Sainsmatika Fairy Book_Connecting Open-Ended Problems to Fairy Stories

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Sainsmatika Fairy Book: Connecting Open-Ended Problems to Fairy Stories As a Tool to Develop Students' Mathematical Creativity

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Abstract. Stimulating mathematical creativity is very important for students'cognitive development. Unfortunately, conventional classroom approaches to stimulate students' mathematical creativity have not been satisfactorily effective. However, a prospective approach to stimulate mathematical creativity can be applied through a teaching tool that integrates open-ended problems with interesting things, such as engaging students in the atmosphere of reading fairy stories. In this study, the *sainsmatika* fairy tale book (SFB) was used as a science and mathematics teaching material to improve student mathematical creativity. A pretest-posttest control-group experimental design was used to investigate the effectiveness of SFB to develop fourth-grade students' mathematical creativity. The participants consisted of eighty fourth-grade students in one of the districts in Indonesia. Characteristically, this study employed quantitative data that were collected from observing students' activities. Based on the one-way ANOVA statpistical analysis, it was found that the comparison of mathematical creativity scores between $\mu 1$ and $\mu 2 = 0.961 > 0.05$, $\mu 2$ and $\mu 3 = 0.011 < 0.05$, and $\mu 1$ and $\mu 3 = 0.024 < 0.05$. Therefore, it can be concluded that the use of SFB is significantly effective to enhance students' mathematical creativity.

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Introduction

Many disagreements exist among primary educators regarding how primary school students typically solve open-ended problems. The disagreements revolve around the facts that students need to compete globally (Lesh et al, 2008) and teachers' limited capabilities may be one of the missing links. Creative thinking is considered to be the essence of mathematics (Mann, 2006). Mathematical creativity ensures the growth of the field of mathematics as a whole (Sriraman, 2004). Today, approaches to mathematics teaching need to divert from traditional perspectives (Lesh & Yoon, 2004). Teachers are required to not only focus on low-level mathematical problems (Chamberlin, 2005) but also facilitate students to solve the problems creatively. Drilling and explaining mathematical procedures are known to be the most conventional approaches to teach mathematics. For some specific purposes, these approaches are able to enhance students' comprehention but not effective to improve their creativity. Teachers need to create a new learning environment for students where they can effectively apply what they have learned to deal with real-life mathematical problems using higher-order thinking such as critical thinking and problem solving (Eric, 2008). Mathematical creativity is considered to be an important thing that refers to "one of the

greatest assets of a nation". In relation to the development of a nation, creativity must be fostered in order to develop and improve the productivity of its human resources. Therefore, teachers need to acknowledge the importance of creative thinking to learning processes. However, the implementation of learning and evaluation of creative thinking requires planning that will not be easy for teachers. In Indonesia, creative thinking is commonly excluded in mathematics teaching. Most of Indonesian teachersstill consider creativity as a part of art and language, not a part of mathematics. Consequently, this incorrect perception leads to a concerning fact that mathematical creativity is not developed in almost all levels of education, especially in primary schools.

Literature Review

Mathematical Creativity Indicator

Creative thinking refers to the abilities to produce original ideas or answers (Ching & Darussalam, 1997), and to perceive new and unsuspected relationships or unrelated factors (William, 2002). In other words, creativity is the ability to find new ways to design unusual solutions. Mumford (Duff et al, 2013) noted that, regarding creative performance, identifying and defining problems are important. Guilford and Hoepfner (Cropley, 2001) stated that creative people are sensitive to problems, and they can define problems in detail if compared to those who are not. Although Runco (Mumford, 2003) confirmed that creativity is very helpful for solving problems, he believed that creativity has other purposes as well. Lemon (Guilford & Hoepner 1997) also noted that creativity is a multifaceted trait. Several researchers report that recognizing, finding and being aware of problems are predominant traits of creativity (Runco, 2007).

Divergent thinking is considered as a critical component of creative thinking. When someone is able to show numerous responses to open-ended problems or questions, it is likely that he makes creative responses (Piaw, 2010). Torrance (Lemon, 2011) mentioned that fluency (the number of responses), flexibility (diversity of response categories), and originality (uniqueness of response) are widely used in a number of studies to represent a person with divergent (creative) thinking ability. Guilford (Yee, 2002) theorized that divergent thinking is a part of creativity, in which the process is very contrarily different from conventional ideas or answers, and from conventional convergent thinking that only focus on one answer. Divergent thinking is more diverse, with different viewpoints of possible ideas to come up with. Divergent thinking is often known by encouraging students to produce a number of ideas (responses) through specific stimuli (Cropley, 2001). For example, a student are given a piece of paper filled with circles, then he is asked to create a number of images from the circles. Originality and the number of responses given are used as a basis for assessing one's creativity.

Guilford (1967) also explained that creativity is not only supported by divergent thinking skills, but also by the ability to change things and adjust the sensitivity to problems. Furthermore, Guilford formed a basic assumption that creativity consists of three types of problem solving: (a) sensitivity to problems or ability to identify problems, (b) fluency, which is the ability to generate different ideas, develop or organize words into a phrase or a paragraph, or to write down a number of words relevant to a proposed word, (c) flexibility,

which is the ability to produce an original and unique response. Lubart (Kail & Cavanaugh, 2016) asserted that solving a problem can encourage creativity if there is a problematic situation, and then the process of generating a solution can actually occur.

Torrance (Guilford, 1967) has developed a general instrument of creativity measurement called TCTT, which measures individual creativity in terms of fluency, flexibility, originality and elaboration (a careful description of an object / event). However, TCTT is used to measure creativity in general. Boesen (Sternberg et al, 1999) explained that the indicators of creative thinking can be seen from 4 (four) aspects including uniqueness, flexibility, plausibility, and basic mathematics (knowledge).The ability of mathematical creative thinking or mathematical creativity refers to the ability to produce a wide variety of responses appropriately (Torrance, 1976) . In this case, flexibility is an important factor in the process of mathematical creative thinking. Mathematical creativity includes the ability to generate new knowledge and problem solving flexibly (Huang et al, 2017). Artz and Armour-Thomas (1992) developed a cognitive-metacognitive framework that identified 6 (six) categories in problem solving, including i) reading, ii) analyzing, iii) investigating, iv) planning/implementing, and v) truth testing. In a different perspective, Mayer (1985) gave the idea of problem-solving components in mathematics that include i) translating, ii) integrating, iii) plotting solutions, and iv) executing. The mathematical process can be attributed to science that some scholars (Harlen, 2007), describe as the relationship between science and mathematics, presenting mathematics as the 'grammar' for science. A number of literatures also indicate that divergent thinking skills play significant roles in mathematical thinking skills. In problem-solving activities, redefining or solving problems (Haylock, 1997) include all activities where students are able to think divergently to solve mathematical problems (Huang et al, 2007). Most mathematical creativity measurements include measurements of divergent thinking like Make-Up Problem Test (Haylock, 1997) Creative Ability in Mathematics Test (Sriraman, 2004), and Divergent Production in Mathematics (Becker & Shimada, 1997). In this study, the mathematical creativity is refers to the ability to create useful and original solutions to open-ended problems.Here, ‘create’ refers to flexibility, originality and fluency.

Open-Ended Problem

Current teaching practice have been speculated over the past several decades are lack to produce creative minds in mathematics (Sawyer et al, 2006). This perspective may have connection to general teacher perspective towards creativity. Teacher are generally believe that creative restricted to art and giftedness, doesn’t need basic knowledge, and appraised as great discovery. Teacher should realize that creativity is exist on every subject. Creative thinking may developed through stimulation play and discovery.

Teachers usually found difficulty in constructing the open-ended problem and many of them were apprehensive about giving their pupils such problem. The reason is student doesn’t adapted to do open-ended problem. In general, an open-ended problem is a problem which contain numerous answer. Open-ended problem is a problem open to many different solutions (Kwon et al 2006). Different with close-ended problem, open-ended problem allow the possibility of divergent thinking. It is also enable students to use high dimension of thinking skills by engaging various methods (Munandar, 1997) and responses. The

advantages of using open-ended problem are: 1) student actively engaging in class activity and independently express their idea; 2) student have opportunity to explore their mathematical knowledge; 3) student can answer the problem in their own ways; 4) student sense a rational experience; and 5) student offered the chance to feel the fulfillment of discovery (Sawyer et al, 2006). Furthermore, open-ended problem offers student a chance to feel real mathematic situation. In this paper, the open-ended problem will be integrated to fairy stories.

Integrating Open-ended Problem and Fairy Stories

The main tale is a work of fiction that interested elementary school children, in addition to comics, pictorial stories and novel children. The tale has a distinctive prologue 'In ancient times'. Fairy storys always contain a positive message that students can capture as readers. In addition through the fairy storys students can independently discover the essence of friendly characters through the characters in the fairy story and the storyline in it. Not a few fairy storys that tell a friendship that can easily affect students' perceptions in peer relationships.

In relation to the imagination that is always offered in the fairy story, Kwon et al (2006) reveals that fictional reading not only offers entertainment but also improves the ability to think creatively by inviting students as readers to imagine. Thus, fairy storys not only serve role model to think creatively by the figure behavior in the story but also challenging student to practice the task in joyful way. Munandar (1997) asserted that the development of creativity should seep into the curriculum. Its meaning, attention to how creativity and mathematical creativity can be linked to all activities within the class needs to be improved. The ability to think creatively becomes a facilitated ability in several subjects, two of which are science and math. Both have common content that contains facts and assignments that require troubleshooting. By bringing math problems into fairy storys, students as readers are directed to solve the divergent science and mathematical problems sublimated into the storyline in fairy storys. By combining materials, learning activity guidance, and evaluation guidance in one teaching material is expected to fulfill the school's need to develop student creative thinking ability.

Material & Methodology

In this study, the student groups' examined to respond some open-ended problem which presented during 3 week instructions. The final result for this study is investigating the use of Sainsmatika Fairytale Book as a tool to enhance student creativity, so that the design of this study is pre-test post-test control group design. Before and after learningprocess, students responses a test were scored on 3-point scale (scoring guidance was shown in table 3). The population involved in this research consists of 78 fourth-grade students in one of the regencies in Indonesia. These research subjects are 37 male students and 43 female students who live in a homogenous area, which is a highland area not far from the city center. The respondents were selected through a purposive sampling technique, where only fourth-grade students of elementary schools which are appointed to undertake pilot projects of the national curriculum of Indonesia were involved.

Three indicator of mathematical creativity were selected and adapted for open-ended problem (Table 1). The indicator such as fluency, flexibility and originality are adapted to the

fairy stories problem. The problem was develop based on area and perimeter substance. The first problem, given to improve student fluency in connecting concept comprehention and real situation. The second and third problem, was given to develop originality in desgin project. Some student will be faces difficulty if don't accustomed to independently share their idea. The fourth problem, was given to develop fluency in problem solving. The description of integration aspect of mathematical creativity problem and fairy stories is shown in table 1.

Table 1. Open-ended Problem X Fairy Stories.

Fairy Stories Problem	Objectives	Mathematics
The magical door in the gave only want to open if Atta could mention as much as thing which have area and perimeter	Mention as much as thing which have area and perimeter or usually looked for area and perimeter.	Fluency of connecting concept comprehension and real situation.
Guiliram (a dreadful monster) give a challenge for Atta to arrange his castle	Create a home plans in plot paper based on area and perimeter measurement.	Originality of making design.
Atta could grab hold of Purple Dragon by entrap it to the box	Imagine how long the area and perimeter of trap box, create the trap box that possible to entrap Purple Dragon (length: 10 meter and wide include the wings: 15 meter).	Originality of making design.
Peri Hutan had a challenge to measuring fort (multiple shape)	Find the possible way to measure area and perimeter of multiple shape.	Flexibility to measuring area and perimeter.

Design and Procedure

The use of Sainsmatika Fairy Book (SFB) to develop mathematical creativity is an alternative to subtitute conventional approach. In this study, researchers using a quantitative design to investigate the use of (SFB) as a tool to develop students' mathematical creativity. An approach to connect open-ended problem and fairy stories, which student engage in authentic mathematical problem under fairy stories atmosphere. The implementation of SFB series in classroom is about 3 weeks. This study limited to area and perimeter substance in fourth grade. Researchers asessing student mathematical creativity using open-ended question of Thomas F. Sweeney (2013) paradigm. During the 3 week study, 78 participants engaged in instruction which using SFB as teaching tool. Student were randomly split into groups and learn to intermingle with everyone in classroom. Student reading the opening page of SFB together. In the middle of the reading activity, teacher give opportunity to student reading aloud the SFB in front of classroom. After a pure atmosphere, then student offered opportunity to answer the challenge they found in SFB. The control group engaged with the conventional method. Teacher explain and demonstrate the principal theory of area and perimeter. In elaboration, student discuss to solve a problem which given by teacher. At the end of instruction, student take a daily test to assess their comprehention. Students'

mathematical creativity level assessing based on their answer to the question during the pre and post test. The answer is scored based on this score guidance.

Table 2. Scoring guidance

Aspect	Score		
	1	2	3
Fluency	Student response in one number answer	Student response in two number answer	Student response in more than two number answer
Flexibility	If the response is false but the approach is right	Student response using only one approach	Student response using more than one approach
Originality	The similarity level of respons with another student > 50%	The similarity level of respons with another student < 50%	The respons is totally different with common respons

The collected quantitative data were then analyzed using a descriptive and one way ANOVA statistics method with the error rate at 5%. It is to determine if the use of *sainsmatika* fairytale books significantly affects students' mathematical creativity.

Result

Descriptively, the data of the results of the assessment of creative thinking are described in several ways, namely fluency, flexibility and originality. Creative thinking ability of mathematics was assessed in control and experiment class. The result of student creative thinking ability of mathematics is shown in table 3.

Table 3. Score average in control and experimental class.

Aspect	Fluency		Flexibility		Originality	
	Pre test	Post test	Pre test	Post test	Pre test	Post test
Control class	1,92	2,69	1,46	2,42	1,38	2,23
Experimental class I	1,53	3,23	1,58	2,76	1,29	2,65
Experimental class II	1,92	3,23	1,46	2,88	1,38	2,42

Based on table 3, it can be seen that the result of pretest in all aspects of both control class and experimental class I and II, no one reached score 2 (enough category). While in the post test results, the distribution of heterogeneous values, where the average range range is 2.23 to 3.23. The distribution of these values indicates a tendency to improve students' mathematical creative thinking ability on the aspect of fluency, flexibility and originality.

The improvement off mathematical creative thinking ability of the control class on the aspect of fluency, flexibility and originality, showing symptoms increase almost the same score, ie 1 point. While in the experimental class I, a considerable increase occurred in the aspect of fluency. Where the average score of 1.53 increased to 3.23. Similarly, in the

experimental class 2, where the increase in scores on aspects of fluency is higher than the aspect of flexibility and originality.

Table 4. ANOVA output for student mathematical creativity

Fairy Stories Problem	df	SS	MS	F	Sig.
Between groups	2	349,65	174.82	5.55	.006
Within groups	75	2410.29	32.14		
Total	77	2759.94			

[a] Ho: μ1 = μ2 = μ3 = 0
[b] Ha: there must be μ with different values at a minimum of one pair

In table 4, it can be seen that F score of between group is 5.55, because of 5.55> 2.72 then Ho is rejected, so by using level of significance 0,05 hence can be concluded that there is difference of mean result learn from method A, method B, and method C. Based on p-value the probability is 0.006<0.05 then Ho is rejected and Ha is accepted. It means that there is a mean difference of mathematical creativity score between the three group.

Table 5. The Post Hoc Test Based In The Results of Mathematical Creativity Test

	(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Experimental Class 1	Experimental Class2	-.425	1.588	.961	-4.22	3.37
		Control Class	4.219*	1.573	.024	.46	7.98
	Experimental Class2	Experimental Class1	.425	1.588	.961	-3.37	4.22
		Control Class	4.644*	1.558	.011	.92	8.37
	Control Class	Experimental Class1	-4.219*	1.573	.024	-7.98	-.46
		Experimental Class2	-4.644*	1.558	.011	-8.37	-.92
Bonferroni	Experimental Class1	Experimental Class2	-.425	1.588	1.000	-4.31	3.46
		Control Class	4.219*	1.573	.027	.37	8.07
	Experimental Class2	Experimental Class1	.425	1.588	1.000	-3.46	4.31
		Kelas Kontrol	4.644*	1.558	.012	.83	8.46
	Control Class	Experimental Class1	-4.219*	1.573	.027	-8.07	-.37
		Experimental Class2	-4.644*	1.558	.012	-8.46	-.83

*. The mean difference is significant at the 0.05 level.
[a] Ho: μ1 = μ2 = μ3 = 0
[b] Ha: there must be μ with different values at a minimum of one pair
[c] The mean difference is significant at the 0.05 level.

In table 5, it can be seen the comparison of mathematical creativity scores between experimental class 1 and 2 that μ1 and μ2 = 0.961 > 0.05. This indicates that there is no mean difference between experimental class 1 andexperimental class 2. However, when experimental class 2 is paired with control class, it is found that μ2 and μ3 = 0.011 < 0.05. This indicates that there is significant mean difference between experimental class 2 and control class. In the same way, when experimental class 1 is paired with control class, it is

found that$\mu 1$ and $\mu 3 = 0.024 < 0.05$.This indicates that there is significant mean difference between experimental class 1 and control class. From these results, it can thus be concluded that there is significant difference regarding mathematical creativity between experimental classes (1 & 2) and control class.

Conclusion

Through Open-ended Problem in Fairy Stories, Students' Problem Sensitivity is Stimulated

Fairy story as part of children's literature does not only bring entertainment, but it also allows character values which are believed by the society as the truth to be passed down from generation to generation. Even by people in the past, a fairy story is considered to be the only way to teach readers especially children about important values in life.Indeed, a fairy story exists through its mission to deliver creative thinking.It sets examples which provide guidance on how one should behave and live his life, and the messages it contains are usually implied or expressed through pictures or persuasive plots. A fairy story gives children the chances to practice self-reflection, encouraging them to feel as if they are parts of the story so they are emotionally engaged to take good examples from their experiences through the fairy story. As a literary work, a fairy story is a tool which can effectively teach students about mathematical creativity aspect, by integrating the story with open-ended problem which challenging student to answer.

In addition, Carvalho-Neto (1972) says that the usefulness of a fairy story can be manifested in teaching materials, and it can also be effective as a source of solace, a projection of pent-up desire, and criticism. At the age of 7-11 years old, children are able to construct and identify specific conceptions. In this range of age, children love reading fictional stories which tell about adventures, so they can use their imagination to feel as if they experience the adventures. During the concrete operational stage, children will develop the ability to perceive their surroundings with different points of view. In this stage their logical thinking will improve, and therefore they need to read books which can connect them to different points of view, provide facts and deeper information, and challenge them to solve problems, mysteries or riddles. Therefore, a fairy story that connect to open-ended problem can be used as a tool to teach children creative thinking, specifically in the scope of mathematical creativity.

People with creative ability is usually show problem sensitivity in they environment, so that problem sensitivity is usually attributed with creative traits. By integrating open-ended problem with fairy stories, students' problem sensitivity and various view to response a problem can stimulate simultaneously. For example, after read a paragraph of story with open-ended problem, students will stimulated to sense the problem in a plot of story, make a problem framework and develop various perspectives to solving the problem. This conclusion is supported by Huang, that proposes a combination of prerequisites that need to be addressed in teaching creative thinking approaches in the classroom, including learning prerequisites (collaboration between students, games and hands-on experience) and creativity prerequisites (provoking ideas, curiosity, and wonder). The prerequisites ultimately lead to a conclusion that incorporating creative thinking concepts in learning can be done with fun and interesting approaches for students, such as using unique materials to spur curiosity, spurring ideas with

meaningful game approaches, and maximizing dialogue between teachers and students to share ideas, which is can stimulate using open-ended problem in a fairy story.

The Integration of Open-ended Problem and Fairy Stories Improve Students' Mathematical Creativity

Sainsmatika fairy book, characteristically provide mathematical knowledge, divergent thinking process and atmosphere that challenging students to thinking creative on mathematical problem. This characteristic is have similarity with sixth outline number outlines a number of steps that can be taken to develop creative thinking skills in learning situations which proposed by Hadzigeorgiou (2012). First, creativity requires a knowledge base. Knowledge is a prerequisite in the process of thinking and also the pre-requisite in the process of creative thinking. thus, students need to master the science materials as well as possible. Second, creativity in mathematics learning is a divergent / imaginative thinking process, the process requires a comfortable and criticized classroom situation. In other words to cultivate the ability to think creatively, all ideas need to be heard without being derided even as oddly as any idea that erupted. Third, ideas and visualizations are placed within the center of the curriculum and learning. Fourth, the idea of 'amazing experience' and 'feeling of wonder' needs to be applied. An amazing and wondering experience can increase engagement and inspiration in the minds of students (Hazigeorgiou et al, 2012). Fifth, presenting the problems in the future or imagining possible in the future is a strategy that can be included in the learning. Sixth, the social environment in society is the most important part of developing a child's creative thinking ability. Environment is another factor that supports the creation of a person's creative thinking ability.Robinson (2001) explains that creative in general can be developed through many factors, two of which are environmental and challenges presented.

The most important benefit of facing open-ended problem is students allow to find more than one response. All student is allow to share every idea and answer without fear. The most important thing is opportunity to think divergent or think of various possibilities, that sometimes reveal surprising mental model. It's opposite each other with closed-ended problem, which limits students to answer only the things teacher believe to be true. Open-ended problem prompt students to response with sentences, lists, and stories, the implication is open-ended problem give deeper and new insight to students. Students who learning through open-ended problem is stimulated to produce original work, and syntheses own knowledge and dealing with the ability to solve unusual problem using various perspective.

Referring to a number of theories and the research result that have been described in the previous section, it can be synthesized that open-ended problem and fairy story have a common characteristic, that is, stimulate the ability of deductive thinking in solving problems. Mathematics is described as a study of patterns and relationships of ways of thinking by synthesizing to solve abstract and practical problems. An open-ended problem requires the way of organizational thinking, analysis and synthesis, by response with various response. For example, when student facing the problem to design a house, students will past some step such as imagine the design, what shape of the house, what size of it, and how to explain it, so another people will understand the design. This process involving analysis phase and effort to produce originality product simultaneously.

Integrating open-ended problem in a fairy story can provides a way of understanding the situational problem, answering the question flexibly, and more emphasis on the various viewpoint, logic, and explanation that all problem can be solving using various way in joyful atmosphere. Creative thinking can grow and be stimulated well through the approach of thinking synthesis. Every basic question in mathematics requires deep analysis and synthesis, so issues relating to mathematics have the potential to stimulate students' thinking ability.

Study Limitation

This study is an effort to identify the effectiveness of sainsmatika fairy book (SFB) which connecting open-ended problem with fairy stories to improve mathematical creativity. Unfortunately, the implementation of this study is limited to only a few areas and limited to fourth grade student. The next study is expected to develop an identification of the effectiveness of this approach across a broader and more diverse level classroom, so the findings of the research are getting stronger and can be utilized in a wider scope.

References

Artz, A. F., & Armour-Thomas, E. (1992). Development of a cognitive-metacognitive framework for protocol analysis of mathematical problem solving in small groups. *Cognition and instruction*, *9*(2), 137-175.

Becker, J. P., & Shimada, S. (1997). *The Open-Ended Approach: A New Proposal for Teaching Mathematics*. National Council of Teachers of Mathematics, 1906 Association Drive, Reston, VA 20191-1593.

Chamberlin, M. T. (2005). Teachers' discussions of students' thinking: Meeting the challenge of attending to sudents' thinking. *Journal of Mathematics Teacher Education*, 8, 141-170.

Ching, T.P., & Darussalam, B. (1997). An experimeny to discover mathematical talet in primary school in Kampong air. *International Reviews of Mathematical Education*, 23, 94-96.

Cropley, A. (2001). *Creativity in education-learning*. London: Kogan Page.

de Carvalho Neto, P. (1972). Folklore and Psychoanalysis. Jacques MP Wilson. *Trans. Coral Gables, FL: University of Miami Press.*

Duff, M. C., Kurczek, J., Rubin, R., Cohen, N. J., & Tranel, D. (2013). Hippocampal amnesia disrupts creative thinking. *Hippocampus*, *23*(12), 1143-1149.

Eric, C. C. M. (2008). Using model-elicting activities for primary mathematics classrooms. *Mathematics Educator*, 11, 47-66.

Hadzigeorgiou, Y., Fokialis, P., & Kabouropoulou, M. (2012). Thinking about creativity in science education. *Creative Education*, *3*(05), 603.

Guilford, J. P. & Hoepfner, R. (1997). *The analysis of intelligence*. New York: McGraw-Hill Book Company.

Huang, P. S., Peng, S. L., Chen, H. C., Tseng, L. C., & Hsu, L. C. (2017). The relative influences of domain knowledge and domain-general divergent thinking on scientific creativity and mathematical creativity. *Thinking Skills and Creativity*, *25*, 1-9.https://doi.org/10.1016/j.tsc.2017.06.001.

Harlen, W. Education for Teaching Science and Mathematics in the Primary School. *Science and Technology Education Document Series*, 46.

Haylock, D. (1997). Recognising mathematical creativity in schoolchildren. *ZDM*, *29*(3), 68-74.

Huang, P. S., Peng, S. L., Chen, H. C., Tseng, L. C., & Hsu, L. C. (2007). The relative influences of domain knowledge and domain-general divergent thinking on scientific creativity and mathematical creativity. *Thinking Skills and Creativity*, *25*, 1-9.https://doi.org/10.1016/j.tsc.2017.06.001.

Kail, R. V., & Cavanaugh, J. C. (2016). *Essentials of human development: A life-span view*. Cengage Learning.

Kwon, O. N., Park, J. H., & Park, J. S. (2006). Cultivating divergent thinking in mathematics through an open-ended approach. *Asia Pacific Education Review*, *7*(1), 51-61.

Lemon, G. (2011). Diverse perspectives of creativity testing: Controversial issues when used for inclusion into gifted programs. *Journal for the Education of the Gifted*. 34(5), 742-772. Doi:10.1177/0162353211417221.

Lesh, R., Middleton, J.A., Caylor, E., & Gupta, S. A. (2008). Science need: Designing tasks to engage students in modelung complex data. *Educational Studies in Mathematics*, 68, 113-130.

Lesh, R., & Yoon, C. (2004). Evolving comunities of mind: In which development involves several interacting simultaneously developing strands. *Mathematical Thinking and Learning*, 6, 2015-226.

Mann, E. L. (2006). Creativity: The essence of mathematics. Jou*rnal for the Education of the Gifted*, 30(20), 236-262.

Mayer, R. E. (1985). Implications of cognitive psychology for instruction in mathematical problem solving. *Teaching and learning mathematical problem solving: Multiple research perspectives*, 123-138.

Mumford, M. D. (2003). Where have we been, where are we going? Taking stock in creativity Research. *Creativity Research Journal*. 15(2&3), 107-120. doi:10.1080/10400419.2003.9651403.

Munandar, U. (1997). Mengembangkan Bakat dan Kreativitas Anak. Jakarta: Gramedia, 1997.

Piaw, C.Y. (2010). Building a test to assess creative and critical thinking simultaneously. *Procedia-Social and Behavioral Sciences*. 2(2), 551-559. Doi:10.1016/j.sbspro.2010.03.062.

Renzulli, J. S., Owen, S. V., & Callahan, C. M. (1974). Fluency, flexibility, and originality as a function of group size. *The Journal of Creative Behavior*, *8*(2), 107-113.

Robinson, K. (2001). *All our futures: Creativity, culture and education*. Sudbury: DfEE.

Runco, M. A. (2007). *Creativity theories and themes: Research, development and practice*. Elsevier Amsterdam; Boston, Academic Press. Online resource: Retrieved January 17, 2014 from http://sciencedirect.com/science/book/9780126024005 .

Sawyer, R. K., et al. (2006). *Creativity and development*. Counterpoints: Cognition, Memo.

Sriraman, B. (2004). Characteristics of mathematical creativity. *Mathematics Educator*, *14*(1), 19-34 (2004).

Sternberg, R. J., & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms. *Handbook of creativity*, *1*, 3-15.

Torrance, E. P. (1976). Creativity testing in education. *Creative Child & Adult Quarterly*.

William, G. (2002). Identifying problem s that promote creative thinking in mathematics: A tool. *Paper accepted as a research report for the Mathematical Education Research Group of A Austrasia Conference in Auckland*, New Zealand.

Yee, F. P. (2002). *Using short open-ended mathematics questions to promote thinking amd understanding.*

Sainsmatika Fairy Book_Connecting Open-Ended Problems to Fairy Stories

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