develop software to help teachers in diagnosing students difficulties.

In qualitative data, the results of this study are organized into four categories, i.e. (1) teachers' perception on students' learning difficulties, (2) teachers' practices with regard to diagnosing students' learning difficulties, (3) teachers' actions as the responses to the results of diagnosis, and (4) the parties who are involved regarding students' learning difficulties.

Teachers' perception on students' learning difficulties

The teachers were asked to mention the difficulties experienced by their students in learning mathematics. From the teachers' responses to the questionnaire it is found that only 61% of the students' difficulties reported by the Indonesian teachers were related to mathematics. These difficulties include a lack of

calculation skills, low understanding of algebra, and also inability to make a mathematical model representing a contextual problem. Some other Indonesian teachers only listed mathematics domains or topics, such as algebra, geometry, and function without detailed indication about the students'. These Indonesian teachers seemed to focus on the mathematics itself, not on their students' thinking process. The remaining 39% of the difficulties referred to non-mathematical difficulties. These difficulties include a lack of motivation, careless, and ignorance. Interestingly, such non-mathematical difficulties are still mentioned when the Indonesian teachers were asked specifically about their students' difficulties in learning mathematics, i.e. about 23% of teachers' responses.

Teachers' practices with regard to diagnosing students' learning difficulties

With regard to teachers' practice in diagnosing students' learning difficulties, there are two main concerns, i.e. the period when teachers diagnose students' difficulties and the instruments which are used by teachers. The questionnaire shows that 53% of the Indonesian teachers diagnosed their students' learning difficulties during the mathematics lessons. About 42% of the Indonesian teachers reported that they performed the diagnosis after the completion of teaching a particular topic. The remaining 5% of the Indonesian teachers said that they diagnosed students' difficulties at the beginning of the semester. Based on these results, it seem that the Indonesian teachers did not distinguish diagnosis (or formative assessment), evaluate (or summative assessment), and prediction test. The fact that the teachers 'diagnose' students' difficulties after the completion of a particular topic indicates that the teachers perform an evaluation, instead of a diagnosis. During the FGD many teachers reported that they perform the diagnosis after a series of lesson addressing a particular topic in order to see whether their students accomplished the learning objectives. Few teachers reported that their schools administer a kind of bridging test or a so called of matriculation test at the beginning of semester in order to get information about students' prior knowledge. Such practice also does not fit the purpose of diagnosis. Despite these inappropriate practices of diagnosis, more than a half of the teachers showed a good

understanding of diagnosis process. These teachers reported that they investigate students' difficulties during the teaching and learning process.

The second concern regarding teachers' practice in diagnosing students' difficulties is the instrument or ways to diagnose. The questionnaire data show that most Indonesian teachers used more than one ways or instruments. The most frequently used ways to diagnose students' learning difficulties was test, i.e. 56%. The Indonesian teachers reported that they diagnosed students' learning difficulties by administering a test and analyzing its results. The Indonesian teachers also reported that they also diagnose students' difficulties through observation during the learning process, i.e. 28%. The teachers explained that they could identify students who experienced difficulties by observing students' gesture and the kinds of questions posed by students. The last way that used by the Indonesian teachers to identify students' difficulties was interview or conversation, i.e. 17%. The teachers explained that they could diagnose students' difficulties through conversation. However, the FGD data indicates that some teachers did not entirely diagnose students' difficulties during the conversation because what they asked mainly about whether or not their students like mathematics and what make students like or dislike mathematics.

Teachers' actions as the responses to the results of diagnosis

The third issue that was explored in the present study is investigating what the teachers do after diagnosing students' learning difficulties. The finding about this issue could provide information whether the teachers diagnose students' difficulties as a part of their attempt to conduct an effective teaching or not. Based on the data from questionnaire and FGD, there are four types of action that were performed by the Indonesian teachers after diagnosing students' learning difficulties. The most frequently performed action was remedial, i.e. 48%. The teachers reported that they conducted a remedial when many students in their class had difficulties in learning mathematics. This remedial was mainly in the form of re-teaching the difficult topic. For the remedial, the teachers still used their regular teaching strategies. The teachers also often gave drill and practices, i.e. 31%, to

overcome students' learning difficulties. They gave students similar tasks to solve. Only 17% of teachers' actions were in the category of developing or planning new teaching strategies. Some teachers explained that students' learning difficulties might be influenced by the teachers' teaching strategies. Therefore, these teachers tried to find new teaching strategies to overcome students' learning difficulties. In this respect, these teachers explicitly mentioned joyful learning. It indicates that the teachers consider students' uncomfortableness during the learning process is a cause for students' learning difficulties. The least frequently performed action was developing teaching media, i.e. 5%. Some teachers argued that a lack of media might contribute to students' learning difficulties; therefore designing appropriate media is an important action to take after diagnosing students' difficulties.

The parties who are involved regarding students' learning difficulties

The teachers were asked about the parties who should take action regarding the results of the diagnosis. In general, the Indonesian teachers mentioned four parties, i.e. the school principal, teachers, school counselor, and parents. According to the teacher, school principal need to take action at school level to overcome and prevent students' learning difficulties. It might be in the form of school program such as extra study hours at school. The teachers themselves are the main actor who should take action on the basis of their students' learning difficulties. In an addition to principal and teacher, school counselor is also an important party who should participate in overcoming students' learning difficulties. The involvement of school counselor seems to correlate to teachers' perception that students' difficulties in learning mathematics include non-mathematical aspects, such as students' motivation and careless. Lastly, the Indonesian teachers emphasize that overcoming students' learning difficulties is not only the responsibility of teachers and schools, but also the parents' responsibility.

CHAPTER V

CONCUSSIONS

The present study was aimed to explore teachers' perception on students' learning difficulties and teachers' practice in diagnosing students' learning difficulties. With regard to the teachers' perception, the results of the study show that the teachers do not perform in-depth diagnosis of students' difficulties in learning mathematics. The teachers do not thoroughly identify students' thinking process in relation to the mathematics concepts they are learning. Paying more attention to such specific aspect could help teachers perform an appropriate follow-up action other than re-teaching. As recommended by Ciltas and Tatar (2011), teachers could identify appropriate teaching methods when they have enough information about students' thinking process. Similarly, NCTM (2000) also emphasize a need for understanding what students know and need to learn in order to provide support for students. Another important finding of the present study is the fact that the teachers also do not differentiate diagnosis, evaluation, and prediction test. Regarding the strategies used by the teachers to diagnose students, analyzing students' responses to tests was the majority followed by observation and interview. The teachers perform various actions on the basis of their finding in diagnosing students' difficulties in learning mathematics. The major action taken by the teachers is remedial in the form of re-teaching. Many teachers also perform drill and practices to overcome students' learning difficulties. Developing teaching strategies and media that fit students' learning difficulties is a minor action taken by the teachers.

The output of this first year of study is draft of paper for publication (see appendix 1). The paper discusses the findings of this first year of study focusing on the perspectives of Indonesian and Japanese mathematics teachers on students' difficulties in learning mathematics and the diagnostic practices for it. The second year of study will focus on developing software or an online system for diagnosing students' learning difficulties. The online system will be developed on the basis of a comparison of the learning difficulties experienced by Indonesian and Japanese students.

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Appendix 1 Draft Paper

Diagnosing students' learning difficulties in the eyes of Indonesian and Japanese mathematics teachers

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Abstract

The purpose of this study was to explore teachers' perception and practices regarding diagnosing students' learning difficulties. The participants of the study were 28 Indonesian mathematics teachers and 10 Japanese mathematics teachers. The data was collected through a Focus Group Discussion and a teacher questionnaire. The data was analyzed qualitatively to describe how the teachers perceive learning difficulties and how the teachers diagnosed students' learning difficulties. The results of analysis reveal that the teachers do not yet perform an in-depth diagnosis of students' difficulties in learning mathematics. The teachers only focus on the mathematics topics and non-mathematical issues, instead of on students' thinking process. The teachers also do not differentiate diagnosis, evaluation, and prediction test. With regard to the strategies used by the teachers to diagnose students' difficulties, analyzing students' responses to tests was the majority. The results of the diagnosis are mainly used as the basis for remedial and drill and practices.

Keywords: diagnosis, learning difficulties, teachers' perception, teachers' practices

Introduction

A number of studies have shown that mathematics is experienced as a difficult subject by many students in various levels of education. In elementary school level, Wijaya (2017), for example, revealed students' difficulties with fractions. Students in his study understood fractions as parts of a whole, but more than 90% of these students were unable to solve problems involving fractions as parts of a collection of objects. Mathematics is also difficult for secondary school students. Retnawati, Kartowagiran, Arlinwibowo, and Sulistyaningsih (2017) revealed that only 5% of junior high school students in their study who could deal with fractional exponents such as $4^{\frac{2}{3}}$. The concept of subset and parallel lines are also difficult for these students as indicated by the low percentages of students' correct answer, i.e. only about 30%. In upper secondary school, Coşkun (2008) revealed that students experience difficulties with: (1) division algorithm that forms the basis of modular

arithmetic, (2) symbolic representation of the division algorithm with modular arithmetic notation, and (3) equivalence class with the concept of mod. Difficulties with mathematics are also experienced by university students. A study of Klymchuk, Zverkova, Gruenwald, and Sauerbier (2010) revealed that many university students could not construct a simple function that representing a familiar context. A general perspective on students' difficulties in mathematics is given by Russell, O'Dwyer, and Miranda (2009) who found that students' difficulties in mastering concept occur are caused by students' inability to link between the knowledge that they are studying and the prior knowledge they have.

Awareness of the difficulties experienced by students in their learning process is an important first step for teachers to design and manage mathematics lessons (Çiltas & Tatar, 2011; Wijaya, van den Heuvel-Panhuizen, Doorman, & Robitzsch, 2014). In this respect, analyzing students' learning difficulties is often seen as a crucial step to access students' reasoning (Brodie, 2014). Analyzing students' difficulties can be a preliminary step in the process of improving student performance because it sheds light on key aspects of students' learning process that need to be developed. After diagnosing students' difficulties in learning mathematics, Tall and Razali (1993) recommend that less able students cannot be simply helped by providing them with specific strategies to overcome their specific errors. These students also need overall powerful mathematics strategies. Furthermore, on the basis of their analysis Tall and Razali also highlight that developing the confidence of less able students is also an important step to help them gain a better result in mathematics. Another example of instructional recommendation on the basis of analyzing students' difficulties can be found in the study of Wijaya et al (2014). The results of an error analysis conducted by Wijaya et al imply that improving the task comprehension of students requires a focus not only on students' language competence, but also on the ability to select relevant information. Furthermore, the ability to identify the required procedure or concept was found to be another key competence that needs to be improved.

To identify and overcome students' difficulties during their learning process are not only a requirement of modern education, but also parts of teachers' responsibilities (Çiltas & Tatar, 2011). This is in agreement with one of the principles for school mathematics proposed by the National Council of Teachers of Mathematics (2000) that an effective mathematics teaching requires teachers to understand what students know and need to learn. Such understanding forms a basis for teachers to support their students to learn mathematics well. Therefore, it is crucial for teachers to be aware of their students' difficulties in learning mathematics in order to develop and perform learning activities effectively (Yetkin, 2003). This expectation implies that teachers need to have a competence to identify students' learning difficulties. With respect to the teaching of foreign language,

Edelenbos and Kubanek-German (2004) defined a so called ‘teacher’s diagnostic competence’ as “the ability to interpret students’ foreign language growth, to skillfully deal with assessment material and to provide students with appropriate help in response to this diagnosis” (p. 260). Transforming this idea into the teaching of mathematics, teacher’s diagnostic competence could be defined as teachers’ ability to interpret students’ thinking and reasoning process, to monitor students’ progress and difficulties, and to provide appropriate responses to the results of the diagnosis. With respect to diagnostic competence, teachers need to engage in more one-on-one contact with their students and must be able to describe and interpret the individual student’s abilities and difficulties.

The present study was aimed to investigate teachers’ diagnostic practices. This investigation includes not only how teachers perform the diagnosis, but also teacher’s perspective on students’ learning difficulties.

Method

The present study was a qualitative research employing Focus Group Discussion (FGD) and survey through questionnaire. FGD was chosen because of the following reasons it is a powerful exploratory tool that could provide information about how people think, feel, and act regarding a particular topic (Freitas, Oliveira, Jenkins, & Popjoy, 1998). In the present study the particular topic was diagnosing students’ learning difficulties. The FGDs were conducted separately in Indonesia and in Japan. A total of 28 Indonesian mathematics teachers participated in the FGD in Indonesia, whereas in Japan the FGD involved 10 mathematics teachers. In addition to the FGDs, the teachers also filled in an open questionnaire. The FGD and the questionnaire covered the following issues:

- (a) teachers’ perception on students’ learning difficulties,
- (b) teachers’ practices with regard to diagnosing students’ learning difficulties,
- (c) teachers’ actions as the responses to the results of diagnosis,
- (d) the parties who are involved or informed regarding students’ learning difficulties

In the first step of analysis, the questionnaire data was reported quantitatively to show the occurrence of particular practices with regard to diagnosing students’ learning difficulties. In the next process, this data were described qualitatively and supported by the results from the FGDs.

Results

The results of this study are organized into four categories, i.e. (1) teachers’ perception on students’ learning difficulties, (2) teachers’ practices with regard to diagnosing students’ learning difficulties, (3) teachers’ actions as the responses to

the results of diagnosis, and (4) the parties who are involved regarding students' learning difficulties.

Teachers' perception on students' learning difficulties

The teachers were asked to mention the difficulties experienced by their students in learning mathematics. From the teachers' responses to the questionnaire it is found that only 61% of the students' difficulties reported by the Indonesian teachers were related to mathematics. These difficulties include a lack of calculation skills, low understanding of algebra, and also inability to make a mathematical model representing a contextual problem. Some other Indonesian teachers only listed mathematics domains or topics, such as algebra, geometry, and function without detailed indication about the students'. These Indonesian teachers seemed to focus on the mathematics itself, not on their students' thinking process. The remaining 39% of the difficulties referred to non-mathematical difficulties. These difficulties include a lack of motivation, careless, and ignorance. Interestingly, such non-mathematical difficulties are still mentioned when the Indonesian teachers were asked specifically about their students' difficulties in learning mathematics, i.e. about 23% of teachers' responses.

Teachers' practices with regard to diagnosing students' learning difficulties

With regard to teachers' practice in diagnosing students' learning difficulties, there are two main concerns, i.e. the period when teachers diagnose students' difficulties and the instruments which are used by teachers. The questionnaire shows that 53% of the Indonesian teachers diagnosed their students' learning difficulties during the mathematics lessons. About 42% of the Indonesian teachers reported that they performed the diagnosis after the completion of teaching a particular topic. The remaining 5% of the Indonesian teachers said that they diagnosed students' difficulties at the beginning of the semester. Based on these results, it seem that the Indonesian teachers did not distinguish diagnosis (or formative assessment), evaluate (or summative assessment), and prediction test. The fact that the teachers 'diagnose' students' difficulties after the completion of a particular topic indicates that the teachers perform an evaluation, instead of a diagnosis. During the FGD many teachers reported that they perform the diagnosis after a series of lesson addressing a particular topic in order to see whether their students accomplished the learning objectives. Few teachers reported that their schools administer a kind of bridging test or a so called of matriculation test at the beginning of semester in order to get information about students' prior knowledge. Such practice also does not fit the purpose of diagnosis. Despite these inappropriate practices of diagnosis, more than a half of the teachers showed a good understanding of diagnosis process. These teachers reported that they investigate students' difficulties during the teaching and learning process.

The second concern regarding teachers' practice in diagnosing students' difficulties is the instrument or ways to diagnose. The questionnaire data show that most Indonesian teachers used more than one ways or instruments. The most frequently used ways to diagnose students' learning difficulties was test, i.e. 56%. The Indonesian teachers reported that they diagnosed students' learning difficulties by administering a test and analyzing its results. The Indonesian teachers also reported that they also diagnose students' difficulties through observation during the learning process, i.e. 28%. The teachers explained that they could identify students who experienced difficulties by observing students' gesture and the kinds of questions posed by students. The last way that used by the Indonesian teachers to identify students' difficulties was interview or conversation, i.e. 17%. The teachers explained that they could diagnose students' difficulties through conversation. However, the FGD data indicates that some teachers did not entirely diagnose students' difficulties during the conversation because what they asked mainly about whether or not their students like mathematics and what make students like or dislike mathematics.

Teachers' actions as the responses to the results of diagnosis

The third issue that was explored in the present study is investigating what the teachers do after diagnosing students' learning difficulties. The finding about this issue could provide information whether the teachers diagnose students' difficulties as a part of their attempt to conduct an effective teaching or not. Based on the data from questionnaire and FGD, there are four types of action that were performed by the Indonesian teachers after diagnosing students' learning difficulties. The most frequently performed action was remedial, i.e. 48%. The teachers reported that they conducted a remedial when many students in their class had difficulties in learning mathematics. This remedial was mainly in the form of re-teaching the difficult topic. For the remedial, the teachers still used their regular teaching strategies. The teachers also often gave drill and practices, i.e. 31%, to overcome students' learning difficulties. They gave students similar tasks to solve. Only 17% of teachers' actions were in the category of developing or planning new teaching strategies. Some teachers explained that students' learning difficulties might be influenced by the teachers' teaching strategies. Therefore, these teachers tried to find new teaching strategies to overcome students' learning difficulties. In this respect, these teachers explicitly mentioned joyful learning. It indicates that the teachers consider students' uncomfortableness during the learning process is a cause for students' learning difficulties. The least frequently performed action was developing teaching media, i.e. 5%. Some teachers argued that a lack of media might contribute to students' learning difficulties; therefore designing appropriate media is an important action to take after diagnosing students' difficulties.

The parties who are involved regarding students' learning difficulties

The teachers were asked about the parties who should take action regarding the results of the diagnosis. In general, the Indonesian teachers mentioned four parties, i.e. the school principal, teachers, school counselor, and parents. According to the teacher, school principal need to take action at school level to overcome and prevent students' learning difficulties. It might be in the form of school program such as extra study hours at school. The teachers themselves are the main actor who should take action on the basis of their students' learning difficulties. In an addition to principal and teacher, school counselor is also an important party who should participate in overcoming students' learning difficulties. The involvement of school counselor seems to correlate to teachers' perception that students' difficulties in learning mathematics include non-mathematical aspects, such as students' motivation and careless. Lastly, the Indonesian teachers emphasize that overcoming students' learning difficulties is not only the responsibility of teachers and schools, but also the parents' responsibility.

Conclusions

The present study was aimed to explore teachers' perception on students' learning difficulties and teachers' practice in diagnosing students' learning difficulties. With regard to the teachers' perception, the results of the study show that the teachers do not perform in-depth diagnosis of students' difficulties in learning mathematics. The teachers do not thoroughly identify students' thinking process in relation to the mathematics concepts they are learning. Paying more attention to such specific aspect could help teachers perform an appropriate follow-up action other than re-teaching. As recommended by Ciltas and Tatar (2011), teachers could identify appropriate teaching methods when they have enough information about students' thinking process. Similarly, NCTM (2000) also emphasize a need for understanding what students know and need to learn in order to provide support for students. Another important finding of the present study is the fact that the teachers also do not differentiate diagnosis, evaluation, and prediction test. Regarding the strategies used by the teachers to diagnose students, analyzing students' responses to tests was the majority followed by observation and interview. The teachers perform various actions on the basis of their finding in diagnosing students' difficulties in learning mathematics. The major action taken by the teachers is remedial in the form of re-teaching. Many teachers also perform drill and practices to overcome students' learning difficulties. Developing teaching strategies and media that fit students' learning difficulties is a minor action taken by the teachers.

Acknowledgment

We would like to express our gratitude to the Graduate Program of Yogyakarta State University for providing a research grant. We would also like to thank all Indonesian and Japanese teachers who participated in the study for their valuable information and experiences.

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Appendix 2 Curriculum Vitae of the Research Team

CURRICULUM VITAE

A. Identitas Diri

1	Nama Lengkap dan Gelar	:	Dr. Ariyadi Wijaya
2	Jenis Kelamin	:	Laki-laki
3	Pangkat/Golongan	:	III/c
4	Jabatan Fungsional	:	Lektor
5	NIP	:	19820716 200501 1 005
6	NIDN	:	0016078201
7	Tempat dan Tanggal Lahir	:	Banjarnegara, 16 Juli 1982
8	Alamat e-mail	:	a.wijaya@uny.ac.id ; a.wijaya@staff.uny.ac.id
9	Nomor HP	:	081578765605
10	Alamat Kantor	:	Juridik Matematika FMIPA UNY Kampus Karangmalang Sleman, Yogyakarta 55281
11	Lulusan yang telah dihasilkan	:	S1 = 21 orang
12	Mata kuliah yang diampu	:	1. Kajian matematika sekolah menengah (S1) 2. Sejarah matematika (S1) 3. Logika dan himpunan (S1) 4. Pembelajaran mikro (S1) 5. Workshop matematika (S2) 6. Daya matematika (S2) 7. Matematika model (S2)

B. Riwayat Pendidikan

	S-1	S-2	S-3
Nama Perguruan Tinggi	UNY	Utrecht University	Utrecht University
Bidang Ilmu	Pendidikan Matematika	Pendidikan Matematika	Pendidikan Matematika
Tahun Masuk-Lulus	2000-2004	2006-2008	2011-2015
Judul Skripsi/Tesis/	Karakteristik Perangkat Tes	<i>Design Research in Mathematics</i>	<i>Context-based mathematics tasks in</i>

	S-1	S-2	S-3
Disertasi	Seleksi Masuk SLTPN Kota Yogyakarta Mata Pelajaran Matematika Berdasarkan Teori Respon Butir Dua Variabel	<i>Education: Indonesian Traditional Games as Means to Support Second Graders' Learning of Linear Measurement</i>	<i>Indonesia: Toward Better Practice and Achievement</i>
Nama pembimbing /promoter	Edi Prajitno, M.Pd Atmini Dhoruri, MS	Dr. Michiel Doorman Dr. Ronald Keijzer	Prof. Dr. Marja van den Heuvel-Panhuizen Dr. Michiel Doorman

C. Pengalaman Penelitian dalam Lima Tahun Terakhir

No	Tahun	Judul Penelitian	Pendanaan	
			Sumber	Jumlah (Juta Rp)
1	2015	Pengembangan e-learning untuk Mata Kuliah Kajian Matematika Sekolah Menengah	IDB	25
2	2015	Analisis Kesulitan Menyusun Rencana Pelaksanaan Pembelajaran Matematika SMA Sesuai Kurikulum 2013	DIPA FMIPA UNY	10
3	2015	Upaya Meningkatkan <i>Pedagogical Content Knowledge</i> Mahasiswa Melalui Mata Kuliah Psikologi Belajar Matematika dengan <i>Lesson Study</i>	DIPA FMIPA UNY	5

D. Pengalaman Pengabdian Kepada Masyarakat dalam Lima Tahun Terakhir

No	Tahun	Judul Pengabdian Kepada Masyarakat	Pendanaan	
			Sumber	Jumlah (Juta Rp)
1	2015	Pelatihan Pengembangan 'Soal Matematika Kreatif' (Creative Mathematics Task) untuk Guru Matematika SMP Kabupaten Sleman	DIPA FMIPA UNY	4
2	2015	Penyusunan Bahan Ajar untuk <i>Short Course on Realistic</i>	QITEP in Mathematics	4

		<i>Mathematics Education</i> di QITEP in Mathematics		
3	2015	Narasumber <i>Short Course on Realistic Mathematics Education</i> di QITEP in Mathematics	QITEP in Mathematics	3
4	2015	Narasumber <i>Short Course on Joyful Learning in Mathematics</i> di QITEP in Mathematics	QITEP in Mathematics	3

E. Publikasi Artikel dalam Jurnal dalam Lima Tahun Terakhir

No.	Judul Artikel Ilmiah	Nama Jurnal	Volume/Nomor/Tahun
1	<i>Students' Information Literacy: A Perspective From Mathematical Literacy</i>	Journal on Mathematics Education	7/2/2016
2	<i>Teachers' Teaching Practices and Beliefs Regarding Context-based Tasks and Their Relation with Students' Difficulties in Solving These Tasks</i>	Mathematics Education Research Journal	27/4/2015
3	<i>Opportunity-to-learn context-based tasks provided by mathematics textbooks</i>	Educational Studies in Mathematics	89/1/2014
4	<i>Difficulties in solving context-based PISA mathematics tasks: An analysis of students' errors</i>	The Mathematics Enthusiast	11/3/2014

F. Pemakalah Seminar Ilmiah (*Oral Presentation*) dalam Lima Tahun Terakhir

No.	Nama Pertemuan Ilmiah/Seminar	Judul Artikel Ilmiah	Waktu dan Tempat
Seminar Internasional			
1	The Ninth Congress of the European Society for Research in Mathematics Education (CERME 9)	<i>Identifying ways to improve student performance on context-based mathematics tasks</i>	4 – 8 February 2015 Prague, Czech Republic
2	The International Conference on Research, Implementation and Education of Mathematics and Sciences 2015	<i>Metacognitive prompt as a means to improve students' task comprehension</i>	18-19 Mei 2015 Yogyakarta State University

No.	Nama Pertemuan Ilmiah/Seminar	Judul Artikel Ilmiah	Waktu dan Tempat
3	The 3rd South East Asia Design/Development Research Conference 2015	<i>Looking for ingredients of an 'appropriate' innovation (as keynote speaker)</i>	18-19 April 2015 Sriwijaya University, Palembang
4	The International Seminar on Innovation in Mathematics and Mathematics Education (1st ISIM-MED)	<i>Identifying (Indonesian) students' difficulties in solving context-based (PISA) mathematics tasks</i>	26 – 30 November 2014 Yogyakarta State University
Seminar Nasional			
1	Seminar Pendidikan Matematika IKIP PGRI Madiun 2015	Peran Cendekia dalam Pendidikan Karakter dan Pengembangan Kecakapan Abad 21 (<i>sebagai keynote speaker</i>)	26 April 2015 IKIP PGRI Madiun
2	Seminar Pendidikan Matematika UMS 2015	Kesalahan siswa dalam memilah data relevan pada soal matematika berbasis konteks	7 Maret 2015 Universitas Muhammadiyah Surakarta

G. Karya Buku dalam Lima Tahun Terakhir

No.	Judul Buku	Tahun	Jumlah Halaman	Penerbit
1	Asyiknya Belajar Matematika Untuk Siswa SMA/SMK	2014	102	Penerbit Mobius (imprint Graha Ilmu)
2	Matematika Itu Asyik (Untuk SMP)	2014	104	Penerbit Mobius (imprint Graha Ilmu)
3	Pendidikan Matematika Realistik; Suatu Alternatif Pendekatan Pembelajaran Matematika	2013	97	Penerbit Graha Ilmu

Semua data yang saya isikan dan tercantum dalam biodata ini adalah benar dan dapat dipertanggungjawabkan secara hukum. Apabila di kemudian hari ternyata dijumpai ketidaksesuaian dengan kenyataan, saya sanggup menerima sanksi.

Demikian biodata ini saya buat dengan sebenarnya untuk memenuhi salah satu persyaratan dalam pengajuan Penugasan Penelitian Kerja Sama Luar Negeri dan Publikasi Internasional.

Yogyakarta, 27 Maret 2017

Ketua Pengusul,



Dr. Ariyadi Wijaya

CURRICULUM VITAE

- a. Nama : Dr. Sugiman, M.Si.
- b. NIP : 19650228 199101 1 001
- c. NIDN : 0028026505
- d. Tempat dan tanggal lahir : Kutoarjo, 28 Februari 1965
- e. Alamat surat : FMIPA Universitas Negeri Yogyakarta
Jl Colombo No. 1 Yogyakarta
- f. Nomor telepon:
 - i. Kantor : 0274-548203
 - ii. Handphone : 08122786314
- g. Nomor Faksimili : 0274-548203
- h. Alamat e-mail : sugiman@uny.ac.id
sugiman_uny@yahoo.com

i. Riwayat Pendidikan

No.	Universitas	Program (S1,S2,S3)	Bidang Ilmu	Tahun Lulus
1.	IKIP Yogyakarta	S1	Pendidikan Matematika	1989
2.	ITB Bandung	S2	Matematika	1997
3.	Universitas Pendidikan Indonesia	S3	Pendidikan Matematika	2010

j. Pengalaman Organisasi

No.	Jabatan	Tahun
1.	Ketua Program Studi Pendidikan Matematika FMIPA UNY	1993-1997
2.	Ketua Jurusan Pendidikan Matematika FMIPA UNY	2011-2015

3.	Koordinator Kegiatan Pendidikan Matematika Realistik di FMIPA UNY	2005-2015
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k. Riwayat PPM terkait

No.	Peran dalam Kegiatan PPM	Tahun Lulus
1.	Pengurus P4MRI UNY	1992-sekarang
2.	Anggota IP-PMRI sebagai perwakilan P4MRI UNY	2010-sekarang
2.	Anggota PPM Fakultas dengan tema “Implementasi PMRI untuk Guru-Guru SMP”	2011
3.	Nara sumber dalam kegiatan “Pembelajaran Matematika Berbasis PMRI di MI Kricing Secang Magelang”	2011
4.	Ketua Lomba “Literasi level SMP dan Seminar Guru tentang PISA Wilayah Yogyakarta”	
5.	Nara sumber PMRI dalam “Start up PMRI di Mataram”	2011
6.	Panitia dalam “Grand Final Lomba Literasi Tingkat Nasional” di P4TK Yogyakarta	2012
7.	Pelatihan Penyusunan Perangkat Pembelajaran Matematika dalam PTK untuk PKB Guru Matematika SMP	2015 Anggota
8.	Narasumber dan Pendamping Penelitian Tindakan Kelas Guru SMKN 3 Kasihan, Kabupaten Bantul, DI Yogyakarta pada Semester 2 Tahun Pelajaran 2015/2016.	2016

l. Riwayat Penelitian yang terkait

No.	Judul	Sumber Dana	Keterangan
1	Pengaruh Pembelajaran Matematika Realistik terhadap Kemampuan Pemecahan Masalah dan Keyakinan Matematik Siswa SMP di Yogyakarta	Hibah S-3	Ketua (2010)
2	Pemberian <i>Scaffolding</i> dalam Konstruksi Proses Pada Pembelajaran Matematika yang Konstruktivistik	DIPA FMIPA	Ketua (2011)
3.	Pengembangan Strategi Pembelajaran Berbasis Pendidikan Matematika Realistik untuk Memfasilitasi pencapaian Kemampuan Literasi Matematis Siswa SMP	I-MHERE UNY	Ketua (2012)
4.	Pengembangan Laboratorium Pendidikan Matematika Virtual: <i>Adaptive E-Learning</i> dan <i>Cognitive Load Theory</i>	Hibah Bersaing	Ketua (2013)

5.	Pengembangan Bahan Ajar Matematika dengan Pendekatan Kontekstual untuk Pembelajaran Di SMK	IDB	Anggota (2015)
6.	Pengembangan Bahan Ajar Matematika dengan Pendekatan Kontekstual untuk Pembelajaran Di SMK (Tahun kedua)	IDB	Anggota (2016)
7.	Efektivitas Pembelajaran Kolaboratif Berdasarkan Kognitif Load Teori.	Unggulan DIPA UNY	Anggota (2016)

m. Publikasi yang terkait

No.	Judul	Keterangan
1.	Koneksi Matematik dalam Pembelajaran Matematika di SMP” pada Jurnal Pythagoras Vol.4, No.1, Juni 2008	Mandiri (2008)
2	”Aspek Keyakinan Matematik Siswa dalam Pendidikan Matematik” pada Jurnal Matematika Integratif Vol. 7, Edisi Khusus, Desember 2008;	Mandiri (2008)
3	”Pembelajaran Matematika Sekolah yang Memberdayakan Siswa dalam Kehidupan Bermasyarakat” pada Semnas Matematika dan Pendidikan Matematika di Jurusan Pendidikan Matematika FMIPA UNY tanggal 24 November 2007;	Mandiri (2007)
4	”Pembelajaran Peluang di Sekolah Menengah Pertama: Problematika dan Solusinya” pada Semnas Matematika dan Pendidikan Matematika di Jurusan Pendidikan Matematika FMIPA UNY tanggal 28 November 2008;	Mandiri (2008)
5.	”Kemampuan Pemecahan Masalah Matematik Siswa SMP: Problematika dan Cara Melatihkannya” pada Prosiding Seminar Nasional di FMIPA UNY tanggal 16 Mei 2009;	Mandiri (2009)
6.	”Pemecahan Masalah dalam PMRI” pada Konferensi Nasional Pendidikan Matematika III di Unimed Medan tanggal 23 Juli 2009;	Ketua (2009)
7.	Pandangan Matematika sebagai Aktivitas Insani beserta Dampak Pembelajarannya” pada Semnas di Jurusan Pendidikan Matematika FMIPA UNY tanggal 5 Desember 2009;	Mandiri (2009)
8.	”Peningkatan Keyakinan Matematik melalui Pembelajaran Matematika Realistik” pada Prosiding Seminar Nasional Matematika di Jurusan Pendidikan Matematika FMIPA UNY tanggal 17 April 2010;	Mandiri (2010)
9.	”Peningkatan Kemampuan Pemecahan Masalah Matematik melalui Pembelajaran Matematika Realistik” pada Prosiding Seminar Nasional di FMIPA UNY tanggal 15 Mei 2010	Mandiri (2010)

10.	"Prosep-Prosep dalam Matematika Sekolah" pada prosiding Seminar Nasional MIPA di FMIPA UNY tanggal 14 Mei 2011	Mandiri (2011)
11.	Student's Competency in Solving and Creating Mathematical Problem in Pre-Service Training Program. Jurnal Teknologi, 63:2 (2013) 117-121	Mandiri (2013)
12.	The Development of a Virtual Mathematics Teaching Aid Based on Cognitive Load Theory, ICREAM 2014 in FMIPA UNY.	Penulis I (2014)
13.	Guru Matematika di Era Masyarakat Ekonomi ASEAN, Seminar Nasional Program Studi Pendidikan Matematika Universitas Lambung Mangkurat (UNLAM) Banjarmasin, 30 April 2016.	Pembicara Utama (2016)

Yogyakarta, 27 Maret 2017



Dr. Sugiman

CURRICULUM VITAE

A. Identitas Diri

1	Nama Lengkap	: Wahyu Setyaningrum, Ph.D.
2	Jenis Kelamin	: :♂/P
3	Jabatan Fungsional	: Lektor (300)
4	NIP/NIK/Identitas lainnya	: 19810319 200312 2 001
5	NIDN	: 0019038102
6	Tempat dan Tanggal Lahir	: Wonogiri, 19 Maret 1981
7	Email	: setyaningrum.w@gmail.com
9	Nomor Telepon/Faks/ HP	: 08112640090
10	Alamat Kantor	: Jurusan Pendidikan Matematika FMIPA UNY
11	Nomor Telepon/Faks	: -
12	Lulusan yang Dihasilkan	S-1= 9 orang; S-2= - Orang; S-3= - Orang
13.	Mata Kuliah yg Diampu	<ol style="list-style-type: none"> 1. Media Pembelajaran Matematika 2. Metode Pembelajaran Matematika 3. <i>Mathematics instructional design</i> 4. <i>Microteaching</i> 5. Kalkulus Differensial 6. Kalkulus Integral 7. Aljabar 8. Bahasa Inggris 9. Matematika Dasar

B. Riwayat Pendidikan

	S-1	S-2	S-3
Nama Perguruan Tinggi	UNY	Monash University	University of Dundee
Bidang Ilmu	Pendidikan Matematika	Mathematics and Science Education	Mathematics Education
Tahun Masuk-Lulus	1999-2003	2007-2009	2011-2015
Judul Skripsi/Thesis/Disertasi	Identifikasi Kesulitan Siswa dalam Menyelesaikan Soal berkaitan dengan	Evaluating Mathematical Software Used by Indonesian Teachers: Case	Learning Math in English for Indonesian Students: An investigation into code-switching

	Exponen dan Logaritma	Study in Seven Schools	practices, obstacles and attitudes
Nama Pembimbing/Promotor	1. Edi Prajitno, M.Pd. 2. M. Fauzan, M.Sc.St	Prof. Peter Sullivan	1. Prof. Brian Hudson 2. Dr. Ian Barron 3. Dr. Sheila Henderson

B. Pengalaman Penelitian Dalam 5 Tahun Terakhir

No.	Tahun	Judul Penelitian	Pendanaan	
			Sumber*	Jml (Juta Rp)
1	2011-2015	Tugas Belajar S3		
2	2016	Analisis Kemampuan Komunikasi Dan Koneksi Matematis Mahasiswa Dalam Statistika	DIPA FMIPA UNY	10
3	2016	Persepsi Calon Guru Perempuan tentang Pengalaman Mengajar di Masa "induksi" Karir: Analisis Gender	DIPA UNY	15

C. Pengalaman Pengabdian Kepada Masyarakat Dalam 5 Tahun Terakhir

No.	Tahun	Judul Pengabdian Kepada Masyarakat	Pendanaan	
			Sumber*	Jml (Juta Rp)
1	2011	Pelatihan penyusunan handout berbahasa Inggris jurusan Pendidikan Matematika UAD Yogya	Universitas Ahmad Dahlan	2
2	2012	Kegiatan <i>Indonesia Goes to Schools</i> di sekolah-sekolah Dasar di Dundee, Scotlandia	Kedubes RI di London	5
3	2014	Mengenalkan Indonesia kepada mahasiswa Internasional di University of Dundee	Kedubes RI di London	5
4	2016	Workshop penyusunan LKS guru matematika SMP di MGMP Kota Yogyakarta	Diknas Kota DIY	0.5
5	2016	Juri Lomba Matematika Tingkat SMP dan SMA Se-Jawa dan Bali	UNY	0.5
6	2016	Workshop Seameo " <i>Joyfull Mathematics Learning for Primary School Teachers</i> "	Seameo QITEP	2
7	2016	Sarasehan Tenaga Pendidik PAUD se DIY: Mengenalkan Matematika untuk Anak Usia Dini	LPPM UNY	0.5
8	2016	Pelatihan Pengembangan Pembelajaran Matematika Berbasis Matematika Realistik di Sekolah Dasar Islam Terpadu (SDIT) Kabupaten Sleman dan Bantul	UNY	5
9	2017	Fasilitator kegiatan <i>Sea-Teachers: Teaching Practices in Indonesia</i>	Seameo-UNY	1.5

D. Pengalaman Penyampaian Makalah Secara Oral Pada Pertemuan / Seminar Ilmiah Dalam 5 Tahun Terakhir

No	Nama Pertemuan Ilmiah / Seminar	Judul Artikel Ilmiah	Waktu dan Tempat
1	The Annual Conference of Scottish Educational Research Association, 2012	Learning Mathematics through English as a Second Language	The University of West Scotland, 21-23 Nov 2012
2	The Annual Conference of Scottish Educational Research Association, 2013	Students' Obstacles in Learning Mathematics through a Foreign Language	University of Glasgow, 22-23 Nov 2013
3	The 40 th Annual Conference of British Educational Research Association, 2014	Students' Attitude towards Learning Mathematics through English as an Additional Language	Institute of Education, London, 2014
4	Seminar Internasional Penelitian, Pendidikan dan Penerapan MIPA	E-Learning Readiness in Indonesia: A Case Study in Junior High School Yogyakarta	UNY, 2014
5	Seminar Internasional "The 3rd ICRIEMS" 2016	Teachers' Perception towards ICT in Mathematics Classroom: A case study in Yogyakarta Secondary Schools	UNY, 2016

Semua data yang saya isikan dan tercantum dalam biodata ini adalah benar dan dapat dipertanggungjawabkan secara hukum. Apabila di kemudian hari ternyata dijumpai ketidak-sesuaian dengan kenyataan, saya sanggup menerima risikonya.

Yogyakarta, 21 Maret 2017
Pengusul



Wahyu Setyaningrum, Ph.D.
NIP. 19810319 200312 2 001

Curriculum Vitae

Associate Prof. Kazuhiro Aoyama

(kaoyama@aecc.aichi-edu.ac.jp)

Department of Mathematics Education, Faculty of Education

Aichi University of Education

Research Interest

- Statistic education
- The use of ICT in education

International Publication:

Aoyama, K. (2012). Developing Statistical Teaching Material through Statistical Literacy. *Proceedings of the APEC - Tsukuba International Conference VI* (14 – 18 February, 2012), Tokyo and Tsukuba.

Aoyama, K. (2010). Developing a Statistical Learning Environment: Japanese Census at School Project. In C. Reading (Ed.), *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS 8, July, 2010)*, Ljubljana, Slovenia. Voorburg, The Netherlands: International Statistical Institute.

Aoyama, K. (2007). Investigating a Hierarchy of Students' Interpretation of Graphs. *International Electronic Journal of Mathematics Education*, 2(3), 298 – 318.

Aoyama, K. (2006). Investigating a Hierarchy of Students' Graph Interpretation. *Proceedings of the International Conferences on Teaching Statistics (ICOTS) 7*, Salvador, Bahia, Brazil.

Aoyama, K., & Stephens, M. (2003). Graph Interpretation Aspects of Statistical Literacy: A Japanese Perspective. *Mathematics Education Research Journal*, 15(3), 207-225

Research project

A Study of Statistical Education in School Mathematics (2000 – 2005)

Hierarchy of Graph Interpretation Aspect of Statistical Literacy (2003 – 2010)



Associate Professor Kazuhiro Aoyama
(Aichi University of Education)

Appendix 3 Letter of Agreement for Research Colaboration



AGREEMENT OF ACADEMIC COOPERATION
between
Yogyakarta State University
and
The National University Corporation
Aichi University of Education

Yogyakarta State University, Indonesia and The National University Corporation Aichi University of Education, Kariya, Aichi, Japan agree to enhance international education programs and to strengthen understanding and friendship between the two countries. Yogyakarta State University and The National University Corporation Aichi University of Education agree as follows:

1. The two universities, based upon the principles of respect for each other's independence and of mutual benefit, will participate in the following activities:
 - (1) Exchange of students
 - (2) Exchange of professors, administrative staff, and research scholars
 - (3) Exchange of scientific materials, publication and information
 - (4) Joint research, cultural and other educational activities
2. In order to carry out the above mentioned activities, a detailed plan may be formed after consultation between the representatives of the two universities.
3. This agreement may be revised or terminated upon mutual consultation and consent between the two universities.
4. This agreement is valid for 5 years from the date signed. This agreement may be continued every 5 years, unless one of the two universities offers to terminate this agreement. This agreement may be terminated by either university with a six-month notice in writing.
5. This agreement is made in English, and Japanese, and All texts are equally authentic.

In Witness Whereof: Both parties have executed this Agreement, in duplicate on this 17th day of March, 2014 .

Rochmat Wahab Date: March 17, 2014
President
Yogyakarta State University
Yogyakarta
Republic of Indonesia

Masahisa Matsuda Date: March 17, 2014
President
The National University Corporation
Aichi University of Education
Kariya, Aichi
Japan



**General Conditions for Implementing Students Exchange
between
Yogyakarta State University
and
The National University Corporation
Aichi University of Education**

Based on the Agreement of Academic Cooperation dated on March 17th, 2014 between Yogyakarta State University and The National University Corporation Aichi University of Education, the following general conditions have been agreed upon for a smooth operation of mutual student exchange.

1. The maximum number of exchange students to be accepted by both sides each year shall be three.
2. The exchange students are classified as special non-degree students.
3. The period of exchange for each student shall be six months or one year.
4. Applicants are required to take a language course as part or all of their academic program if they do not possess sufficient language proficiency (Indonesian / Japanese).
5. The exchange students shall choose courses to study for credits and pursue other research activities under the guidance of his/her academic advisor.
6. The credits acquired by the exchange students may be honored by the home institution. Transferring of credits will be conducted in accordance with the regulations of the home institution.
7. Space permitting, a place in university/college residence may be guaranteed for exchange students.
8. The exchange students shall pay the regular tuition fee to the home institution during their stay at the host institution. They are not required to pay the host institution fees, such as entrance examination fee, admission fee and tuition fee.
9. The institution will not assume any financial responsibility for the exchange student. Personal expenses (including food, clothing, accommodation, transportation, school supplies, medical care, health insurance) are the responsibility of the student.
10. Other items necessary for a smooth and successful pursuit of study by the exchange student (including the obligatory purchase of a special health insurance) will be determined by the host institution.
11. The details of these general conditions may be revised upon mutual consent between the two institutions.
12. These general conditions shall be effective for five years from the date signed, and may be automatically renewed every five years unless either of the institutions gives six months' notice of the intentions to revise or terminate the conditions.

March 17, 2014

Rochmat Wahab
President
Yogyakarta State University

Masahisa Matsuda
President
The National University Corporation
Aichi University of Education

LETTER OF AGREEMENT FOR SUPERVISION

Date : 21 April 2016
Supervisor name : Associate Professor Kazuhiro Aoyama (Aichi University of Education, Japan)
Researcher name : Dr. Ariyadi Wijaya (Yogyakarta State University, Indonesia)

This letter serves as an agreement between Dr. Ariyadi Wijaya as the research project leader from Yogyakarta State University (Indonesia) and Associate Professor Kazuhiro Aoyama from Aichi University of Education (Japan) as the supervisor in a research project entitled 'Developing an Online System for Diagnosing Mathematic Learning Difficulties (A Synthesis Based on A Comparison of Indonesian and Japanese Students' Learning Difficulties)'.

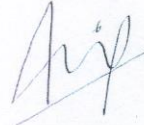
Associate Professor Kazuhiro Aoyama agrees to collaborate and to take supervisory responsibility for the research project that is proposed and conducted by Dr. Ariyadi Wijaya. As the supervisee, Dr. Ariyadi Wijaya agrees to include Associate Professor Kazuhiro Aoyama in the authorship of any publication related to the research project.

Supervisor,



Associate Professor Kazuhiro Aoyama
(Aichi University of Education)

Supervisee,



Dr. Ariyadi Wijaya
(Yogyakarta State University)

