

THE DEVELOPMENT OF INNOVATIVE LEARNING MATHEMATICS INSTRUCTIONAL MATERIAL AND EVALUATION INSTRUMENTS MATHEMATICAL HARD SKILLS AND SOFT SKILLS OF STUDENTS

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ABSTRACT

Middle School Mathematics Curriculum mandates that mathematical skills development as part of mathematical hard skills & social skills and other affective aspects as the components of mathematical soft skills should be implemented simultaneously and equally. The mandate has motivated the researchers to conduct the study in the first year (2014) and the second year (2015) for developing students' mathematical hard skills & soft skills through a variety of innovative learning approaches with nuance of norm & character education. Therefore, based on the findings in the study of the first and second year, the third year study (2016) is focused on the development of teaching materials of innovative mathematics learning with nuance of norm & character education and the development of evaluation instruments to measure secondary school students' mathematic hard skills & soft skills. The development of teaching materials of innovative mathematics learning with nuance of norm & character education and the development of evaluation instruments of students' mathematical soft skills & hard skills are conducted through analyzing the books, preparing instructional materials and instruments based on an examples in the books, discussing the books, conducting field test and reflecting on the improvements of the books. The teachers' responses to the books indicate generally favorable reviews and they find the books really helpful in increasing their insight and reference in improving the ability to prepare teaching materials and evaluation instruments.

Keywords: *Hard Skill, Soft Skill, Mathematics, Norm, Character*

A. INTRODUCTION

Curriculum 2013 explains that, in mathematics teaching and learning, mathematical skills as part of mathematics *hard skills* and other affective aspects, including norms in culture & character education as the components of mathematical *soft skills*, should be implemented simultaneously and equally. Grants Research conducted by STKIP Siliwangi Postgraduate Team in the first year (2014) and the second year (2015) has produced the following outputs:

1. 6 faculty research articles have been presented and published in the proceeding of International seminar at the State University of Yogyakarta, Meijo University in Japan, Naruto University of Japan, and Malaysian Institute of Teacher Education at Tumenggong Ibrahim Campus and are also published in the national Journal with ISSN.
2. 12 students' articles having been presented and published in the national seminar and are also published in the national journal ISSN.
3. 18 media of mathematics innovative learning with nuance of norms & characters education.

4. 18 evaluation instruments for measuring secondary school students' mathematical hard skills and soft skills.
5. 12 thesis of mathematics education of postgraduate students who graduate on time.

In addition, Grants Research by Postgraduate Team in the first and the second year obtained findings in the field as follows:

- a. In general, hard skills and soft skills of students receiving a variety of mathematical innovative learning with nuance of norm & character are better than those receiving conventional learning.
- b. In general, there is an association between students' mathematical hard skills and soft skills in classes receiving a variety of innovative learning with nuance of norms & character.
- c. Students' opinions, perceptions and attitudes towards innovative learnings with nuances of norms & character that they have followed are generally positive.
- d. There are still difficulties experienced by students during the lesson and when carrying out mathematical hard skill assignments and its soft skills components.
- e. Teachers' *Hard Skills* and *Soft Skills* are generally considered to be in the *moderate* category.
- f. There is a high association between hard skills and soft skills owned by teachers.
- g. There are still difficulties for teachers to implement a variety of innovative learning with nuance of character & norm education and difficulties in arranging the assignments which are in line with the indicators of hard skills and soft skills wanted.

Based on these findings, it is for the third year of this study, the research is focused on development of teaching materials of innovative mathematics learning with nuance of norm & character education and the development of evaluation instruments to the students' mathematic hard skills and soft skills. Therefore, the problems in this third year research are formulated as follows:

- a. How to develop teaching materials of various mathematics innovative learning with nuance of norm & character education?
- b. How to develop evaluation instruments to measure the students' mathematical *hard skills* and *soft skills*?
- c. How are the teachers' and experts' responses towards mathematics innovative learning books with nuance of norm & character education and the learning evaluation book to measure students' mathematical hard skills and soft skills?

B. STUDENTS AND TEACHERS' HARD & SOFT SKILLS

Students' mathematical *Hard skills* and *soft skills* developed in every students' research are derived from the core competence and basic competences of mathematics at grade class level of sub-study concerned. Based on the analysis towards some experts (Baron, and Sternberg, (Editor), 1987, Barody in Yonandi 2010, Glazer, 2000, Hassoubah 2004, Munandar, 1977, Polya, 1973, Schafersman, 1991, Sriraman 2004, Starko, 1995, Supriya, 2000, Williams, 2002, Yudha, 2004), Sumarmo (2006, 2010a, 2012) offers

some kind of mathematical *hard skills* that can be selected by students, which are: comprehension, problem solving, communication, connections, reasoning, logical thinking, creative thinking, critical thinking, and mathematical reflective thinking.

Additionally, Sumarmo (2006, 2010a, 2012) offers several types of mathematical soft skills that can be selected by student researchers, including: mathematical disposition, logical thinking disposition, critical thinking disposition, creative thinking disposition, *self-regulated learning*, *self-efficacy*, *self esteem*, *habits of mind*, emotional intelligence, and the education of norm, culture, and character.

The reference for mathematics teachers' hard skills and soft skills refers to Permendiknas No. 8 in 2009, which are:

1. Professional Competence (Knowledge and Understanding) and pedagogical Competence (intellectual skills) as hard skills
2. Personality Competence (practical skills) and social Competence (managerial and attitudes skills) as soft skills

C. MATHEMATICS INNOVATIVE LEARNING

According to Burhanuddin (2014), innovative learning is kind of learning that is packaged by learners at the instigation of their new ideas which are the product of *learning how to learn* to perform the steps of learning, so as to obtain the advancement of learning outcomes. Broadly speaking, according to Burhanuddin (2014), innovative learning can be described as follows:

1. Students are involved in various activities that develop understanding and their skills with an emphasis on learning by doing.
2. Teachers use a variety of media and different ways of uplifting, including using the environment as a learning resource to make learning more interesting, fun, and suitable for students.
3. Teachers organize classes by displaying more attractive books and learning materials and provide a 'reading corner.'
4. Teachers implement a way of teaching that is more cooperative and interactive, including how groups learn.
5. The teacher encourages students to find their own way of solving problems, to express their ideas, and engage students in creating their school environment.

In regards with the education of norms and character, Sauri (2010) suggests four ways of implementing character-based mathematics learning, namely by: a) giving true understanding of character education, b) habituation, 3) the examples of teachers' characters, and 4) implementation of mathematics learning integrally. Basically, norms are not taught but are being actively developed and sustained (Ghozi, 2010). Paying attention to the norms contained in the culture and character education as well as how to develop it, is the duty of teachers to implement the culture and character education in mathematics so that mathematical competence and dispositions as well as cultural norms & characters evolve simultaneously.

Mathematics Innovative learning with nuance of norms and character in this study include: indirect learning, Game macro media flash, Discovery Learning, Problem-Based Learning, Probing Prompting Learning, and PQR4, and so forth.

D. METHODS

As in the first and second year of research, the research of this third year is planned to involve six student researchers. Three students researchers and two lecturer researchers develop teaching materials of mathematics innovative learning with nuance of norm & character education and three student researchers and a lecturer researchers develop evaluation instruments to measure the students' mathematical *hard skills* and *soft skills*. Once teaching materials and learning evaluation instruments are completed, the lecturer and students researchers go to schools to ask for feedback to teachers towards teaching materials and learning evaluation instruments. Based on the teachers' feedback and input, there will be any improvements as necessary to teaching materials and learning evaluation instruments.

E. RESULTS AND DISCUSSION

1. Implementation of Various Mathematics Innovative Learning with Nuance of Norm & Character

To see the teachers' understanding towards teaching materials compiled by the researchers; the researchers asked them to examine the grain of teaching materials in the book compiled researchers, then ask them to implement a single learning approach contained in the book based on their understanding of the book, and the following is the result in the trial of Implementation of *Personalized System of Instruction*.

Based on observations of researchers the in the field, mathematics learning activities using the approach of *Personalized System of Instruction* had run smoothly as expected. At the beginning of the learning, the researchers briefed the students about this study, the researchers then gave the initial test (pre-test) for them to start the first meeting with the aim to determine the students' prior ability, as seen in Figure 5.1 below.



Fig. 5.1
Situation during the Pre-test

This learning Model is a new learning model for vocational students studied. Learning in the experimental class using Learning Model PSI (Personalized System of Instruction) is assisted by Student Worksheet (LKS). The worksheet contains the items of communication skills and mathematical reasoning. Students are required to complete

worksheets with learning steps using Learning Model PSI (Personalized System of Instruction) in group that is guided by teachers and assisted by tutors in each group.

In the experimental class, the students are very active in receiving the instructions by learning model of PSI (Personalized System of Instruction); some students responded well when the researchers held a question and answer session regarding the matter and items that were not understood on the material of Geometry Dimensions Two, as seen in Figure 5.2 below.



Figure 5.2
Situation of Learning that Took Place

The learning process using Learning Model PSI (Personalized System of Instruction) is, at the previous meeting students are required to understand the subject on two-dimensional geometry and its items, if there were things not understood, the students must record and submit at the next meeting. At the next meeting, the teachers asks the students to collect any material that is not understood by the students in the two-dimensional geometry of the material. It is intended that the teacher can determine the benchmark mastery or learning material to be studied.

Sub-chapter of materials or the subjects of discussion were broken down into smaller parts so that it can be studied thoroughly by the students. After that, the teacher set up a group, each group consisted of four people, as well as determining tutor students in each group. Then each group was given worksheets, and the students discuss with their group led by a tutor who had been chosen by the teacher (researcher).



Fig. 5.3
Situation of Students Group and Discussion on Worksheet



Fig. 5.4

Situation of the Class when the Teachers guided students in groups

During the discussion students are allowed to ask the teacher if there are problems poorly understood by students and teachers guide the discussion group. Each group is required to fill out worksheets with their own language, and after the students completed the worksheet (LKS), then, each group is given the opportunity to present the results of their discussions with the group in front of the class forum. Determining the students group who would like to appear first is selected randomly by the teacher, every meeting there will be three groups of seven groups that performed in front of the class forum.

At time one of the groups presented the results of their discussion, another group listened and were allowed to add or refute what was presented by the group, so the interaction occurred between them. Such interactions would build an atmosphere of student-centered learning; besides, it is also expected that students can individually build his own knowledge.



Fig. 5.5

Situation of when the students presented discussion results in class forum

After six meetings, the teacher (researcher) gave evaluation form, namely the formative test in the form of material items learned in the previous meeting. The results of formative tests were notified to the students so that each individual student know its score for measuring the extent to which an understanding of the material had been learned. If there was student whose score was below KKM, then he/she should be

followed up by the teachers and ended up with remedial, and so on, or by following a system of mastery learning in order to improve his/her score beyond school hours together with tutor group and of course the researchers themselves, as seen in the figure below.



Fig. 5.6

Situation of learning beyond school hours for those who get lower score than KKM

Once the students mostly achieve a success rate of each unit studied, the teachers begin to teach next lesson units. Thus, all students in the class always start learning a new lesson units together, the same procedure is followed in the teaching of other subjects units until the material is completed. After all the series material is completed, students take tests covering the entire unit of the chapter study. The final tests are summative or called by post-test, which aims at evaluating the level of success, achievement and improvement of the students' mathematical communication skills and reasoning after being given treatment using model PSI (Personalized System of Instruction).

At the first meeting of the experimental classroom, the researchers had difficulties in implementing learning steps which are in line with the Learning Model of PSI (Personalized System of Instruction). This is because by the fact that the students were accustomed to conventional teaching or lecturing method, or because that they were used to depend on the role of a teacher. While on the Model of Learning PSI (Personalized System of Instruction), the students are required to be individually more active and to have more understanding control of the material being studied and should be completed in learning.

Although researchers had experienced difficulties in implementing learning steps to the students' learning, but they were gradually able to follow the learning steps of PSI and can be done well and receive good learning PSI at the next meeting. In general, the implementation of learning mathematics by using Learning Model of PSI (Personalized System of Instruction) in the experimental class had proceeded smoothly as expected. But at the time of the study, the researchers had difficulty in applying this learning model of PSI.

The difficulties experienced by the researchers are as follows:

- a) During the learning process, the teachers has little difficulty in sharing ideas about the material being studied.
- b) When students are grouped, teachers have difficulty choosing a tutor who can guide other students, because the students sometimes feel not confident that they can do the best but they do not acknowledge their ability.

- c) When students are grouped, not only do the teachers have difficulty in regulating students but also in determining the members of each group adjusted to the ability of each student, so to create fair group, there are groups of students whose abilities are considered good and low are in the same group. Sometimes students do not want to be grouped with the people who are not good friends.
- d) During the learning process, the students complained to the teacher a little bit because they are unaccustomed to attend frequent formative tests to measure their mathematical abilities of each section of material ends.
- e) When the formative tests are in progress, the teachers have difficulties to instill honesty attitude in taking the test.
- f) When the teacher asked the students who do not fully understand yet or whose score is less than KKM with one unit (section) Learning to learn outside of school hours, sometimes the teacher has difficulties to persuade the students to be motivated, sometimes there are students who are lazy to learn more or there are students who get embarrassed by his friends because he felt he was not familiar or slow in learning mathematics.

To determine the response of students to mathematics learning being conducted, we use a questionnaire consisting of 18 questions with a *yes* or *no* choice. From the results of the questionnaire processing, it can be seen that 86% of students respond positively to the learning of mathematics being implemented. To determine the response of teachers to teaching practices, the authors propose a number of written questions to the teachers who are implementing the learning process. From the teacher's responses, it can be seen that, in general, the teachers do not encounter significant obstacles in carrying out planned learning.

During the study, the percentage of student activity is included in the active category. While the most dominant activity is working in a group. If it is compared, then, the students' activities on next learnings are better than on previous learning.

To investigate the activity of the teachers, we use the teacher activity observation sheet and a number of written questions in an effort to confirm the results of observations. The result can be concluded that the teachers feel that 90% of activities they are already in line with the learning planned. At the same time, based on the authors' observation, it appears that the teacher's activities are mostly done to guide the students' activities. The quality of the teachers' activities on the second learning is better than the activity of the teacher on the first observation.

2. Developing Evaluation Instruments of Mathematical Hard Skills & Soft Skills

Evaluation Instruments Books of mathematical Hard & Soft Skills also are tested to six teachers who piloted book about teaching materials of innovative learning. The teachers are trying to make an evaluation instrument of hard skills & soft skills based on the examples contained in the book and then discuss it with six post-graduate students. Once the instrument is completed, then, it is tested to the students and the results are as follows:

To see the teachers' understanding of the Book Evaluation of students' mathematical Hard Skills & Soft Skills, then, the teachers are asked to examine the questions for measuring particular hard skills & soft skills and then together with the researchers, they set the items for measuring a variety of hard skills in basic competence. The teachers begin by identifying indicators of hard skills & soft skills to be measured, then they prepare exercise or statement items based on these indicators. After that, they formulate scoring guidelines for assessing hard skills by using *Analytic scoring rubric*. And then, they pilot test items having been made to calculate the validity, reliability, discrimination power and the difficulty level. Based on the recapitulation results towards the instrument test, it is known that the items can be used, revised or replaced.

Once the instrument is completely formulated, piloted and analyzed, then, the teachers' responses are as follows:

1. Teachers generally find the Evaluation book of Hard Skills & Soft Skills really helpful, and they feel that they can learn on their own to make mathematical hard skills items based on the available examples and indicators.
2. Teachers who usually only arrange questions dominated by a matter of understanding and tend to have only one answer, find it has an additional insight by creating problems that could explore the diversity of the students' answers.
3. The teachers still have difficulties in formulating diverse items to measure diverse hard skills but they are convinced that if they get used to arrange items that are not routine will further spur their creativity in formulating questions.
4. The teachers still have concerns students would have difficulty working on the problems of the hard skills and will make the students run out of time to do it. But they are finally convinced that forming the habit of students' thinking for long-term hard skills development will be more beneficial for the students rather than just solving routine problems in which students solve problems simply by imitating the examples given by the teachers.
5. The Attitude Scale used to measure soft skills makes the teachers aware that they so far only emphasize more on the cognitive aspects and less concerned about the acquisition in terms of students' affective aspects.
6. The teachers feel that they can take advantages of assistance in implementing innovative learning with nuance of norm & character and formulation of hard skills items soft skills statement items by the authors and post-graduate students, and they suggest that the activities are routinely and continuously carried out by whom it may concern.

7.

F. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

Based on the trial results of using teaching material books of mathematics innovative learning with nuance of norm & characters and the evaluation book of students' mathematical hard skills & soft skills, the following conclusions are obtained:

- a. Both books are developed by asking the teachers to scrutinize the books, then compile teaching materials of basic competence by using the books as reference, discussing them with the researchers, implementing them and then are asked to give input and response.
- b. The books can be easily understood and implemented by teachers and can be the main references in implementing innovative learning and preparing questions to measure hard skills & soft skills statement items.
- c. Mentoring conducted by the researchers and post-graduate students is really helpful for the teachers in understanding and implementing the materials in the books.

2. Suggestions

Appropriate measures need to be assessed in helping teachers formulate hard skills items & students' soft skills statement items as well as efforts to support teachers in implementing innovative learning with nuance of norm & character norms regularly and continuously.

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