The use of ASSURE learning design to improve mathematical problem solving ability and self-determination of junior high school students

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Abstract. The ability to solve problems and self-determination of junior high school students in West Bandung Regency is still low, so various alternative solutions are needed to overcome them. This study aims to determine the improvement of problem solving ability and self-determination of class VIII students by using ASSURE design (Analyzing student characteristics; State standards and goals; Choosing methods, media and materials; Utilizing media and materials; Requiring student participation; and Evaluating and revising) based on his learning style. This study used an experimental method and one group pretest post-test design. The sample is class VIII students selected by purposive sampling at one of the junior high schools in West Bandung Regency. The instrument of this study used a descriptive test of 5 questions about problem solving ability and 30 scales of student self-determination attitudes. Based on the results of the study, it can be concluded that: Improving problem solving ability and student self-determination using ASSURE learning design is suitable for all types of student learning styles (auditory, visual and kinaesthetic).

1. Introduction
One of the objectives of mathematics learning is that students are expected to overcome mathematical problem solving ability. Problem solving is seen as a process or a way that someone does to solve mathematical problems based on known data and information by using mathematical concepts that they already have. Students who are trained in problem solving ability will have a tendency to be skilled in selecting relevant information, can analyze, and evaluate the results they do. This ability, can lead to intellectual satisfaction in students, optimize potential, and train students how to do a search through discovery [1]. Problem solving ability are life skills that are important for students to overcome, the process consists of analysis, interpretation, prediction, evaluation, and reflection [2].

Problem solving is an integral part of mathematics learning and becomes a mathematical skill that students need to master. Problem solving is one of the high-level mathematical thinking ability, therefore it is necessary to train students from elementary to secondary education [3]. The importance of problem solving ability was also raised by Sumarmo, Branca and Kilpatrick, Swafford & Findell. Sumarmo and Branca stated that: 1) Problem solving ability is the general goal of mathematics teaching, even as the heart of mathematics, and 2) Problem solving is the core and main process in the mathematics curriculum which includes methods, procedures and strategies or methods used [4, 5]. Kilpatrick, Swafford & Findell assert that problem solving is one of the very important aspects of mathematics [6].
Based on these opinions, mathematical problem solving ability are very important for students. But in reality, the mathematical problem solving abilities still need to be improved. The results of the study found that the mathematical problem solving abilities of junior high school students in Cimahi City were still low [7]. Other studies reveal students who have low mathematical understanding ability, most (80.9%) come from students who have low mathematical problem solving abilities [8].

In addition to problem solving ability, students' positive attitude towards mathematics is a goal of mathematics learning that must be achieved. One component of the student's attitude is self-determination. In order for these two aspects to be achieved, one way that can be done is by creating and developing a learning atmosphere that encourages students to practice mathematical abilities and self-determination so that mathematics learning is more meaningful. Related to that, the role of learning media is needed to understand mathematics so that students are able to learn mathematics more meaningfully. The advantages of learning media are concrete, images can overcome space and time, overcome limitations of observation, clarify a problem so that it can prevent / correct misunderstandings [9]. The cube and cuboid material in this study are part of Geometry which is one of the branches of mathematics that is most easily associated with real life [10]. Referring to the advantages of learning media, it can be possible to use media in the form of concrete teaching aids in mathematics learning to improve students' mathematical abilities.

The usefulness of the media in the teaching and learning process has quite important meaning, because in these activities the obscurity of the material delivered can be helped by presenting media as an intermediary. The complexity of the material delivered to students can be simplified with the help of the media. The media can represent what the teacher is unable to say through certain words. In addition, learning media have entertainment value, so they can reduce boredom, focus more, and play an active role in using the media so as to increase interest in learning.

The reality in the field, especially in junior high schools in West District, is that only a few mathematics teachers use learning media in teaching and learning activities. This can be seen from the fact that there is no junior high school that has a mathematical laboratory specifically. From this, the use of new learning media is limited to being understood and discussed among mathematics teachers, only a small number of teachers have implemented learning media or teaching aids in classroom learning. The use of learning media is very influenced by the selection of learning designs that are used by the teacher.

In a learning process an innovative learning design is needed that can improve students' problem solving abilities. The learning design used is ASSURE learning design, because it is more oriented to the characteristics of students and involves the use of learning media. In this study the media used is concrete props. Previous research regarding the use of ASSURE learning design is research on students M.Ts. in Cirebon Regency regarding the use of ASSURE learning models assisted by Autograph software. From the results of the study, it was concluded that, generally, an increase in mathematical creative thinking ability of students who learned using ASSURE learning models assisted by software Autograph was better than students who used learning directly [11].

Research related to self-determination includes revealing that intrinsic motivation has the potential to predict student success in school. In general, the findings conclude that student academic success at the school and college level is strongly associated with intrinsic motivation [12]. Noting some of the explanations above, to improve problem solving skills and student self-determination, the researchers conducted research on the use of ASSURE learning designs.

2. Method
The type of research in this study was an experiment with One group Pretest Posttest Design [13]. While the sample subject was class VIII students who were selected by purposive sampling at one of the junior high schools in West Bandung Regency. The instrument of this study used a descriptive test of 5 questions about problem solving skills and 30 scales of student self-determination attitudes.

Class VIII was chosen as a research sample with the consideration that based on their age ranged from 12 to 15 years. Based on Piaget's theory, the age level of cognitive level is still in transition from the level of concrete operational thinking to formal operations so that the use of learning media is needed in understanding mathematical material through ASSURE learning design. Learning design ASSURE
stands for components or important steps contained in the design of learning, namely: Analyze learner characteristics, State standards and objectives, Select methods, media and materials, Utilize media and materials, Require learner participation and Evaluate and revise. The material taught in this study is the cube and cuboid material which is divided into 5 meetings. In this study obtained from the results of the problem solving ability test and the scale of student self-determination. The test scores of students' abilities were obtained from the results of the pretest and posttest, while the results of self-determination were obtained from the results of the pre-response and post-response.

Indicators of problem solving abilities in this study refer to Rosalina D, namely: 1) Identifying the elements that are known, asked and the adequacy of the elements needed; 2) Formulate mathematical problems or develop mathematical models; 3) Implement strategies to solve everyday problems; 4) Explain or interpret the results according to the initial problem, and 5) use mathematics meaningfully [14]. The indicators of self-determination in this study are autonomy, relatedness, and competence [15]. Autonomy in several studies is also called self-determination, namely the ability of oneself to control himself, decide the best for him, and run things without any compulsion from outside him. The relatedness is a feeling someone has towards meaningful relationships with others; experience authentic relationships from others and experience a sense of satisfaction when participating and engaging with their social environment. Furthermore competence describes the level when a person feels capable of performing different tasks whether related to learning or not.

3. Result and Discussion

3.1. Result

Table 1 presents the student activities in using ASSURE Design in learning.

**Table 1. Recapitulation of ASSURE Design Activities**

| The Phase of ASSURE Design | Activities |
|---------------------------|------------|
| Analyze Learner           | Grouping Student Learning Styles |
| State Objectives          | Deliver the learning objectives |
| Select Methods, Media dan Materials | Use of ASSURE Design with LAS and concrete props. |
|                           | Example of LAS: |

Example of Cube and Cuboid:
Require Learner Participation
Students carry out research on the problems under study and discuss with their group friends, the teacher monitors the course of the discussion.
Evaluate and Revise
The teacher evaluates students during the learning process. The evaluation results are an improvement for the next meeting.

Based on the data from the increase in mathematical problem solving skills using ASSURE learning design, an overview of the increase in problem solving skills and student self-determination is obtained as follows in Table 2.

**Table 2. The Results of Improving Problem Solving Ability and Self-Determination**

| Learning Style | Problem Solving Ability | Self Determination | N-Gain |
|----------------|-------------------------|--------------------|--------|
|                | Pretest | Posttest | N-Gain | Pre-response | Post response | N-Gain |
| Audio          | 21.98  | 44.37   | 0.29 (low) | 78.05  | 107.90 | 0.31 (medium) |
| Visual         | 22.08  | 54.70   | 0.42 (medium) | 77.98  | 110.24 | 0.34 (medium) |
| Kinesthetic    | 21.88  | 54.90   | 0.42 (medium) | 77.80  | 113.51 | 0.37 (medium) |

Table 2 shows that the results of the pre-test and posttest problem solving abilities were carried out on three groups of learning styles, for the auditory group there was an increase in the average test score of 29% from 21.98 to 44.37 for the visual group with an average increase the test score was 42% from 22.08 to 54.70 and for the kinesthetic group there was an increase in the average test score of 42% from 21.88 to 54.90. The results of the pre-response and post response self-determination of auditory group students have an increase in the average test score of 31% from 78.05 to 107.90, for the visual group there is an increase in the average test score of 34% from 77.98 to 110.24, and for the kinesthetic group there is an increase in the average test score of 37% from 77.80 to 113.51. The results of the t-test show that the two increases are significant. This shows that learning using the ASSURE design is able to improve problem solving skills and student self-determination.

3.2. Discussion
In the early stages of learning implementation using the ASSURE Design, which is Analyze Learner. Student analysis is done by making observations and students are asked to fill out a questionnaire regarding the tendency of student learning styles. The results of the analysis of student learning styles are grouped into three groups of learning styles, namely: auditoria, visual, or kinaesthetic. The evaluation results show that students who have auditory learning styles feel less comfortable in the group, because they feel "disturbed" by students who have kinesthetic learning styles. Likewise with students who have a visual learning style, they are more comfortable in groups with those who have the same learning style. But for students who have kinesthetic learning styles, they feel comfortable with the diversity of learning styles in their groups. Based on the results of these evaluations, group changes are made, and students are grouped according to the same learning style. With this grouping technique, the teaching and learning process, especially in the implementation of group discussions is more lively, smooth, and more comfortable. It's just that groups of students with kinaesthetic learning need special attention in terms of order and comfort in discussion.

Often students who have kinaesthetic learning styles and low self-determination, interfere with other groups who are carrying out discussions or if they do not disturb other students, they make scribbles in their notebooks in the form of pictures or writings that have nothing to do with the material being discussed, or some are still sleepy during learning. However, kinesthetic students who have medium/ high self-determination, they are
more confident, brave and enthusiastic in working on the problems and appearing in front of the class to work on the questions.

The next stage, Objectives, is the teacher conveying the learning objectives to be achieved. In determining learning objectives take into account ABCD, namely: 1) A (Audience) or students, namely what can be done by students after learning; 2) B (Behavior), namely operational verbs that describe the ability of students (audience) after learning; 3) C (Condition), which is a statement of the purpose that states the performance (implementation) that can be observed; 4) D (degree), which states the standard or criteria [16].

The next step in the design of ASSURE learning is Select Methods, Media and Materials. In this study, the learning media used are concrete teaching aids. The material used as material for research is about cubes and cuboid. In the Utilize Methods, Media and Materials stage, the Teacher encourages students to discuss LAS seriously. Through group discussion activities that are a means of improving students' mathematical problem solving abilities, it can accelerate the assimilation and accommodation of new knowledge learned by students with prior knowledge. This makes the learning atmosphere of students become more active. On the other hand, students are more motivated and challenged to solve the problems posed. This is in accordance with Piaget's opinion that knowledge that is built into the mind of a child, as long as the child is involved in the learning process is the result of active interaction with the environment through the process of assimilation and accommodation [17].

The next stage is Require Learner Participation. The teacher goes around to monitor the course of group discussions and provides guidance to each group to conduct an investigation. In the process of discovery of concepts, students get help from the teacher, assistance provided using scaffolding techniques, namely to provide assistance to students who have difficulty. During the discussion, if there are students who experience difficulties, then the question is not directly answered by the teacher. However, the teacher asks students to more closely discuss the questions asked, the answers must be found by the students themselves. Therefore, the teacher guides students with additional instructions to help guide the answers to questions or concepts learned. Instructions are not given only to the group asking questions, but to all students in the class. This is done so that there is no repetition of questions by other students' groups. After completing the investigation, students enter the phase of developing and presenting the work by pointing to one group to present the results of the discussion in front of the class, and providing opportunities for other groups to respond.

The last step, in the use of the ASSURE design is Evaluate and Revise. Based on the results of observations during the implementation of learning in the classroom, students who were treated by using the ASSURE design were some students who experienced confusion in dealing with the problems given. During the filling of the Student Activity Sheet (LAS), some of the students were actively involved in conducting group discussions. However, some students are less interested in the direction of the discovery of the concept, so mastery of the material given tends to be very varied. In addition, there are some students who have mastered several concepts that will be learned. This resulted in them being less interested in the direction of concept discovery that had been provided.

In general, the use of ASSURE design can improve problem solving ability and student self-determination, but if analyzed further based on student learning styles, for aspects of mathematical problem solving abilities, the use of ASSURE learning design is more suitable for groups of students who have both visual and kinaesthetic learning styles. This is because in the application of ASSURE design with the presentation of problems in the form of images and the use of concrete props, so students who have a visual learning style tend to learn by seeing and observing the image [16] and students who have learning styles kinaesthetic tends to learn by using his skills to make concrete props.

Whereas from the aspect of student self-determination, there was no significant difference between students who had auditory, kinaesthetic, and visual learning styles. This means that every good student who has an auditory, kinaesthetic and visual learning style has the same increase in self-determination. However, even though the increase in self-determination has not been maximized, students who have a visual learning style are more suitable to use the ASSURE design than other learning styles. There are many factors that have caused the maximum increase in student self-determination. Theory of self-determination seems to emphasize that when individuals can realize their potential optimally, the individual will feel the satisfaction expressed [17]. This increasing tendency to self-determination shows that students' orientation during learning is more on learning goals to avoid failure.
4. Conclusion
Overall, the use of ASSURE learning designs can improve students' problem solving abilities. Based on student learning styles, the use of ASSURE learning designs to improve student problem solving ability is more suitable for groups of students who have both visual and kinaesthetic learning styles. Whereas to increase self-determination is suitable for all types of student learning styles (auditory, visual and kinaesthetic).

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