International Journal of Research and Review
Vol. 10; Issue: 2; February 2023
Website: www.ijrrjournal.com
Research Paper *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Characteristics of Creative Mathematics Teachers in Posing Contextual Mathematics Problems

Suryo Widodo[1], Yuni Katminingsih[2], Bambang Agus Sulistyono[3], Nurwiani[4], Aprilia Dwi Handayani[5]

[1,2,3,5]Department of Mathematics Education, Nusantara PGRI University of Kediri, Indonesia
[4]Department of Mathematics Education, STKIP-PGRI of Jombang, Indonesia

Corresponding Author: Suryo Widodo

DOI: https://doi.org/10.52403/ijrr.20230208

ABSTRACT

Both teachers and students have carried out various studies on creativity. In general, creativity research is associated with solving mathematical problems. In this research, we want to reveal the characteristics of the creative mathematics teacher subject as another finding in uncovering the stages of the teacher's creative thinking. The results of this study found that creative teachers can observe, ask questions, reason, make analogies and try.

Keywords: [observing, asking, reasoning, analogizing, and trying]

INTRODUCTION

The 2013 curriculum requires a change in the teacher's mindset in learning, including learning to use a scientific approach through observing, asking, trying, reasoning, and building networks. Learning uses science as a driving force for learning all subjects. Learning leads students to discover, not to be told (discovery learning). Learning emphasizes language skills as a means of communication, a carrier of knowledge, and thinking logically, systematically, and creatively. Assessment measures the level of students' thinking from low to high. Assessment emphasizes questions that require deep thought [not just memorization]; it measures the work process of students, not just the results of student work. The assessment uses student learning portfolios. The teacher directs students to behave creatively, including giving assignments that do not only have one correct answer; tolerating idiosyncratic answers; emphasizing process, not just results; encouraging students to try, determine for themselves what is unclear/complete information, have their interpretation of knowledge/events, provide a balance between structured and spontaneous/ expressive activities.

Dyers J.H. et al. (2011) said that 2/3 of a person's creative ability is obtained through education, and the remaining 1/3 comes from genetics. On the other hand, for intelligence abilities, it applies that 1/3 of intelligence abilities are obtained from education and the remaining 2/3 from genetics. This means that we can only do a little to increase someone's intelligence, but we have many opportunities to increase someone's creativity. Furthermore, in his research Dyers (2011) found that intelligence-based learning will provide little results (only a 50% increase) compared to creativity-based learning (up to 200%). These findings provide many opportunities for teachers to increase student creativity. To make creative, students needed a creative teacher. Creative teachers are needed and urgent to be fulfilled. Ratnawati (2022) says that creative teachers can be innovative, active and creative in teaching students. Many studies show that creativity

can be learned and can applied anywhere, so education should be directed at strengthening creative skills. Widodo's research (2012) on teacher creativity in making contextual math problems found that teachers can make contextual math problems that meet the criteria for creative product results, namely fluency, flexibility, and novelty. In previous research, Widodo (2011) also found that in creating new contextual math problems, mathematics teachers with qualifications for S-1 mathematics education used (a) innovation techniques to replace the quantity (number), (b) innovation techniques to change the context (c) innovation modification techniques the question, and (d) the innovation technique of adding information. (2) in generating new contextual math problems, mathematics teachers with qualifications of S-1 mathematics use (a) innovation techniques to replace the numbers, (b) innovation techniques to change the context, and (c) innovation techniques to add information. However, the innovation techniques used by the two teachers needed to be maximized when referring to the innovative techniques developed by Vistro-Yu (2009). He developed the idea of innovative techniques to generate new problems adapted from innovation techniques in storytelling: (1) replacement – making the same problem but changing the quantity, amount, units, and shape, (2) addition – making the same problem but adding information new or constraints or adding obstacles, (3) modification - taking the quantity or number given remains the same but changing the problem context, (4) contextualizing the problem so that the problem is made more relevant to students, (5) changing the problem around or reversing the problem - taking the same problem but taking the final goal as given and what is given as the final goal, (6) reformulation - making the same problem in different representations.

Based on the analysis of the 2009 PISA results, it was found that of the 6 (six) ability levels formulated in the PISA study, almost all Indonesian students were only able to master subjects up to level 3 (three), while many other countries involved in this study reached level 4 (four), 5 (five), and 6 (six). With the belief that all humans are created equal, the interpretation that can be concluded from the results of this study is only one, namely, what we teach is different from the demands of the times. This means that math teachers need to train themselves to make high-level questions (levels 4, 5, and 6)Analysis of TIMSS results in 2007 and 2011 in mathematics and science for Grade 2 students of junior high schools also showed similar results. In the field of mathematics, more than 95% of Indonesian students are only able to reach the intermediate level. For example, in Taiwan, almost 50% of the students can reach high and advanced levels.

From these results, what is taught in Indonesia differs from what is tested or standardized at the international level.

The results of further analysis for the TIMSS and PIRLS studies show that the questions used to measure students' abilities are divided into four categories, namely

1. low measures of ability to know the level,
2. intermediate measures ability up to the level of applying,
3. high measures ability to level reasoning,

advance measures ability to the level of reasoning with incomplete information

From this fact, the 2013 Curriculum emphasizes modern pedagogical dimensions in learning, namely using a scientific approach (scientific approach). This scientific approach requires the following main steps (1) Observing (observing), (2) Questioning (asking); (3) Associating (reasoning); (4) Experimenting (trying); Networking (forming networks) (Kemdikbud, 2013).

The scientific approach to learning all subjects includes digging up information through observation, asking questions, experimenting, reasoning to form networks, processing data or information, presenting data or information, followed by analyzing,

reasoning, concluding, and creating. It was visible that this scientific approach is only sometimes correctly applied procedurally. In certain subjects, materials, or situations with conditions like this, the learning process must continue to apply scientific values or characteristics and avoid non-scientific values or characteristics.

From the description above, the research questions can be formulated as follows, What abilities do creative teachers have in making contextual mathematical problems? The purpose of this study is to reveal the abilities of creative teachers in making contextual math problems.

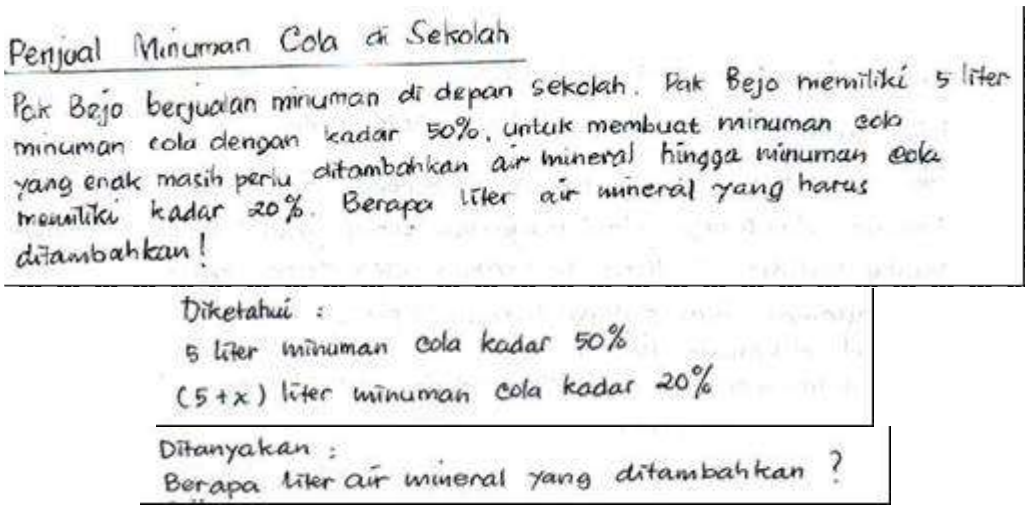
MATERIALS & METHODS

This research is qualitative. This research is classified as exploratory research when viewed from its purpose to explore what teachers do in posing contextual math problems. To get this description, the researcher gave the subject, a junior high school mathematics teacher in the Kediri district, "Jimy" (a pseudonym), to make contextual math questions. Jimmy and Pamela (a pseudonym) are junior high school mathematics teachers in Kediri City with an academic qualification of a Bachelor's degree in mathematics education. Based on the results of the assignments made by the two teachers, it was found that they were creative teachers (Widodo, 2015). Next, the researcher conducted in-depth interviews with Jimy based on the results of the task of posing contextual math problems, which are often called task-based interviews. The main instrument in this research is the researcher. At the same time, the auxiliary instruments are audio and audiovisual recording devices (Handycam) and the researcher's notes during the research process. The research steps are as follows: First, selecting research subjects according to predetermined criteria. Second, giving assignments to teachers to make contextual questions to get their innovative products. Third, conducting interviews with teachers based on the results of assignments that have been done and making direct observations (assisted by camcorders). Fourth, analyze the results of written assignments and interviews. Fifth, reveal the abilities possessed by creative teachers in posing contextual math problems.

RESULT AND DISCUSSION

In the disclosure of Jimmy's creative thinking, it is known that some of Jimmy's hidden characteristics are known. Furthermore, from the credible data that has been generated, it is revealed again with a focus on the characteristics of the teacher. Among these characteristics is Jimy's ability to observe, make questions (ask), reason, make analogies and try.

An example of Jimmy's math problem,



Dijawab :
Misal air mineral yang ditambahkan x liter.
(5+x) liter minuman cola kadar 20%

$5.\frac{50}{100} + x.\frac{0}{100} = (5+x).\frac{20}{100}$

$250 + 0 = (5+x).20$ → (Ruas kiri dan ruas kanan dikali 100)

$250 = 100 + 20x$

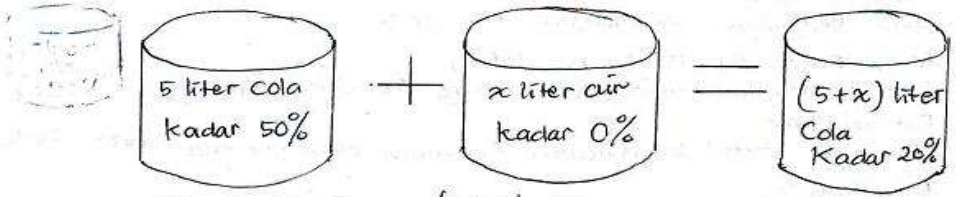
$250 - 100 = 20x$

$150 = 20x$

$x = 7.5$

Jadi air mineral yang harus ditambahkan adalah 7,5 liter.

Cara lain :
Digambar terlebih dahulu ;



$5.\frac{50}{100} + x.\frac{0}{100} = (5+x).\frac{20}{100}$

$250 + 0 = (5+x).20$ → Ruas kiri dan ruas kanan dikali 100

$250 = 100 + 20x$

$150 = 20x$

$x = 7,5$

Jadi air mineral yang harus ditambahkan adalah 7,5 liter.

Another way to use a comparison,

Banyaknya air dalam Minuman cola	Kadar Cola dalam Minuman
5	50 %
5+x	20 %

Jika air ditambah maka kadar Cola akan semakin kecil, Berarti merupakan masalah perbandingan terbalik

$\frac{5}{5+x} = \frac{20\%}{50\%}$

$(5+x).20\% = 5.50\%$

$5.\frac{20}{100} + x.\frac{20}{100} = 5.\frac{50}{100}$

$100 + 20x = 250$

$20x = 150$

$x = 7,5$

Jadi agar kadar Cola menjadi 20% harus ditambah air 7,5 liter.

Jimmy, in posing contextual math problems, begins by observing the social environment of students or schools. This is shown by excerpts from an interview with Jimmy as follows:

Researcher: How did you manage to arrange the questions?

Jimmy: At this time, the children are learning about percentages, then I think about what activities can be related to percentages.

Researcher: So?

Jimmy: I saw a cola seller in front of the school. Incidentally, the weather is hot again, seen many children queuing to buy iced cola. Moreover, among the sellers at the school, this cola seller is the best

.....

Researcher: Where did you get the idea for a double discount?

Jimmy: From experience walking in malls, there are often double discounts like that.

Like I have a shopping club membership card. Often get double discounts, namely from promotional discounts plus discounts from card ownership.

.....

This is also shown by the results of the researcher's interview with Pamela as follows:

Researcher: Mother, have you finished making a math problem with the context of a bananagetuk agent? Can you please tell me how the problem occurred?

Pamela: Across from the school, an agent sells "getuk gedang" (a food made from bananas). Every morning many Getuk Pisang vendors line up to pick up Getuk Pisang at the agent.

Researcher: So what?

Pamela: I was thinking about the materials that fit the incident, including lots of getukbanana packages, lots of getukbanana vendors, how long they have been selling, and the price of getukbananas. Then I connect with the subject matter of comparison.

.....

Jimmy and Pamela made observations of phenomena in the environment of everyday life when students learned things related to mathematical topics whose discussion could be directly related to everyday life. The observed phenomena will produce statements related to everyday life. Furthermore, the statement is stated in the language of mathematics or becomes the opening of the discussion of abstract mathematical objects. These results indicate that creative teachers have more observing abilities. This ability supports the teacher in generating many ideas in making contextual mathematical problems. This result is also in line with what was produced by Dyers (2011), who found that an innovator's skill in observing is higher than the average person's.

From the results of the interviews, it can be seen that to make contextual mathematical problems. Jimmy always observes events in the student environment. This means that Jimmy has more ability in terms of observation.

Jimmy was able to raise many questions on the contextual math problems that had been made. This is shown by excerpts from an interview with Jimmy as follows:

Researcher: Besides the percentage of cola content, do you have any other ideas?

Jimmy: Still, for example, the profit/loss percentage from the sale of cola drinks, setting the selling price per glass with a certain profit percentage. For example, the amount of mineral water added is known to be asked about the cola content after the mix.

……

Researcher: Any other ideas other than the time the pigeons met?

Jimmy: If both pigeons are released from the same base, after how many seconds is Andika dove released so that the doves arrive at the same time?

……..

This is also shown by the results of the researcher's interview with Pamela as follows:

Researcher: From this context, other questions can be asked.

Pamela: Yes; for example, how many hours

does it take if the agent gets bananas
to increase the number of vendors up to 36 people? How many packets of Getuk Pisang That 24 vendors can sell in 2 hours?
.....
Researcher: From this context, other questions can be asked.
Pamela: Yes; for example, what is the area of the rectangle? If the edge of the rectangle is covered with aluminum with a width of 5 cm, what is the circumference of the board that is not covered with aluminum?
.....
The results of the interviews show that in making contextual math problems, both Jimmy and Pamela have many ideas for making questions. This means that if given a math problem, both Jimmy and Pamela can raise many questions from the problem. In fact, the number of questions proposed exceeds the answers. The ability to make these questions will support the teacher in learning. Teachers are expected to refrain from giving answers to questions. If there are obstacles in the process of answering questions, or it is predicted that there will be obstacles in answering questions, the teacher can provide questions in stages that lead to obtaining answers to questions by the students themselves. This is where the teacher's role is to provide scaffolding or 'leverage' to maximize ZPD (Zone Proximal Development) in students (Katminingsih, 2007). Jimmy has good reasoning skills in making mathematical equations and determining the numbers used as information. This is shown by excerpts from an interview with Jimmy as follows:
Researcher: where did you determine the number 15 as the speed of Andika pigeons, 12 as the speed of good pigeons, and 300 as the distance between bases?
Jimmy: The idea is from The puzzle of the number and multiples of integers. Two integers are known if the multiple of 10 of the sum of the two numbers is 270.
Researcher: What do you mean? I'm still not clear!
Jimmy: In this problem, 270=10x27. 270 I mean distance, ten meantime, and 27 mean average speed.
Researcher: Does that mean I can take those two numbers, 10 and 17? Why did you take 15 and 12?
Jimmy: Indeed, 10 and 17 are 27, but the distance in the question is made 300, so 270+2x15= 300, so the speed is 15m/sec and 12m/sec, respectively. **Researcher**: Why add 2x15?
Jimmy: This is where the problem lies, so this question cannot be done in a straight line
live.
.....
Also shown by the following excerpts of an interview with Pamela:
……
Researcher: How did you come up with the idea of the comparison problem?
Pamela: From what happened at the agency, I will relate it to comparative material.
Researcher: What incident do you mean?
Pamela: From what happened at the agency, the more vendors selling getuk gedang, the faster the getuk gedang will run out at the agency. Inikan can be connected by comparison.
……
Jimy can try based on reasoning (experiments) in determining general information and requirements in contextual mathematical problems. This is shown by excerpts from an interview with Jimmy as follows:
Researcher: How did you determine the cola content of 20% and 50%?
Jimmy: From this problem, the relationship is 5•50% +x•0/100=(5+x) •20%.
Furthermore, the numbers can be changed according to our wishes.
.....
Researcher: Where did you get the idea of 12800 as the purchase price, 8000 and 16000 as the price of chicken satay and goat satay?
Jimmy: From the equation 8000x + 16000 y = 12800, the x and y values can be

experimented with, so the equation 8000x + 16000 y = 12800 is proper. 128000 should be is a multiple of 8000 and 16000.

.....

Also shown by the following excerpts of an interview with Pamela:

Researcher: How did you determine the number of vendors over time?

Pamela: from trying Now, if the known number of vendors is 11, then 3x11=33, so n=16.5. Answer this will need to be clarified for my students. Are there many vendors 16,5, so the result should be a positive integer?

.....

This means that in making questions, the teacher needs the ability to try so that the questions produced can be worked on by students. Jimmy and Pamela have this ability to make contextual math problems.

Jimmy can analyze information and mathematical equations in contextual mathematical problems in other contexts. This is shown by excerpts from an interview with Jimmy as follows:

Researcher: From the context of pigeons returning home, it is known that pigeons fly 20 km in the day to the cage and at night fly 10 km in the opposite direction to the cage. Do you have any other ideas about this context?

Jimmy: Yes. For example, the journey of migratory birds. The number of birds leaving/entering the group per day. The distance traveled per day is distinguished between going against the wind or in the same direction. In the context of climbing areca nut, with a height of 10 m, one climb can cover 2 m while resting drops 1 m. How many times can the participant climb to the top?

……

Also shown by the following excerpts of an interview with Pamela:

Researcher: *Is there an idea of a context different from the context of the Getuk Pisang Agent? Pamela: The idea for the context of this getuk banana agent can also be made into another idea, namely the idea about the painting job. Researcher: how concrete?*

Pamela: *If more vendors were at the banana selling agent earlier, the faster bananas would sell out. If the context is changed to the context of painting a school building, it means that the more workers, the quicker the painting job will finish.*

Researcher: *what?*

Pamela: *12 peddlers replaced by 12 workers, spent three hours selling, replaced by spending three days painting. How much does the Getuk Pisang seller have if the Getuk Pisang must be sold out in 2 hours? replaced by how long it takes workers to build a building can it be finished painted within two days?*

.....

Creative mathematics teachers can analyze objects, relations, and mathematical concepts in one context and a second context. The teacher needs this ability to generate many ideas in making and solving contextual mathematical problems. If it is related to the characteristics of innovative products, this ability is a characteristic of fluency, namely the ability of innovators to generate many ideas. This finding was not seen in Dyers' research on innovators.

The findings above follow the research conducted by Dyers (2011) that creative people or innovators can observe, ask questions, reason, and try and build networks. However, Dyers did not find the ability to make analogies for innovators so the findings of this study can complement what Dyers has found. But Kumari A. (2020) found that a culture that values and recognizes diversity in individual thoughts and actions naturally reinforces to introduce of something unique and new. It characterizes the characteristics of creative people.

CONCLUSION

From the description above, it can be concluded that creative teachers have the following characteristics: (1) in making contextual math problems, they always start by observing the social environment of students or schools; (2) the ability to make

many questions in making contextual mathematical problems; (3) good reasoning ability in making mathematical equations and determining numbers used as information; (4) the ability to try based on reasoning (experiments) in determining known information and requirements in contextual mathematical problems; and (5) the ability to analyze information, mathematical equations in contextual mathematical problems to other contexts

Declaration by Authors
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Dyers, J.H. et al. Innovators DNA**:** *Mastering the Five Skills of Disruptive Innovators,* Harvard Business Review; 2011.
2. Ina V.S. Mullis et al.. *TIMSS 2011 Assessment Frameworks,* Boston College: TIMSS & PIRLS International Study Center Lynch School of Education; 2011
3. Ina V.S. Mullis et al. . *PIRLS 2011 Assessment Frameworks,* Boston College: TIMSS & PIRLS International Study Center Lynch School of Education; 2011
4. Endah Ratnawati, Subagyo, Sugiono. Efforts to increase economic learning motivation online through improving learning facilities, teacher creativity and social support during the COVID-19 pandemic. International Journal of Research and Review. 2022; 9(2): 361-367. DOI: https://doi.org/ 10.52403/ijrr.20220247
5. Katminingsih , Yuni. . *Vygotsky dan Teorinya dalam Mempengaruhi Desain Pembelajaran Matematika*. *Cakrawala Pendidikan*, 2009;11 (1): 93-105.
6. Kemdikbud.. *Pendekatan Scientific (Ilmiah) dalam Pembelajaran*. Jakarta: Pusbangprodik;2013.
7. OECD. *Learning Mathematics for Life: A Perspective from PISA*, Paris: OECD; 2009.
8. Sharp, C.. Developing young children's creativity: What can we learn from research.2004 Isue 32, 5-12.
9. VISTRO-YU, C.P. . *Using Innovation Techniques to Generate 'New' Problems*. in Kaur, B. Yeap, B. Kapur, M. (eds) *MATHEMATICAL PROBLEM SOLVING Yearbook 2009,* Singapore: World Scientific Publishing Co.;2009
10. Widodo, S.. *Pembelajaran Matematika yang Mendukung Kreativitas dan Berpikir Kreatif.* Jurnal Pendidikan Matematika. Januari 2010 Vol. 1 No.1 Hal 43 – 53.
11. Widodo, S. *Teknik-Teknik Inovasi Yang Digunakan Guru SMP Dalam Membuat Soal Matematika Kontekstual.* Prosiding Seminar Nasional Penelitian, Pendidikan dan Penerapan MIPA tanggal 14 Mei 2011 di Universitas Negeri Yogyakarta.2011
12. Widodo, Suryo. *Profil Kreativitas Guru SMP Dalam Membuat Masalah Matematika Kontekstual Berdasarkan Kualifikasi Akademik.* Prosiding Seminar Nasional Matematika dan Pendidikan Matematika, tanggal 10 November 2012 di Universitas Negeri Yogyakarta. 2012
13. Widodo, S., *Profil Kreativitas Guru SMP yang berijazah S-1 Matematika Dalam Membuat Masalah Matematika Kontekstual*. Laporan Penelitian. UNP Kediri: tidak dipublikasikan. 2013.
14. Widodo, S. . Profil Berpikir Kreatif Guru Matematika SMP dalam Membuat Masalah Matematika Kontekstual berdasarkan Kualifikasi Akademik. (*Disertasi tidak dipublikasikan*). 2015.Universitas Negeri Surabaya
15. Kumari A. Impact of cultural differences on creativity. *International Journal of Research and Review*. 2020; 7(10): 120-124.

How to cite this article: Suryo Widodo, Yuni Katminingsih, Bambang Agus Sulistyono et.al. Characteristics of creative mathematics teachers in posing contextual mathematics problems. *International Journal of Research and Review*. 2023; 10(2): 41-48.
DOI: *https://doi.org/10.52403/ijrr.20230208*

******