Improving effectiveness learning solar system through mind mapping strategy with mase paper ball and flashcard

R Priyatin
UPTD SDN Langkap 4 Burneh Bangkalan, Granggurar, Langkap, Burneh, Bangkalan Regency, East Java, Indonesia 69121

E-mail: rahayupriyatin@gmail.com

Abstract. Natural Science Lessons emphasize providing direct experience, to develop competencies in order to explore and understand the natural surroundings scientifically. It is taught to equip students to have knowledge (knowing various ways) and skills (how to do it) that can help students to understand natural phenomena in depth. However, in the learning process, students still have difficulty understanding of the solar system. Inadequate media and conventional learning processes make students' enthusiastic in participating in learning still low, and this makes learning not as expected by the teacher. In the solar system topic, the teacher expects students to be able to understand the position of the planets in the solar system in order and correctly. The strategy used in the learning process is to apply two-dimensional mind mapping using mase paper balls made of pulp and flashcards made by the teacher. The goal that is expected in the learning process using these strategies and media is to increase the effectiveness of student learning. The research was conducted using the R and D (Research and Development) method using the ADDIE model development method (Analysis, Design, Development, Implementation, Evaluation). Effective learning is active, creative and fun learning for students so that learning outcomes increase. Effectiveness is the level of success achieved from implementing a strategy and learning media, in this case measured from student learning outcomes. The results of the final assessment are in the form of a process assessment and a final assessment.

1. Introduction

Natural Science deals with how to find out about nature systematically, so that Science is not only the mastery of a collection of knowledge in the form of facts, concepts, or principles but is also a process of discovery. The discovery process is a process where we are able to create something new. So that in teacher learning is expected to be able to facilitate students for these activities.

Science learning is taught to equip students to have knowledge and skills (how to do it) that can help students understand natural phenomena in depth. Apart from that, they also realize the Oneness of Allah SWT. Learning is an activity carried out between students and teachers through a process in a learning environment. Learning can also be said to be the process of conveying knowledge between teachers and students. Learning activities can be carried out through effective learning to improve student abilities which will lead to increased learning outcomes.

Science Education (IPA) in SD / MI aims for students; (1) develop curiosity and a positive attitude towards science, technology, and society, (2) develop process skills for investigating the environment, solving problems and making decisions; (3) developing knowledge and understanding of scientific
concepts that are useful and can be applied in everyday life; (4) transfer knowledge, skills and understanding to other teaching fields; (5) participate in maintaining, protecting and preserving the natural environment; (6) appreciating the various forms of God's creation in this universe for further study and use.

In order to improve 21st Century Learning Skills and the era of the Industrial Revolution 4.0, teachers are required to be creative and innovative in making learning media so that the learning process runs as expected and can improve learning outcomes. The teaching and learning process will run smoothly and effectively by using various kinds of learning components. One of them is the media.

The media is used by the teacher to clarify in delivering material so that it is easily accepted by students, so that students can understand the material presented in learning and increase the effectiveness of learning outcomes. The learning media can be an effective learning resource and create a pleasant atmosphere for students so that the expected goals in learning can be achieved.

The use of media in learning should be in all subjects, including Natural Science lessons. In Natural Science class VI semester 2, there is material on the Solar System being taught, one of which is to discuss the order of the planets from the closest to the sun to the furthest from the sun. In this lesson, the teacher explains by writing on the blackboard, sometimes providing pictures about the layout of the solar system. Then do the question and answer, so that learning is not memorable for students and students easily forget the material. Learning will be boring because the interactions that are formed are only centered on the teacher while students are only listeners, and the learning experience gained is minimal during the learning process. Media made by the teacher has not been able to improve students' ability to understand the material presented, so that it has an impact on learning outcomes that are low or ineffective.

Effective learning is active, creative and fun learning for students so that learning outcomes increase. Based on the above problems, it is necessary to have a solution in the teaching and learning process so that learning is created as expected, namely effective learning. The effective learning is not always guided by results but also in the process [1]. From this opinion it can be stated that the process in question is a learning process carried out aimed at improving students' abilities in the material presented which will result in the ability to describe learning outcomes.

To carry out the learning referred to in the description above, a learning innovation from the teacher is needed. The solution made by the author is to apply a two-dimensional mind mapping strategy that uses paper mase balls made of pulp and flashcards which are made by the teacher himself which contains information about the planets in the solar system. The advantages of the above media are cheap, easy to make and practical to use. Cheap here is the material used is often found and the price is affordable, easy to make the media, and practical here is the media is easy to use as a learning medium.

Based on the background and problems above, the problem formulations can be determined as follows:

- How can the application of a two-dimensional mind mapping strategy with the aid of paper balls and flashcards increase the effectiveness of learning about the solar system?
- How to increase the effectiveness of student learning about the solar system by using a two-dimensional mind mapping strategy made of mase paper balls and flashcards?

The objectives of implementing a two-dimensional mind mapping strategy with the help of mase paper balls and flashcards for students are as follows:

- Describe the application of a two-dimensional mind mapping strategy with the aid of mase paper balls and flashcards to increase the effectiveness of learning about the solar system.
- Describe the increase in the effectiveness of student learning about the solar system by using a two-dimensional mind mapping strategy made of mase paper balls and flashcards.
2. **Theoretical perspektif**

2.1. *Learning*
Learning is an activity in conveying knowledge between teachers and students. Learning activities are a process of interaction between students and teachers in a learning environment. Learning can be done through effective learning which will lead to the achievement of learning outcomes.

Effective learning is not always guided by results but also in the process [1]. From this opinion it can be stated that the process in question is a learning process carried out aimed at improving students' abilities in the material presented which will result in the ability to describe learning outcomes.

Every human being is always experiencing a learning process. Every learning process that goes through must have an impact and results, either directly or indirectly. Behavior changes that are obtained after learning can also be referred to as learning outcomes, in the form of changes in behavior or the like.

2.2. *Mind Mapping*
Mind mapping is a creative note-taking method that makes it easier for us to remember a lot of information [2]. Learning based on the concept of a mind map (mind mapping) is a way of learning that uses a comprehensive learning concept. When finished, the notes are made to form a pattern of related ideas, with the main topic in the middle, while the subtopics and details become the branches.

Basically, this mind mapping method departs from the results of a study on how the brain processes information. We originally thought that the brain processes and stores information in a linear fashion, much like the traditional method of writing and recording. However, now we find that the brain takes information in a mixture of images, sounds, smells, thoughts and feelings and separates it into a linear form, for example in the form of writing or oration. When the brain remembers information, it usually takes the form of colorful pictures, symbols, sounds, and feelings. Mind maps involve both halves of the brain, so we can remember information more easily. The steps in making a mind mapping are:

- Write the main idea in the center of the paper and cover it with a circle, square or other shape.
- Add a branch extending from the center for each main point or idea. The number of branches will vary depending on the number of ideas or segments. Use a different color for each branch.
- Add symbols and illustrations to get a better memory.

2.3. *The Solar System*
The solar system is a collection of celestial bodies consisting of a star called the sun and all objects that are bound by gravity, which is a system consisting of the sun, planets, satellites, asteroids and comets [3]. The solar system belongs to a very large part of the universe. The solar system is located within one of the many galaxies of the stars. The solar system is an arrangement of celestial bodies that revolves around the sun as its center. These celestial bodies consist of 8 planets with elliptical orbits, natural satellites, comets, asteroids and meteoroids. The planets are always moving around the sun because of the influence of the sun's gravitational force.

The solar system is composed of several parts, namely: the sun, 4 outer planets and 4 inner planets, the asteroid belt and the outer part. The planets in the solar system move around the sun. All the planets around the sun are arranged into one unit and make a very orderly system, so that one planet does not experience collisions. A perfect system called the solar system.

The sun as the center of the solar system is surrounded by celestial bodies, which are the brightest stars from the earth compared to other stars. Planets are celestial bodies in the solar system that circulate around the sun in a path called orbit [3]. These planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. The circulation of a planet around the sun is called a revolution, where the direction of circulation in the solar system is counterclockwise. Based on their physical properties, the planets are grouped into inner and outer planets. The inner planets consist of Mercury, Venus, Earth and Mars. While the outer planets consist of Jupiter, Saturn, Uranus and Neptune.
2.4. Learning Effectiveness

Effective learning is active, creative, and fun learning for students so that learning outcomes increase. Effectiveness is a very important factor in learning because it determines the level of success of an innovative learning.

The effectiveness of the learning process with regard to the way, the techniques and strategies used in achieving the goals optimally, precisely and quickly. Effectiveness shows success in terms of whether the targets have been achieved or not. If the activity results are closer to the target, it means the higher the effectiveness.

Learning outcomes are in the form of aspects, namely cognitive, affective and psychomotor aspects in accordance with the opinion of [4] which states that learning outcomes are a change in behavior and these changes include cognitive, affective, and psychomotor aspects after the student experiences the learning process. So, it is not true that the assumption that states that learning outcomes are limited to the values contained in student report cards. More than that, changes in attitudes, increased abilities and skills of students are also learning outcomes.

This is in line with Kingsley's opinion [4] which states that there are three types of learning outcomes, namely: knowledge and understanding, skills and habits as well as attitudes and ideals. Many things that have a direct or indirect effect on learning outcomes. The determinants of this learning success can come from within the student or from outside the student. Factors that come from within students are usually related to the innate nature of the student, which involves innate intelligence.

Meanwhile, external factors concern the student's learning environment. Also, the quality of teaching is said to be one of the best and most dominant environmental factors in influencing student learning outcomes [5-9]. Quality teaching is teaching that is effective and that effectiveness can be achieved with the right media and methods and can stimulate students to easily achieve the learning objectives.

In this study, the effectiveness aspect is active, creative and fun, which are described as follows:

- Active is doing an activity or activity. As for the active aspects in the learning process are as follows:
  1) Students do a lot of learning activities.
  2) Students can express opinions.
  3) Students study painstakingly.
  4) Students interact with the subject matter.

- Creative is the ability to create something new and innovative. The creative aspects of the learning process are as follows:
  1) Students have an opinion about the media.
  2) Students are able to be creative in media.
  3) Students have creativity in learning.

- Fun is learning that can be enjoyed by students, where students feel comfortable, fun, and safe during the learning process. The fun aspects of the learning process are as follows:
  1) Media that is fun for students.
  2) There is student interest in the media.
  3) A learning process that creates a safe atmosphere
  4) Comfortable
  5) The involvement of all students during the learning process.

3. Method

The research method used in this study refers to the R & D (Research and Development) Model, using the ADDIE model development method (Analysis, Design, Development, Implementation, Evaluation) which aims to develop learning tools in the form of lesson plans and worksheet. The teacher chooses the ADDIE model because this model is a media development model that has a simple framework and has a general structure, so that it can be applied in any condition [9].

According to [9] there are several stages that must be taken by teachers to create and develop learning media based on the ADDIE model. The description of the ADDIE model learning is as follows:
3.1. Analysis

Analysis is the stage that is carried out to define everything students will learn. This analysis starts from the identification of problems, needs, and tasks. Learning is boring because the interactions that are formed are only centered on the teacher while students are only listeners, and the learning experience that is obtained is minimal during the learning process which is a problem that often occurs in the learning process, as well as the student's need for change. The application of a two-dimensional mind mapping strategy with the aid of *mase* paper balls and flashcards is the development of an innovation in the learning process designed in such a way to solve problems about the solar system.

At this stage, the main activity is to analyze the need for the development of new learning models/methods and to analyze the feasibility and requirements for developing new learning models/methods. The development of new learning methods begins with a problem in the learning model/method that has been applied. Problems can occur because the existing learning models/methods are no longer relevant to target needs, learning environment, technology, characteristics of students, etc.

3.2. Design

The steps that must be taken in the Design stage are: (1) Formulation of learning objectives. This formulation was carried out so as to achieve Specific, Measurable, Applicable, Realistic (SMAR) criteria; (2) determining models and strategies to achieve learning objectives. The two-dimensional mind mapping strategy is designed to improve student learning effectiveness. At this stage the teacher designs the media that will be used to make a two-dimensional mind mapping, namely the mase paper ball as the planets in the solar system, where the gold paper ball has been named according to the name of the planet in the solar system and the path of the solar system made of cardboard as well as a flashcard that contains instructions in determining the location of the planet on its path.

![Figure 1. Drawing of media design (two-dimensional mind mapping aids).](image)

3.3. Development

This stage is the stage where the teacher prepares the tools and materials that will be used to implement the two-dimensional mind mapping strategy and the steps in making the tools. At this stage, the teacher invites students to make *mase* paper balls made of wood pulp as planets in the solar system.
3.4. Implementation

The implementation stage is the stage of implementing a strategy that has been designed into the learning process. At this stage we can try and even implement it into the learning process, the extent to which this strategy can increase the effectiveness and learning outcomes of students. At this stage, it is a trial stage for the use of media in the classroom. Furthermore, the results of this implementation are used as the basis for conducting the evaluation. In this stage, the teacher applies a two-dimensional mind mapping strategy with mase paper balls and flashcards about the solar system to students.

In the learning process, the teacher prepares a piece of cardboard as a trajectory to place the planets in their orbits in the solar system, and a flashcard that contains information about planets in the solar system, as well as a paper ball that has been given the names of the planets in the solar system. Sun.
The teacher divides the students into large groups and explains how to make a two-dimensional mind map with *mase* paper balls and flashcards about the location of the planets in the solar system. Before giving an example of making a two-dimensional mind mapping, the teacher explains the names of the planets in the solar system according to the order of the closest and farthest distances from the sun. The names of these planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

The teacher gives an example of how to place a planet in its path according to the location of the planet in its orbit, by reading the instructions on the flashcard that has been provided. Students take turns, are asked to make a mind mapping with the help of a gold ball by reading the instructions on the flashcard, then placing the gold ball according to its name on the trajectory of the planets in the solar system. The teacher provides a process assessment to students, in making a two-dimensional mind mapping and the truth is in putting it on the path of the solar system, on the process assessment instrument. Then students report the results of the mind mapping on the worksheet provided by the teacher as at the end of the lesson.

### 3.5. Evaluation
The evaluation stage is the stage carried out based on the results of the implementation of the two-dimensional mind mapping strategy assisted by *mase* paper balls and flashcards in the classroom. The purpose of the evaluation is so that the strategy used becomes a better and optimal strategy. The evaluation is carried out in two stages, namely the assessment process obtained when students make mind mapping and the final assessment with a post test.

The process assessment is carried out by the teacher when students make a two-dimensional mind mapping, the accuracy of the students in placing the planets on their trajectory according to the order of the planets in the solar system. The process assessment aspect includes three indicators, namely the active, creative, and fun indicator aspect. Post-test assessment by working on description questions about the solar system.

### 4. Result and Discussion
From the results of the application of the two-dimensional mind mapping strategy assisted by *mase* paper balls and flashcards about the solar system, in the learning process which includes the process assessment stage and results assessment, the following data can be described:

#### 4.1. Analysis
Analysis is the main activity is to analyze the need for the development of new learning models / methods and to analyze the feasibility and requirements for developing new learning models / methods. The development of new learning methods begins with a problem in the learning model / method that has been applied.
4.2. Design
At this stage the teacher designs the media that will be used to make a two-dimensional mind mapping, namely the mase paper ball as the planets in the solar system, where the gold paper ball has been named according to the name of the planet in the solar system and the path of the solar system made of cardboard as well as a flashcard that contains instructions in determining the location of the planet on its path.

4.3. Development
At this stage, the teacher invites students to make mase paper balls made of wood pulp as planets in the solar system.

4.4. Implementation
The teacher gives an example of how to place a planet in its path according to the location of the planet in its orbit, by reading the instructions on the flashcard that has been provided. Students take turns, are asked to make a mind mapping with the help of a gold ball by reading the instructions on the flashcard, then placing the gold ball according to its name on the trajectory of the planets in the solar system. The teacher provides a process assessment to students, in making a two-dimensional mind mapping and the truth is in putting it on the path of the solar system, on the process assessment instrument. Then students report the results of the mind mapping on the worksheet provided by the teacher as at the end of the lesson.

4.5. Evaluation
The process assessment is carried out by the teacher when students make a two-dimensional mind mapping, the accuracy of the students in placing the planets on their trajectory according to the order of the planets in the solar system. The process assessment aspect includes three indicators, namely the active, creative, and fun indicator aspect. Posttest assessment by working on description questions about the solar system.

At the process assessment stage, the application of a two-dimensional mind mapping strategy assisted by mase paper balls and flashcards on the solar system, the teacher gave an assessment covering three indicator aspects, namely reading flashcards and student activity, accuracy in placing the planet's position on its trajectory, and the results of mind mapping and student interest and sportsmanship during the learning process. Each indicator gets a score of 1-4. This score has the following criteria: 1 = poor, 2 = sufficient, 3 = good, and 4 = very good. The results obtained from the first and second meetings are as follows:

| Table 1. Average Results of Process Assessment indicators Meeting I and meeting II |
|---|---|---|---|---|---|
| No | Indicator     | Meeting I | Meeting II |
|    | Score | Average | Score | Average |
| 1  | Active | 81     | 6,23  | 97     | 7,46   |
| 2  | Creative | 85     | 6,54  | 96     | 7,38   |
| 3  | Great Fun | 91     | 7     | 97     | 7,46   |

Based on table data from meeting I and meeting II, each indicator can be described as follows:

- On the active indicators, reading flashcards and the activeness of students in making two-dimensional mind maps about the solar system obtained a total value of 81 and an average of 6.23 at the first meeting and a total value of 97 with an average of 7.46 at the second meeting.
- In the creative indicators, the accuracy in placing the planet's position on its trajectory and the results of mind mapping obtained a total value of 85 with an average of 6.54 at the first meeting and a total value of 96 with an average of 7.38 at the second meeting.
• On the indicators of fun, interest and sportsmanship of students during the learning process, the total score was 91 with an average of 7 at the first meeting and a total value of 97 with an average of 7.46 at the second meeting.

Seeing the results from the table of aspects of the increase in the average learning outcome at the first meeting and the second meeting there was an increase in percentage of 15% at the first meeting and 20% at the second meeting.

5. Conclusion
With the application of a two-dimensional mind mapping strategy with the help of mase paper balls and flashcards, it can increase the effectiveness of class VI students’ learning about the material of the solar system, where students are able to make mind maps with the help of mase paper balls by reading the instructions on the flashcards, then putting the mase paper balls according to the name and put it on the trajectory of the planets in the solar system and students are able to sort the names of the planets from closest to the sun to farthest from the sun. There is an increase in the effectiveness of student learning about the solar system, this can be seen from the results of the assessment process which includes three aspects of the assessment indicators.

6. References
[1] Sudjana, Nana. 2013. Media Pengajaran. Bandung: Sinar Baru Algesindo.
[2] Nurroeni Chusnul. 2010. Keefektifan Penggunaan Model Mind Mipping terhadap Aktifitas dan Hasil Belajar. Semarang: Universitas Negeri Semarang
[3] Khristiyono, dkk. 2015. Erlangga Straight Point Series IPA untuk SD/MI Kelas VI. Jakarta. Erlangga
[4] Sudjana, Nana. 2005. Penilaian Hasil dan Proses Belajar Mengajar. Bandung: PT Remaja Rosdakarya
[5] Angkowo & Kosasih. 2007. Optimalkan media pembelajaran. Jakarta: Grasindo Rosdakarya
[6] Mudiono. 2010. Pengembangan Bahan pembelajaran Sekolah Dasar. Malang: Fakultas Pendidikan Universitas Negeri Malang
[7] Rohani, Ahmad. 2007. Media Instruksional Edukatif. Jakarta: Rineka Karya
[8] Sadiman. 2011. Media Pendidikan, Pengertian, Pengembangan dan Pemanfaatannya. Jakarta: PT Raja Grafindo Persada.
[9] Mahendra,J. 2016.Model Pengembangan Media Pembelajaran. ADDIE.Retrieved 2018