The analysis of the implementation of the pictorial riddle method in improving the creative thinking skill of fourth grade students in solving of sound propagation problem

D H Agustin\textsuperscript{1,2}, Hobri\textsuperscript{3}, M I Farisi\textsuperscript{4}
\textsuperscript{1} SDN 1 Kotakan, Situbondo, Indonesia.
\textsuperscript{2} Post Graduate Student, Universitas Terbuka, Jember, Indonesia.
\textsuperscript{3} Doctor, Department of Mathematics Education, University of Jember, Indonesia.
\textsuperscript{4} Prof, Director of Universitas Terbuka, Jember, Indonesia.

Email: dwiyanaa73@gmail.com

Abstract: This study aims to produce a learning device pictorial riddle method that is feasible in improving the creative thinking skills of fourth grade students on sound propagation material. This is due to learning devices that are still not able to motivate students to improve creative thinking skills. This type of research uses mixed research which is a combination of quantitative and qualitative methods. The research respondents consisted of two classes, namely the control class of 22 students and the experimental class of 20 students. The instruments of this research are an interview, a questionnaire, observation, and documentation. Quantitative method is applied to analyze the difference of student achievement result among two classes, while the qualitative method is applied to analyze the students’ creative thinking skills. The results show that there are significant differences between the two classes that applied pictorial riddle method and conventional learning. The statistical result indicates that the (2-tailed) significance of the independent sample t-test in the pre-test was 0.000 or $\alpha \leq 0.05$. It implies that the implementation of pictorial riddle method affects the students' creative thinking skill in solving of sound propagation problem.

1. Introduction
Creative thinking is part of reasoning, where creative thinking is one of the stages of higher level thinking. The ability to think creatively is needed to do work and solve existing problems in life in society [1]. Therefore, students must be equipped with good creative thinking skills because in human society they are always faced with problems that require resolution. According to [14] learning thinking skills has several obstacles. One of them is the dominance of the teacher in the learning process and does not provide access for students to develop independently through their discovery and thought processes. So far the learning process experienced by new students to the pursuit of knowledge, has not yet reached the development of thinking skills that lead to the formation of independent students. One of the weaknesses of teachers in teaching is that teachers do not try to get students to think optimally.

So far the learning process experienced by new students to the pursuit of knowledge, has not yet reached the development of thinking skills that lead to the formation of independent students. One of
the weaknesses of teachers in teaching is that teachers do not try to encourage students to think [11]. The statement is in line with what was expressed by [15] that in general science learning tends to be monotonous with scientific activities including low, the most dominant activity for teachers is lecturing or explaining while for students is listening and taking notes. Even though teaching is not only delivering the subject matter but it is training the ability of students to think through the process of self-discovery.

To realize creative student abilities requires a device. Learning tools are a form of preparation done by teachers before they do the learning process [4]. Learning devices are a tangible form of teacher preparation before carrying out learning activities, these learning devices can later be used as teacher guidelines to achieve learning goals. Meanwhile according to [12] learning devices are a set of learning resources arranged in such a way that students and teachers carry out learning activities. Therefore, the existence of a learning device is very necessary because through a learning device the teacher will be easier to carry out learning and students are helped in learning. Learning tools which include lesson plans (lesson plans), student activity sheets (worksheets) and learning achievement tests.

According to Munandar [8] four aspects of creative thinking abilities include fluency, flexibility, originality, and elaboration. Fluency is the ability to generate many ideas, answers, problem solving and questions. Flexibility is the ability to produce ideas that vary from information that has been obtained. Originality is the ability to produce ideas or ideas that are different from before. Elaboration is the ability to develop and add ideas in detail so that it is more interesting.

According to [16], the main objective of learning methods is basically to help develop individual student abilities so that they are able to solve their problems One method developed to improve students' creative thinking skills is the pictorial riddle method. The pictorial riddle method is a method or technique for developing student activities in small and large group discussions, through the presentation of problems presented in the form of illustrations. A riddle is usually a picture, either on a blackboard, a poster board, or projected from a transparency, then the teacher asks questions related to the riddle. The reason researchers in science learning use pictorial riddle is because science cannot be separated from pictures to clarify student understanding so that when teachers give lessons students can immediately capture the material delivered by the teacher. Without pictures students have difficulty accepting lessons or just wishful thinking. This is in accordance with the theory of learning [3] which states that one learning model that can construct students' minds is through pictorial media. With the application of this learning, students are expected to be more active in following the teaching and learning process of Natural Sciences (IPA) and can obtain maximum learning outcomes, so as to increase the understanding of concepts of a material. In accordance with [2] conduct research and get results that the pictorial riddle method can improve students' analytical skills.

The pictorial riddle method is a method used in learning by giving a problem to students to be solved or solved. This is supported by the opinion of [5] pictorial riddle is the provision of scientific information on poster boards or transparency that is used as a center for discussion.

Based on the description above, the problem is formulated, namely: 1) How is the feasibility of the pictorial riddle method of learning the results of the development to improve the creative thinking skills of fourth grade students on sound propagation problem ?; 2) Is there a significant difference between students' creative thinking abilities using the pictorial riddle method of learning tools using conventional models in fourth grade students of sound propagation problem ?; 3) Is the development of the pictorial riddle method of learning devices effective in improving the creative thinking skills of fourth grade students of sound propagation problem ?. The purposes of this study are : 1) Producing a learning tool product pictorial riddle method that is feasible to improve the creative thinking skills of fourth grade students on sound propagation problem; 2) Knowing the significant difference between students' creative thinking abilities using the pictorial riddle method of learning tools using conventional models in fourth grade students of sound propagation problem; 3) Knowing the effectiveness of the development of the pictorial riddle method of learning tools in improving the creative thinking skills of fourth grade students of sound propagation problem?
2. Method

In this study using research and development (R&D) research designs. According to [13] states that, research and development (Research and Development / R&D), is a research method used to develop or validate products used in education and learning. Researchers conduct research and development of learning devices on science subjects with sound propagation problem. The feasibility level of learning resources in the form of learning tools in the form of lesson plans with sound propagation problem is known through validation by experts. Based on the research design, the main purpose of R & D in this study is to develop and validate learning tools that will be used in the classroom.

![Model of Triangulation](image)

**Figure 1.** The model of triangulation of mixed method

There is a dependent variable and two independent variables in this research. The dependent variable is creative thinking skill and the independent variables are teaching learning pictorial riddle method. In brief, we can depict the triangulation model in Figure 1. It can be seen from the figure; we...
started the research by determining the two classes of the 4th grade students of elementary school as an experimental class and a control class. Those consisted of 20 students of the experimental class and 22 students of the control class. Further, we developed a pre-test and we gave to both two classes and analyzed the result for the next steps. We did a sequential mixed method, starting from qualitative, quantitative and ended by qualitative. Since the qualitative results gave the result analysis narratively, we convince the result by statistical inferential.

The experimental design used in the field test was Pretest-posttest control group design. The design of this experiment consists of 2 groups, namely one group for experiments and another for the control group [13]. The experimental group is a group that is given treatment, which will follow the teaching and learning activities based on the pictorial riddle method, while the control group is the group that will follow the teaching and learning activities based on conventional models. Comparison The effectiveness of the two learning models will be seen from the comparison of students' creative thinking abilities through tests and observation sheets. 

### Table 1. Pre- and post-test control group design

| Group           | Pre-Test | Treatment | Post-test |
|-----------------|----------|-----------|-----------|
| A (experimental) | O₁       | X         | O₂        |
| B (control class)| O₃       |           | O₄        |

### 2.1 Population and Sample

This research was conducted at SDN 1 Kotakan and SDN 2 Kotakan Situbondo. The study was conducted from October 2019 to November 2019. The study involved the 4th grade students in SD Negeri 1 Kotakan as an experimental class of 20 students and the 4th grade students of SD Negeri 2 Kotakan as a control class of 22 students.

### 2.2 Instruments

The instruments used in this study were observation, interviews, tests and documentation. Observations were made to obtain information about the learning process in class. Observation was carried out by 2 observers who observed students 'activities in this case the students' creative thinking abilities during the learning process and the implementation of the lesson plans that had been prepared. Interviews were conducted with class IV teachers to find out about the models or methods that had been used in the learning process in class. Interviews were also conducted to students to determine the response after learning using the pictorial riddle method of learning tools. In this study the interviews used were free interviews. The data to be obtained in this study is the learning method used by the teacher in providing learning problems and its response to the application of the pictorial riddle method learning tools and conventional models. The test was conducted to determine the extent to which the students' increased creative thinking abilities before and after learning using the pictorial riddle method by giving pre-test and post-test. Documentation is used to obtain data about fourth grade students as research subjects. The data to be obtained using the documentation method is in the form of a list of names and gender of students, the value of the daily assessment, and the results of photographs of teaching and learning activities.

### 2.3 Tasks

In this study students in the control class and the experimental class were given assignments about sound propagation problems. Inferential statistics use the independent sample t-test to test the difference between the experimental class and the control class by comparing the mean values of the two groups with a significance level of 0.05. To measure the level of high-level thinking skills used tests and observations.
Figure 2. Student worksheet

1. What do you see in Figure A?
2. In Figure A, can a child hear? Why?
3. What happens if the rope is broken? Can they still hear?

Figure B

1. What do you see in Figure B?
2. In Figure B, can the child hear the sound of knocking stones? Why?
3. If it is done in a wider place, for example in a swimming pool, can you still hear the sound of knocking on the stones?

Figure C

1. What do you see in Figure C?
2. In Figure C, can the child hear the sound of lightning? Why?
3. If the child is in a vacuum, can he still hear the sound of lightning? Why?

1. What's the difference between the three pictures?
2. Explain your conclusions based on the three pictures above!
3. Result and discussion

3.1 Result

We provide pre-test and post-test for experimental and control classes. We also apply observations, interviews and documentation with research subjects. Quantitative analysis is applied by using t-test on the results of pre-test and post-test. Qualitative analysis was carried out based on the results of interviews and observation instruments.

3.1.1 The results of the validity and reliability test

Validation of pre-test and post-test questions was carried out by expert and practitioner validators. Based on the results of the validation of the test question sheets, it can be seen the value of CVI is 1, so that it can be categorized very valid.

3.1.2 The distribution of students’ creative thinking skill based on pre-test

Furthermore, we will show the distribution of students’ creative thinking skill of both control and experimental classes based on their pre-test result as follow:

![Figure 3. The distribution of students’ creative thinking skill of the experimental class based on pre-test result](image)

|        | Fluency | Flexibility | Originality | Elaboration |
|--------|---------|-------------|-------------|-------------|
| Poor   | 2       | 3           | 0           | 3           |
| Fair   | 12      | 13          | 9           | 9           |
| Good   | 6       | 4           | 10          | 8           |
| Very Good | 0      | 0           | 1           | 0           |

![Figure 4. The distribution of students’ creative thinking skill of the control class based on pre-test result](image)

|        | Fluency | Flexibility | Originality | Elaboration |
|--------|---------|-------------|-------------|-------------|
| Poor   | 5       | 7           | 2           | 3           |
| Fair   | 10      | 11          | 8           | 10          |
| Good   | 7       | 4           | 11          | 8           |
| Very Good | 0      | 0           | 1           | 1           |
Based on figure 2 and figure 3, it can be seen that both classes have the same variant. The results show creative thinking skill in the experimental class are very good 1%, good 35%, fair 54%, and poor 10% while in the control class the creative thinking skill of students are very good 2%, good 34%, fair 45%, and poor less than 19%. Through this distribution, it can help to interpret students' creative thinking skill in both class.

The next step, we will analyze the homogeneity test and normality test, and finally, we will analyze the mean difference by using the independent sample t-test. Before determining the experimental class and the control class homogeneity tests were done using the daily assessment scores on natural science subjects in fourth grade SDN 1 Kotakan and SDN 2 Kotakan students. Homogeneity test aims to determine whether the daily assessment data in both classes are homogeneous (the same) or heterogeneous (not the same). As for the results of the homogeneity test can be seen in table 2 below.

**Table 2. Homogeneity Test Results**

| Daily Assessment | Levene Statistic | df1 | df2 | Sig.  |
|------------------|------------------|-----|-----|-------|
| Based on Mean    | 1.587            | 1   | 40  | .215  |
| Based on Median  | .311             | 1   | 40  | .580  |
| Based on Median and with adjusted df | .311 | 1 | 31.222 | .581 |
| Based on trimmed mean | 1.416 | 1 | 40 | .241 |

Based on table 4.8 above, it can be seen the significance value (sig.) Based on mean is 0.215 > 0.05 so it can be concluded that the variance of daily assessment data in the experimental class and the control class is the same or homogeneous.

3.1.3 The distribution of students’ creative thinking skill based on posttest

Students' creative thinking skill are measured based on the results of the post-test, that is the answer to the essay question.

**Figure 5.** The distribution of student creative thinking skill in the experimental class based on the post-test result
Based on figure 4 and figure 5, it can be seen that the creative thinking skill in the experimental class are very good 84%, good 5%, quite good 11%, and not good 8% while in the control class the students' speaking skills are very good 14%, good 68%, good enough 18%, and not very good 0%. Through this distribution, it can be seen that the creative thinking skill of the experimental class students are better than the control class.

3.14 Pre-Test and Post-Test Results

Based on table 4.13 above it can be seen that the gain value in the experimental class reaches 0.71 with a high category. As for the gain value in the control class of 0.48 and included in the medium category. Based on data from the pre-test and post-test values in the experimental class and the control class, a normal distribution test was carried out through the Kolmogorov-Smirnov test. Normal distribution test is carried out with the aim to determine the distribution of data to be processed, whether it is a normal distribution or not, so it will determine the statistical technique used. The normality test results can be seen in the following table.

Table 4. Normality Test Results

| Class                  | Statistic            | Kolmogorov-Smirnov | Sig |
|------------------------|----------------------|--------------------|-----|
| Creative thinking skills| Pre-Test Experiment  | .161               | .185|
|                        | Post-Test Experiment | .167               | .145|
|                        | Pre-Test Control     | .142               | .200*|
|                        | Post-Test Control    | .176               | .076|
Based on the above output it can be seen the significance value (sig.) For all data in the Kolmogorov smirnov test > 0.05, so it can be concluded that the research data is normally distributed. Because the data is normally distributed, then the independent sample t test can then be performed.

The results of the independent sample t test can be seen as follows.

**Table 5. T-test Result**

| Class                        | N   | Mean | Std. Deviation | Std. Error Mean |
|------------------------------|-----|------|----------------|-----------------|
| Creative Thinking Skill      |     |      |                |                 |
| Post-Test Eksperimen         | 20  | 81.95| 6.786          | 1.517           |
| Post-Test Kontrol            | 22  | 66.95| 7.859          | 1.675           |

**Table 6. Analysis of Creative thinking skills**

Independent Samples Test

| Levene's Test for Equality of Variances | t-test for Equality of Means | 95% Confidence Interval of the Difference |
|----------------------------------------|------------------------------|----------------------------------------|
|                                        | F          | Sig. | t       | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Creative Thinking Skill                 | Equal variances assumed     | .530 | .471   | 6.587 | .000 | 14.995 | 2.277 | 10.394 | 19.597 |
|                                        | Equal variances not assumed | 6.634 | 39.905 | .000 | 14.995 | 2.260 | 10.427 | 19.564 |

Based on the output above obtained sig. (2-tailed) value of 0.000 <0.05, it can be concluded that there is an average difference in students’ creative thinking abilities between learning using the pictorial riddle method with conventional models. Research Discussion Increased creative thinking skills are obtained by calculating the average observations during the learning process and can be measured from the results of pre-test and post-test. In the experimental class obtained an average at meeting 1 of 79.06 with creative categories and meeting 2 at 93.13 with very creative categories. While the control class obtained an average at meeting 1 of 66.19 with the category of quite creative and meeting 2 of 73.58 with the creative category. Based on students' pre-test and post-test results. The results of pre-test and post-test of students before and after using the pictorial riddle method were analyzed by normalized gain analysis techniques. The gain value in the experimental class reached 0.71 with a high classification and effective category. As for the gain value in the control class of 0.48 with moderate classification and included in the category is quite effective.

### 3.1.5 Students’ Test Results

From the results of the posttest, 3 samples were taken representing speaking skills in the category of very good skill, good skill, and poor skill categories.
3.1.5.1 The Student’s test results with very good categories

I. Fill in the blanks below with the correct answer!
1. Objects that ... always produce ... 
2. Sound propagation can occur through ... solid, liquid, gas
3. Andi’s house is far from the mosque. However, every day Andi can always hear the call to prayer. This can happen because ... There is air
4. Pay attention to the following picture!
   The picture on the side proves that the sound can propagate through ... solid object

5. Sound wave propagation through the air is the most sound propagation ... Easy
6. Pay attention to the following picture!
   To sound the picture beside is by .... beaten

7. Pay attention to the following picture!
   Children can know when to enter the classroom because the teacher sounds ... in a way ... fell, beaten

8. Everything that produces sound is called ... Sound source
9. We can hear other people talking because we have ... ears
10. When speaking, the person speaking is called ... Sound source

II. Answer the following questions briefly and clearly!
11. Mention 3 sound propagation media! solid, liquid, gas
12. Why can we hear someone’s voice even though we are in water? Because the sound can propagate through water
13. What are the benefits of sound properties that can travel through gaseous substances? Can hear other people who are talking
14. Why do we know that a train will come when we put our ears on the rails? Because the sound can propagate through the rails
15. Pay attention to the following picture!

Explain the difference between the two pictures above if related to the sound character!

Figure 1. The sound is loud because it is near.
Figure 2. The sound is doesn’t loud because it is far.

Figure 7. Very good skill student’s test result
3.1.5.2 The Student’s test results with good skill categories

I. Fill in the blanks below with the correct answer!
1. Objects that always produce ... *vibrate*, *sound*  
2. Sound propagation can occur through ... *solid*, *liquid*, *gas*  
3. Andi’s house is far from the mosque. However, every day Andi can always hear the call to prayer. This can happen because ... *there is air*  
4. Pay attention to the following picture!  
   ![Picture](image1.png)  
   The picture on the side proves that the sound can propagate through ... *knock*  
5. Sound wave propagation through the air is the most sound propagation .... *fastest*  
6. Pay attention to the following picture!  
   ![Picture](image2.png)  
   To sound the picture beside is by .... *beat*  
7. Pay attention to the following picture!  
   ![Picture](image3.png)  
   Children can know when to enter the classroom because the teacher sounds ... in a way ... *bell*, *vibrated*  
8. Everything that produces sound is called .... *sound source*  
9. We can hear other people talking because we have ... *ears*  
10. When speaking, the person speaking is called ... *talk*  

II. Answer the following questions briefly and clearly!
11. Mention 3 sound propagation media! *solid*, *liquid*, *gas*  
12. Why can we hear someone’s voice even though we are in water? *because of the loud noise*  
13. What are the benefits of sound properties that can travel through gaseous substances? *can hear the call to prayer*  
14. Why do we know that a train will come when we put our ears on the rails? *because there is vibration*  
15. Pay attention to the following picture!  
   ![Picture](image4.png)  
   Explain the difference between the two pictures above if related to the sound character!
   *Figure 1. The Sound loud —— ?  
   Figure 2. The Sound weak —— ?*

*Figure 8. Good skill student’s test result*
3.1.5.3 The Student’s test results with poor skill categories

1. Fill in the blanks below with the correct answer!
   1. Objects that ... always produce ... 𝑉 𝑉 𝑉 𝑉 𝑉 𝑉 𝑉 ...
   2. Sound propagation can occur through ...

   3. Andi's house is far from the mosque. However, every day Andi can always hear the call to
   prayer. This can happen because ...

   4. Pay attention to the following picture!

   The picture on the side proves that the sound can propagate through ...

   5. Sound wave propagation through the air is the most sound propagation ...

   6. Pay attention to the following picture!

   To sound the picture beside is by ...

   7. Pay attention to the following picture!

   Children can know when to enter the classroom because the
   teacher sounds ... in a way ...

   8. Everything that produces sound is called ...

   9. We can hear other people talking because we have ...

   10. When speaking, the person speaking is called ...

II. Answer the following questions briefly and clearly!

11. Mention 3 sound propagation media!

12. Why can we hear someone's voice even though we are in water?

13. What are the benefits of sound properties that can travel through gaseous substances?

14. Why do we know that a train will come when we put our ears on the rails?

15. Pay attention to the following picture!

   Explain the difference between the two pictures above if related to the sound character!


Figure 9. Poor skill student’s test result
3.2 Discussion

The pictorial riddle method is a series of learning activities that maximally involve students' ability to search and investigate systematically, and critically using pictures or demonstrations so that they can formulate their own findings so as to enhance students' creative thinking skills in conducting investigations and problem solving [7]. So, it can be said that the pictorial riddle method is a learning process that uses picture puzzles with questions related to images for students' creative thinking abilities in small and large group discussions.

Creative thinking can formulate a new idea that is increasingly perfecting something that already exists and creating a completely new way. Creative thinking is considered as a dynamic mental process, including convergent thinking (one solution) and divergent thinking (many solutions) [9]. Another opinion states that creative thinking skills are considered as the basis of learning that development can be done by working with mathematics and being a problem solver [10]. While the understanding of mathematical creative thinking according to [6] is a person's ability to solve mathematical problems by finding different and varied solutions by looking at the quality of the solution. So it can be concluded, mathematical creative thinking is directed thinking to create a new thing by developing all the possibilities that are relevant in the field of mathematics.

The results showed learning outcomes in the pre-test of creative thinking skill in the experimental class are very good 1%, good 35%, fair 54%, and poor 10% while in the control class the creative thinking skill of students are very good 2%, good 34%, fair 45%, and poor less than 19%. The results showed learning outcomes in the post-test of creative thinking skill in the experimental class are very good 84%, good 5%, quite good 11%, and not good 8% while in the control class the students' speaking skills are very good 14%, good 68%, good enough 18%, and not very good 0%. Through this distribution, it can be seen that the creative thinking skill of the experimental class students are better than the control class.

The results showed that the application of the pictorial riddle method could improve students' creative thinking abilities. This is in accordance with the theory of learning [3] which states that one of the learning models that can be students can be more active in following the teaching and learning process of Natural Sciences (IPA) and can obtain maximum learning outcomes, so as to improve understanding of the concept of a problem. This is also in accordance with the results of research conducted by [2] namely the pictorial riddle method can improve students' analytical skills one of them is the ability to think creatively.

Therefore, it can be concluded that the development of the pictorial riddle method of learning devices is effective in improving the creative thinking ability of fourth grade students of sound propagation problem.

4. Conclusion

In accordance with the hypothesis testing, research findings are: 1) A sound propagation learning tool in the form of RPP, LKPD and appraisal instrument based on Pictorial Riddle method is appropriate to improve the creative thinking ability of fourth grade students with SBI average scores for RPP, and LKPD of 62 and 43 with very good categories; 2) There is a significant difference between students' creative thinking skill using pictorial riddle learning tools using conventional models in fourth grade students of sound propagation problem with a value of sig. (2-tailed) of 0.000 <0.05; 3) The development of the pictorial riddle method of learning tools effectively increases the creative thinking skill of fourth grade students with sound propagation problem with a gain value of 0.71 with a high classification and effective category.

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