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Thinking Processes of Prospective Teachers in Modifying Tasks

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Success in compiling questions is a critical aspect for prospective teachers in learning activities. The ability of prospective teachers to modify tasks is a phenomenon that needs to be investigated further. Research conducted by Vistro (2009), shows several innovation techniques that are used to generate new problems in mathematics. But this is not enough for the development in modifying the given tasks. Most of these are limited to modifying changes in the quantity of subjects involved in the task. This study aims to analyse the thinking processes of prospective teacher students in modifying questions. The subjects were 30 fifth semester prospective teacher students, and six students were selected for conducting purposive sampling to review processes detected in conducting the thinking process. Selected students were prospective teachers who answered unusual questions. The results of this study are students' thought processes in modifying questions so that they can produce innovations in building new tasks.

Key words: *Thinking process, modifying, task.*

Introduction

Tasks are an essential part of learning activities (Widyajayanti, 2010; Lee, 2017; Manini et al., 2007; Purnamasari et al, 2003). The quality of the task determines the teacher's experience in teaching. The quality of the task depends on each question given. The facts so far indicate that teachers adopt more questions from books and the internet. Modification of essential tasks in learning activities takes place. Teachers who not only adopt questions from books or the internet aim to enable students who work on these tasks to have a better understanding. The forms of questions generated after modifying the task provide extensive knowledge, especially for students. The success of a teacher in modifying a task is success in the teaching and learning process (Sabriani, 2012).

The success of the teaching and learning process is the primary goal of education in Indonesia. This activity is inseparable from the activities carried out by teachers and students. One characteristic of the 2013 curriculum is the existence of a learning process using a scientific approach. There is one aspect of learning that is termed “asking.” The aspect of "asking" becomes one of the essential parts in the learning process because the teacher can guide the learning process by using questions (Kurniastuti,et al 2018;Ayu, et al, 2015;Maulia & Sujadi, 2018). Questions raised by teachers can be arranged into tasks. Tasks must be designed before teaching and learning activities.

Asking questions is one of the tools that can be used in implementing communication. Teachers must have the ability to communicate well, namely the skills in conveying messages or information so that students can receive learning materials well (Hawkins, 1996; Yasin, 2012; Kusaeri, 2016; Nasor, 2014; Lanani, 2013). The learning process will be useful if communication and interaction between teachers and students occur intensively (Yasol, 2014; Abdullah, 2018;Rizqi, 2014). Questions asked in the form of assignments must always be updated so that students who receive assignments can develop their creativity in thinking. The quality of tasks produced by modifying tasks is better when compared to adopting from the internet. The understanding of students given assignments that have been modified is broader compared to students who are given assignments taken from books or the internet only. Student answers are more developed and can vary with understanding mathematical material. Modifying the tasks of each individual is different, especially the way of thinking for prospective teacher students who will get teaching assignments in schools stimulating and training students (Yani, Muhammad M. Ikhsan, 2016).

The thinking process in this study is intended to be a process carried out by someone in recalling the knowledge that has been stored in their memory. As in research (Widyastuti et al, 2013; Dalilah, 2019; Endrawati, 2013), the goal of the research is to be used in receiving information, processing, and concluding how the process occurs when students teacher candidates modify the assignment. A good thought process will certainly also bring a good impact on learning achievement. Based on the gap between facts and expectations in this study, the thought process of prospective teachers in modifying mathematical assignments is further investigated.

Thinking Process

Thinking, according to (Wasty, 1990), is putting the relationship between the parts of knowledge acquired by humans. Similar views are suggested by (Khodijah, 2006; Suryabrata, 1995). Knowledge here includes all concepts, ideas, and understandings that are possessed and or obtained by humans. Meanwhile, according to (Maulidya, 2018), thinking is a variety of activities that use concepts and symbols as a substitute for objects and event thinking uses

abstractions of "ideas" (Sumadi, 2004). In the process of thinking, someone will do several activities, including management, storage, and recall of information from his memory. Piaget (1969), mentioned: "the filtering or modification of the input is called assimilation and the modification of internal schemes to fit reality is called accommodation." It means that a person's thought process can be observed through two processes, namely assimilation and accommodation.

According to Widyastuti (2013), the thinking process is mental activity or process that occurs in the minds of students. The information entered will be processed in the minds of students. When processing data, the schemes that are in the minds of students will experience adjustments, even changes. This process is called adaptation. Adaptation to the new scheme can be made in two ways, namely assimilation and accommodation.

Assimilation is the process of integrating problems encountered into a pre-existing cognitive structure because the structure of the problem faced is per under the scheme that already exists. While accommodation is a process of cognitive structure change because the cognitive structure that has been owned is not by following the structure of the problem at hand (Blake & Pope T, 2008). Meanwhile, according to Trianto (2009), assimilation is a new knowledge structure created or built based on existing knowledge.

Questions

Modifying the questions in this study is interpreted as an effort to generate new questions based on questions that have been posed previously. These are similar to the research by (Hendri, 2010; Lee, 2017). Several classifications of questions based on each researcher classify questions into four categories: (1) *Probing and follow up*, (2) *Leading question*, (3) *Checklisting*, (4) *student-specific questioning* (McCarthy et al, 2016). Probing questions will help us dig more in-depth information and dive into thinking. This type of question would be very suitable in a cornering and investigative interview pattern. Leading questions are usually used for informants who often avoid giving direct answers. Checklist questions are used by giving a checklist for answers while student-specific questioning is defined as questions given explicitly to the students.

The researchers (Tofade et al, 2013; Zayyadi et al, 2019), divided questions into several categories, namely convergent, divergent, focal, brainstorm, shotgun, and funnel. The convergent question is interpreted as a closed question that does not provide any answer choices. This type of question usually merges into one or several answer lists or is in the form of a checklist. This type of question can encourage or provide a concise response. The divergent question is interpreted as an open question, in contrast to the convergent question. This question provides many responses to allow for exploration in a variety of perspectives

and encourage dialogue between teachers and students. Types of focal questions are interpreted as questions that place students so that they must choose or justify a position. A brainstorm is defined as a question that generates a lot of ideas or points of view that have a specific purpose. Shotgun question types are defined as questions that contain certain areas of content. Whereas funnel question types are defined as questions that begin broadly and gradually lead to more focused investigations.

Based on previous research, the question is one of the factors that can help in the learning process. Teacher questions can improve student learning and self-assessment of the effectiveness of the lessons conducted by the teacher. In connection with this, if the questions is not appropriately packaged, it can hurt student learning processes (McCarthy et al, 2016). While (Bülent Döş et al, 2016) stated that questions had been used as a critical appraisal tool for centuries. It was estimated that there is a relationship between asking the right questions and effective teaching. It means that good quality questions can measure practical teaching activities.

Besides, the research conducted by (Tanner KD, 2012) stated that the preparation of the right questions could improve academic achievement and develop metacognitive thinking. Especially for teachers, quality questions can provide benefits for teachers to ensure the effectiveness of themselves and their classrooms to positively influence the preparation in the process of teaching activities and preparing homework given to students (Hu G, 2015).

Methodology

As mentioned above, the purpose of this study is to investigate the thought processes of prospective teachers in modifying questions. The questions in this study are those that meet the question structure of the cognitive realm, namely the application specifically involving number operations. In achieving this goal, we take the following methodological steps:

Types of Research

This research is descriptive qualitative research. The descriptive method is a problem-solving procedure that is investigated by describing the state or object of research (a person, institution, society and others) (Nawawi Hadari, 2012).

Participants

The research subjects were 30 prospective teacher students in Malang city who are currently in semester five, with enough knowledge to carry out teaching practice in the destination school. From 30 students, six students were selected to examine their thinking processes.

Subject selection uses purposive sampling. It is based on the ability to innovate in modifying questions so that they can be grouped into innovations that are used in the assimilation and accommodation process. Purposive sampling is also referred to as information-oriented sampling, in which the sample is chosen based on the expectation of information discovery (Flyvbjerg, 2011).

Research Instruments

In this study, the main instrument is the researcher himself and the test questions about the ability of prospective teachers to modify questions according to research needs. The command in filling in the instrument is as follows: this test is used to observe the thinking processes of prospective teachers in modifying questions. Students are given six basic questions taken from the fourth-grade elementary school mathematics manual regarding number operations. Students are asked to make as many questions as possible from the six basic questions given. Students can do various kinds of innovations to modify the questions according to the creativity of each student. The instrument includes subject matter about identifying the properties of arithmetic operations, sorting numbers, performing multiplication and division operations, performing mixed count operations, carrying out estimations and rounding, and solving problems involving money. As a benchmark in conducting this thinking process, the researcher uses several innovative techniques that can be used in classifying the innovative techniques that have been carried out by students by understanding the results of students' thinking processes. Innovation techniques used as benchmarks include replacement, addition, modification, transformation, change of view point, recycling the plot, and innovations formed from the results of this study.

Data Collection

The data collection in this study was carried out using the task-based interview method . Polya steps were used to check the validity of the data obtained; the data credibility test is used by triangulation. The triangulation method used in this study is time triangulation, where the researcher checks the subject interviews at different times with the same question modification test (TMP) questions. Data analysis techniques used in this study were qualitative data analysis following the concept of (Miles, M. B., & Huberman, 1992), namely the data reduction stage, the data presentation stage, and the conclusion drawing stage.

Results and Discussion

Thinking Process

Based on the instruments that have been distributed to the subjects and analysing the results obtained from tests given and interviews submitted, students with different abilities were divided into groups. Through analysis conducted on several students, different thinking patterns were observed. Some of them are students who did the replacement, addition transformation, change of viewpoint, recycling plot exercises, and there was also an innovation that was not included in the six innovations, researchers called this an innovation symbol, combining several innovation techniques at one time.

a. Thinking Process Replacement

In this study, replacement is one of the most frequent innovations carried out by prospective student teachers in modifying questions. From 30 students, 26 students were able to innovate on basic questions by only changing the quantity, number, units, or shape or subject. This means that 87% of prospective teacher students in modifying questions often used replacement innovations. The following is a small portion of students who used replacements to modify questions. The results of the replacements in instrument number four are shown in Table 1.

Table 1: The first replacement process carried out by students

No.	***Main Question***	***Basic Question***	***Modification Question***
1.	Perform mixed count operations	512 × (120 – 55) + 20 = …	31 x (150-27)+40 = ….

In generating new questions on instrument number four, students were to replace only the quantity of numbers, without changing the operation of the given number. The results of interviews and more in-depth analysis mentioned that students viewed the question instrument as a mixed count operation. Getting a student accustomed to mixed counting operations is not easy, because they have carried out several counting operations at one time in order. When generating application questions (C3) using Bloom Taxonomy, students must understand the sequence of working on the correct number doing a lot of replacements only, so that students are more familiar with the daily question of number operations. The process of thinking of students making replacement innovations is also found in instrument number six as shown in Table 2.

Table 2: The second replacement process carried out by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Solve problems involving money	Amir's mother shopped at the fish market. He bought 1 kg of catfish for IDR 9,800.00 and 1 kg of tuna for IDR 12,750.00. How many thousand approximately did Amir's mother have to pay?	Dina's Mother shopped at the market to buy 1 kg of catfish for IDR 12,000.00 and eggs for IDR 25,000.00. How much money does Ms. Dina have to pay?

In question instrument number six, students could generate new questions by continuing to make replacements. Still, they did not only change the quantity of numbers, but they also changed the subject and object of the basic questions. But the students did not change the number of operations contained in essential question number six. From the results of interviews, students did that so that they could solve the application questions in the form of story questions easily. Changing subjects and objects, according to some students, will bring a new learning atmosphere even though the completion stage is the same as the basic question. From the results obtained from the student's thinking processes by changing the quantity or subject of the basic question indirectly, the assimilation process had taken place. Subjects continued to use cognitive structures that had been formed from basic questions, but students only changed the number of existing subjects.

b. Thinking Process Addition

Students' thought processes in generating new questions on the second innovation involved innovating addition. In this innovation, students modified questions by using the same basic questions, but adding new things or adding constraints or new mathematical operations. Innovation in modifying the following questions was done by doing additional procedures.

Table 3: The first addition processes undertaken by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Perform multiplication or division operations	136 × 117 = ….	What is the result of (136x117) : 3 = …

To produce questions for instrument number three in Table 3, students were only armed with basic questions without changing, then students added new number operations. From the results of the interview added to more challenging questions, students added a distribution operation on the results. The basis for making the question was students investigated the factors of 136 and 117 given in the basic question. The addition of number operations can

be made using the factors of the obtained numbers used as a divisor on the addition of number operations and also numbers that are not factors of the two numbers in the basic question. However, the students chose to use numbers which were factors of the two numbers in the basic question so that the results obtained were integers. If using any number that is used in a number operation as a divisor, the number generated from the solution is a real number that includes rational numbers that are less attractive to the students.

Some students were doing innovation additions coupled with replacements. This can be seen from the results of the modification of the question on instrument number four.

Table 4: The second addition processes undertaken by students

No.	***Main Question***	***Basic Question***	***Modification Question***
1.	Perform mixed count operation	512 × (120 – 55) + 20 = …	results of -20+(7x5)-18: (-3) is …

Table 4 shows the situation as in the following description. In the main questions, students are asked to modify questions about mixed count operations with basic questions using only multiplication, subtraction and addition operations. Through interviews, students think of adding to add divider arithmetic operations to complete all existing arithmetic operations. It shows one of the innovations by adding new obstacles. But the students did not stop there; one of them even made a replacement innovation on these basic questions. They think of numbers that can be changed and can do all four mixed operations. In their thinking activities, students can choose any integer for addition, subtraction and multiplication operations, since the operation does not require the numbers to be obtained by the students as an integer. The divisor operation students must think that the numbers that can be formed for a division operation are two numbers that have a relationship that the first number is a factor of the amount to be given the calculation divide operation. The goal is that the results of the arithmetic operations when mixed with other arithmetic operations produce integers. In making mixed counting questions, students also gave a direct hint to the resulting question which was in the form of parentheses flanking two numbers with one operation with the aim that students in completing the compound counting operations work first. Students had done the accommodation process in which students feel that the cognitive structure contained in the basic questions is still lacking. Students added new operations and questions so that they could refine the results of the modification of new questions.

c. Thinking Process Modification

The process of thinking in modifying questions using innovation modification is that students take the same part but change the problem. Modification innovations are seen in Table 5.

Table 5: The first modification process conducted by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Identify the properties of arithmetic operations	5 + 2 = 2 +... = ...	5x2 = 2x… =…

An instrument number one shows that students make modification innovations in their number operations. Prospective teacher students understand that the basic question given is the basic question to identify the properties of arithmetic operations. Students know that the quality of arithmetic operations on integers is the same, so that it is easy for students to generate new questions by modifying their operations. If examined from the results of interviews with these students, it was found that the students understood the question form very well , which was a number operation that had commutative properties. Students preferred to use the same number. Still, they changed to arithmetic operations so that when carrying these out, they understood that the commutative properties of integers are the same between addition operations and multiplication. Modification innovation is undoubtedly different from replacement. Students think that a replacement is only enough to replace the subject or quantity without changing the problem. Whereas in innovation replacement students change their arithmetic operations so that the objectives of the resulting problem are different from the results of the modification. It is seen that in the basic questions using the addition operation, to innovate modification, students need to change the calculation operation into multiplication. In the process of thinking, students with almost the same results with the innovation modification technique, do the assimilation process as well as accommodation. Likewise with the process of thinking transformation, change of viewpoint, recycling plot, and others.

d. Thinking Process Transformation

The thinking process of students in generating new questions is the next process of thinking using transformation innovation. Students contextualise the problem to make it more relevant. Contextual, in this case, means students modify the basic questions by linking with real life. One of the things that inspires students to be able to connect basic questions with reallife is to present them in story problems. Following are some of the transformation innovations presented in Table 6.

Table 6: The transformation process conducted by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Sorting numbers	Sort the following numbers, from the largest to the smallest. 107,445, 97,263, 171,200, 79,889, 107,245	In a race Danu is 324 meters from the finish line. Tino is 381 meters from the finish line and Banu is 239 meters from the finish line. If their speed is fixed, what is the order that will enter the finish line first?

In this process, students conduct thinking activities contextualising the problem to make it more relevant. Students try to make questions in the form of story questions related to the material in order of numbers. In making this innovation to produce problems, students are required to have the ability to make a story related to all activities carried out in everyday life. So it's easy for students to make new questions. It only requires expertise to compose sentences so that students can understand them. The steps in generating this question innovation are students determining the topic of questions first, and then students need to connect between themes with real life. After students find their ideas, they need to construct sentences and arrange them into a whole that can be understood .

e. Thinking Process Change of View Point

The thinking process of students in generating new questions is the next process of thinking using the Change of View Point innovation. In doing this innovation, students reverse the problem using the same problem but using the known result. In other words, in doing this innovation, students must be able to solve the problem first. Students who made this innovation in making questions were presented in Table 7.

Table 7: Change of View Point Process conducted by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Perform multiplication and division operations	136 × 117 = ….	15912 : …. = 136 What is the number that can replace the most appropriate points?

In Table 7, it appears that students carry out the thought process to modify the question so that it generates new questions to solve the problem. After finding a solution to a problem

known, students must find the inverse or opposite of the known problem. For example, in Table 7, instrument number three. The student data shows the result of the multiplication of 136 × 117, which is 15912, the next step is that the student thinks that the opposite of multiplication is division, so that the student can generate new questions using the results of the design and reverse the situation to produce new questions. This was confirmed through the results of the interviews as described above.

f. Thinking Process Recycling the Plot

The student's thought process in recycling the plot is when students pose the same problem in different types. Students create question innovations by displaying them in the form of reformulation or other models, including symbols. One example of students doing innovation is shown in Table 8.

Table 8: The process of recycling the plot by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Perform multiplication and division operations	136 × 117 = ….	136 × 117 = n What number can replace the most appropriate letter?

In this thinking process, students do not make any changes to the basic questions. Students only need to assume that the results of solving the problem have been obtained and symbolise it with a variable that will later search for the problem. Students do not need to solve problems first. Students assume that the results of the problem solving are as if the basic question has recognised but kept secret and symbolised by the variables that we have stated. In Table 9, it was determined that the substitute variable is the letter n. so that in completing the problem, the students only needed to complete the basic questions.

g. Other Thinking Processes

In other thought processes, the researcher classifies different thought process categories which do not belong to the six categories previously discussed. Modifications made by students were classified as creative where students not only emphasised the renewal of the change of the questions, but also included the condition of students who will solve the problems. The innovations made can also be in the form of games and images such as diagrams or puzzles, so that students think and are not bored and eager to work on the problems. An important point of this research is the creativity of a prospective teacher in modifying questions that will ultimately have a good impact on teaching and learning activities. Examples made by students in modifying questions are shown in Table 9.

Table 9: Other thought processes undertaken by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Identify the properties of arithmetic operations	5 + 2 = 2 +... = ...	Complete the points below and give an arrow to the answer which is a pair as the commutative nature of the middle number
1.	Identify the properties of arithmetic operations	5 + 2 = 2 +... = ...	Describe the path that must be taken so that Dani finds the right answer pair so that the commutative nature applies

In instrument number one, two students made different modifications for their reasons. The student understands well that the basic questions to be modified are questions that have the purpose of showing the commutative nature of the addition operation. Student one made an innovation using pictures and commands that had not been filled in with numbers that showed the commutative nature. Through this picture, students not only give one question but give three pairs of questions that show the commutative view. While student two made an innovation question on the number one instrument by making a game in the form of a track search following the instructions. Based on the results of student interviews, two stated that questions in the form of play could produce benefits, one of which is that playing increases creativity for children. The original ideas were stored, they will come out quickly even though sometimes they feel abstract to parents. Besides, playing will also help children avoid stress due to boring daily routines. Based on that goal, students classified as creative students will try to make questions that have more innovation than others. In this thought process, some students do two processes simultaneously on a question. One of them is the student doing the replacement process both subject and quantity also adds questions from the basic questions given in Table 10.

Table 10: Other thought processes carried out by students

No.	*Main Question*	*Basic Question*	*Modification Question*
1.	Perform mixed count operations	512 × (120 – 55) + 20 = …	Result of -20+(7x5)-18: (-3) is…

Table 10 shows that in modifying questions, students did two things simultaneously. In the modification of the question, the student claimed that he was replacing the numbers contained in the basic question. Also, he added the number operations, which were originally only three number operations consisting of multiplication, subtraction and addition, the student also added the division operation. In doing this thinking process, students do a simple thing, which is to form routine questions for practice, replacing the quantity or number contained in the basic questions. While thinking, students add division operations so that the questions created are more complex, and the students are better able to apply all number operations to other similar questions. In this process of thinking, students can process assimilation and accommodation . In this process of thinking, students can process assimilation and accommodation according to the overall changes made by the subject to the questions generated.

Difficulties of Student Prospective Teachers in the Process of Thinking Modifying Questions

When doing the thinking process that was done in modifying questions, students experienced different difficulties. Students had almost no problem when it came to replacing replacements, because it is easy to replace quantities or subjects, only requiring students to do the same thing and organise. While in the addition thinking process, more students have difficulty in determining additional questions to be given. Students who are thinking of modification experience difficulties when they have to change existing problems and lack knowledge of existing operations. Students who carry out the transformation thinking process must have sufficient knowledge related to the use of number operations in daily life because students, in this case, experienced difficulties in applying the context of a discussion with the real world. In the process of recycling the plot, students had difficulty in arranging the command language in the questions they asked. While the thought processes of students with other innovations had a higher level of difficulty compared to the others, because in this case, students had difficulty in making questions that were really out of context, which is rarely found in routine questions . Less creative students have difficulty finding question ideas.

Conclusion

Thinking processes of prospective teacher students in modifying the questions vary. The difference in the thought processes produces innovations in modifying questions, including the processes of replacement, addition, modification, transformation, change of view point, recycling the plot and others. Some of these innovations are formed based on the basic knowledge possessed. The level of difficulty is not much and at the level of basic knowledge of the subject. The subject who is doing another thought process must build a thought process that is not yet in the basic question given. This subject changes the essential question

by making creative innovations. The level of difficulty in this thought process lies in the level of creativity of different subjects.

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