



Patterns of Writing Tests in Science Concepts: Development by Teacher Candidates in Elementary Schools

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Abstract. The lack of teacher attention to the assessment activities, especially in the manufacture and development of written test questions is the background in this study. Though these written test questions are instruments that teachers often use to identify the results of learning that have been done. Therefore, compiling and developing written test questions are one of the abilities that are important to understand. To be able to develop written test questions, especially science well, several things must be considered, namely variations in the form of questions, suitability with the rules and learning objectives and suitability of questions to explore students' higher-order thinking skills. The qualitative descriptive method is used to describe the pattern of written science test questions developed by prospective teachers in elementary schools. Data is done through documentation and interviews. The findings show that the form of written science test questions that are often developed by 50 participants are multiple-choice forms, short entries, and descriptions. Of the 152 questions developed by the participants, it was found that the questions had met the rules in the preparation of each variation of the form of questions and were by the specified learning objectives. However, the 152 questions analyzed did not meet the criteria for the High Order Thinking Skill. Of the four indicators analyzed there are three indicators (variations in form, rules, and suitability of questions with objectives) must have met the criteria while 1 indicator has not been fulfilled (suitability of questions with High Order Thinking Skill).

Keywords: Question patterns, written tests

INTRODUCTION ~ The PISA Survey (Program for International Students), in 2015, Indonesia was known to have increased 6 ranks from the previous two lowest 72 countries participating (Suprpto, 2016). However, "the increase in achievement is still below the average of the Organization for Economic Co-operation and Development countries" (OECD). Based on the data, the OECD country's average science score is 493. While Indonesia has only reached a score of 403. While in reading the average score of Indonesia is only 397. In fact, the OECD's average is 493 "(Velasufah&Setiawan, 2019).

The low achievement of Indonesia in the PISA survey is due to several factors. One fact is that students in Indonesia are not familiar with the questions tested by PISA

and TIMMS. In general, the ability of Indonesian students is very low in: (1) understanding complex information; (2) theory, analysis and problem solving; (3) use of tools, procedures and problem solving; and (4) conducting an investigation" (Fanani, 2018). Therefore, the improvement of the assessment listed in the curriculum must be adjusted to the international standard assessment. Assessment of student learning outcomes is expected to explore higher order thinking skills / HOTS (Higher Order Thinking Skills) so that students are able to think broadly and deeply about the material taught at school (Saido, Siraj, Nordin, & Al_Amedy, 2018).

The results of the description above show that the understanding competency of



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students must be improved one of them through the provision of varied forms of questions (Fatmawati, 2013). and high-level oriented thinking (Garcia, 2015). The ability of teachers to develop good written test questions becomes very important in order to explore student understanding optimally. However, teachers in schools sometimes have difficulty developing these written test questions (Barton & Collins, 1993). Even though this written test is one of the most common evaluation tools and is often used by teachers in schools. Examples of written test questions commonly used by teachers in schools include multiple choice, essay, matchmaking, limited content, and right and wrong (Arifin, 2009).

Science products (concepts, principles, theories, and laws) as part of the nature of science need to be well understood by students. One of them is the identification of the ability to understand science products by providing a number of written tests in a variety of forms and multiplying the ability to think at a higher level (Chang & Chiu, 2005).

This article will describe the development of written science test questions by elementary school teachers by paying attention to the variety of questions developed, the compatibility with the creed of written test questions, the suitability of indicators / objectives and the suitability of questions with higher-order thinking skills (HOTS).

METHOD

The study was conducted descriptively. The descriptive research process is carried out by inductive data analysis, from specific to more general matters which will be presented in words (Creswell, 2017). This research will describe the written patterns of natural science test questions developed by prospective teachers in elementary schools.

Analysis of the written test patterns of natural science consists of analyzing the form of tests, the rules of preparing written test questions, the suitability of the test with the learning objectives and the suitability of the test with high-level thinking skills.

The data analyzed came from 50 semester 8 students who had conducted PPL (Field Experience Program) activities as research participants. The participant's identity is kept confidential by the researcher in accordance with the agreement made. Initially from the 50 participants, 3 documents from each participant will be taken, but because the analysis of the questions in this study focused on learning science and at the time the participants did PPL some participants did not reach 3 times in teaching science learning. So that the written test questions document did not reach 3 documents from each participant. Participants with 3 documents totaling 21 participants, participants with 2 documents totaling 17 participants and participants with 1 document totaling 12 participants. So that 109 documents were obtained from the 50 participants.



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The document in question is a set of lesson plans (lesson plans) in which there are written test questions that are used by participants as teacher candidates. The use of this set of RPP documents is based because in the formulation of the problem there is a formula which says the suitability of the written test questions with the learning objectives that have been made. So that in this study must use a set of RPP. Because learning currently uses the 2013 curriculum so learning is made into one unit or thematic with other learning. So that in 1 document RPP (Learning Implementation Plan) there are not only written science test questions but also written learning test questions

RESULTS AND DISCUSSION

The total number of documents there are 582 written test questions consisting of 329 written science test questions and 253

written questions social science test, Indonesian Language, Citizenship Education (PKN) and Cultural Arts and Crafts (SBdP). The percentage of science questions with Social Sciences, Indonesian Language, PKN and SBdP is 56.5% for science questions and 43.5% for Social Sciences, Indonesian Language, PKN and SBdP. Based on the results of interviews conducted by researchers to 6 participants as a sample, shows that the reason most participants develop more written science test questions because basically making written test questions on the lesson plan is adjusted to the indicators. In addition, the basic competencies of science lessons tend to require sufficient evaluation because of the large amount of material. Distribution comparisons of the number of written science test questions with other subjects are listed in table 1.

Table 1. Comparison of the Number of Written Test Questions with Other

| No | subjects | Frequency of Use Data (x) | Relative Frequency (x/ΣX) | Percentage (x/ΣX.100) |
|--------------|---|---------------------------|---------------------------|-----------------------|
| 1. | Science | 329 | 0,56 | 56,5 % |
| 2. | social science, Indonesian Language, PKN and SBdP | 253 | 0,43 | 43,5 % |
| Total | | 582 | | 100% |

Meanwhile 329 forms of written science test questions developed by prospective teachers can be seen in table 2.

Table 2. Use of Written Test Forms of Science

| No | Bentuk Soal Tes | Frequency of Use Data (x) | Relative Frequency (x/ΣX) | Percentage (x/ΣX.100) |
|----|------------------------|---------------------------|---------------------------|-----------------------|
| 1. | Multiple choice (MCQs) | 46 | 0,139 | 13,98 % |

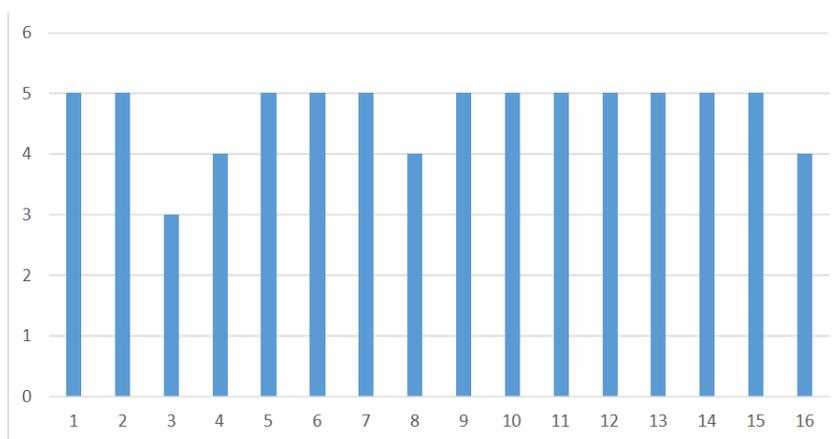


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| | | | | |
|--------------|--------------|-----|-------|---------|
| 2. | True - False | - | - | - |
| 3. | Match up | - | - | - |
| 4. | Short Fields | 13 | 0,039 | 3,95 % |
| 5. | Essay | 270 | 0,820 | 82,06 % |
| Total | | 329 | | 100% |

Written test questions are developed by elementary school teacher candidates in the form of questions. However, because the results obtained are more multiple choice (MCQs) and Essay questions, the

two forms are discussed based on the rules of writing questions. Graph 1 for multiple choices Question (MCQs) and graph 2 for problem description.



Graph 1. Average MSQs diagram developed by participants

0-6= Average number of MCQs developed

1-16= Rules for preparing MQs

1. Questions must be in accordance with the indicators
2. The subject matter must be formulated clearly and firmly
3. The choice of answers must be homogeneous and logical
4. The formulation of the subject matter and choice of answers must be the statement that is needed only
5. Each question must have one correct or most correct answer
6. Principal questions do not give directions to the correct answer
7. The subject matter should not contain double negative statements

8. The length of the choice of answer choices must be relatively the same
9. Answer choices do not contain statements that read "all of the above answer choices are false" or "all of the above answer choices are true"
10. Answer choices in the form of numbers / times must be arranged in order of the number of values / chronological time
11. Pictures, graphs, tables, diagrams etc. The problem must be clear and functional
12. Item items do not depend on the answer to the previous question
13. Formulation of the items must use language in accordance with Indonesian language rules



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14. Problems using communicative language
15. Problems do not use local language
16. Answer choices do not repeat words / phrases that are not a unity of understanding

(Balitbang RI, 2017)

Examples of written test questions in the form of MCQs developed by prospective teachers are as follows:

1. Ari went on a trip with his family to a waterfall tour. Ari saw that water flowed from high to low. This is one example of the nature of objects
a. Liquid c. Solid
b. Gas d. Slippery

2. Can be moved without changing its original form is the nature of objects
a. Liquid c. Solid
b. Gas d. Slippery

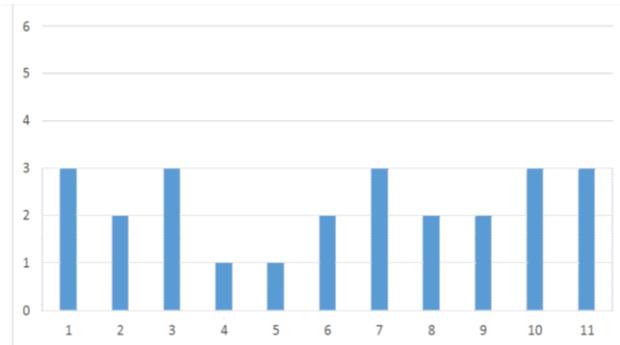
The two questions above ask students to be able to determine the nature of an object. This is not in line with the objectives and indicators that have been made by participants in the RPP document. Good test questions must be in accordance with the objectives / indicators (Rizta et al, 2013). the indicators that have been designed The objectives / indicators of questions developed by participants are shown in table 3.

Table 3. Examples of Learning Objectives and Indicators from Participants

| of Learning Objectives | Indicators |
|--|--|
| Analyzing the effect of heat on changes in temperature and shape of objects in everyday life | Identify the effect of heat on changes in temperature and shape of objects in everyday life. |
| | Identify the effect of heat on changes in temperature and shape of objects in everyday life. |

From the objectives and indicators above it can be seen that the test questions developed by participants are not in accordance with the objectives and learning indicators that have been determined. In the indicators explained that students must be able to identify and explain the effect of heat on changes in temperature and form of objects in everyday life. But the questions developed ask students to be able to determine the properties of an object, so that the problem is not in accordance with the objectives and learning indicators.

In addition, the stimulus is a statement: "Ari went on a trip with his family to a waterfall tour" the statement / stimulus in question number 1 is not functioning properly so it is scattering of words. This problem does not meet the 11th rule of MCQs (Figures, graphs, tables, diagrams, etc. What is in the problem must be clear & functional). Therefore, the determination of the shape of the sample stimulus is very much influenced by the statement or the sentence (Lailly&Wisudawati, 2015).



Graph 2. diagram of essay test questions developed by participants

0-6 = Average number of essay questions developed by participants

1-16 = The rules for preparing essay test questions

1. Each question must be in accordance with the stated learning objectives or indicators
2. Limitation or scope of questions and expected answers must be clear
3. The material or knowledge requested must be appropriate to the level, type of school, or grade level of the student being tested
4. The formulation of the problem or question must use a question word or command that demands an answer to the description, for example: why describe, explain, compare, interpret, prove, count, etc.
5. Questions must be accompanied by clear instructions on how to do the problem
6. The teacher or question writer must make a scoring guide or describe the components to be assessed
7. Complementary components of problems such as tables, figures, graphs, diagram maps, or the like must be presented clearly and legibly and must function.

8. The formulation of the items must use simple and communicative language, so that it is easily understood by students

9. The formulation of the question must avoid the use of words or sentences that cause double interpretation or misunderstanding

10. Item must use good and correct Indonesian language rules

11. Don't use phrases or words that only apply locally.

(Balitbang RI, 2017)

The sample written test questions with Essay forms developed by prospective teachers are as follows:

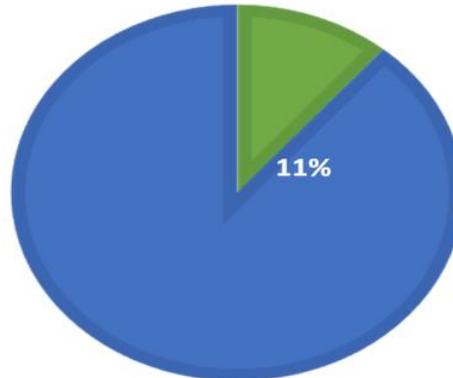
"What is the difference between male puberty and female puberty!"

The rules that have not been fulfilled from the questions above, namely the formulation of questions or questions do not use question words or commands that demand answers to the description, for example: why describe, explain, compare, interpret, prove, calculate, and so on. Students are only asked to mention the difference between male and female puberty. Questions are not accompanied by clear instructions on how to work on the

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problem, and the question writer does not make scoring guidelines or describe the components to be assessed.

Meanwhile, for comparison of the number of written tests based on HOTS and not those that have been made by respondents can be seen in graph 3.



Graph 3. Comparison of HOTS Questions with non-HOTS questions developed by respondents

In Bloom's Taxonomy which was revised by Anderson and Krathwohl in 2001 the cognitive domain consisted of: C1 (remembering), C2 (understanding), C3 (applying), C4 (analyzing), C5 (evaluating) and C6 (creating). Questions that are included in the HOTS are questions that are included in the C4-C6 category (Arase et al, 2016). Here is an example problem based on HOTS:

A student is having trouble opening a metal-threaded glass-covered glass. He took hot water then poured it on the bottle cap. This is done so that

- Bottle caps expand faster so Mudak is opened
- Bottle caps shrink faster so it's easy to open
- Glass bottles expand faster so the lid is easy to open
- Glass bottles shrink faster so the lid is easily opened

These MCQs are classified as HOTS because they demand the ability to

process thinking before students determine answers by providing a statement (stimulus) of data, and this stimulus functions and is a contextual problem. (Sulaiman et al, 2017).

CONCLUSION

Writing written test questions needs to pay attention to the rules of writing correct questions, because one of these evaluation instruments is most often used by teachers when testing student abilities. The preparation of written test questions is a basic ability for prospective teachers to be able to evaluate students' abilities, especially those related to cognitive abilities. In addition, written test questions need to train students for high-level thinking processes through a number of data processing / stimuli that are appropriate. Achievement of cognitive thinking processes in written test questions obtained by students when students will answer a number of questions by



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processing a number of data / stimulus. Therefore, prospective teachers and teachers need to improve professional skills related to the preparation of questions by referring to the teacher's understanding of the rules and forms of written test questions that are varied and practicing to develop written test questions based on high-level thinking, especially in science learning.

REFERENCE

- Arifin, Z. (2009). *Evaluasi Pembelajaran*. PT Remaja Rosdakarya: Bandung
- Arase, A., Kamarudin, N., & Hassan, A. (2016). The Development of Students' Capabilities In Higher Order Thinking Skill (HOTS) Through Science Education. *Jurnal Pemikiran Pendidikan*, 7, 1-18.
- Barton, J., & Collins, A. (1993). Portfolios in teacher education. *Journal of teacher education*, 44(3), 200-210.
- Balitbang RI. (2017). Panduan Penulisan Soal 2017. Pusat Penilaian Pendidikan, Badan Penelitian dan Pengembangan, Kementrian Pendidikan dan Kebudayaan RI. <https://drive.google.com/file/d/1bAfsExVCMz86Affivb4Wb8rXsU4jbTrJ/view>
- Chang, S., & Chiu, M. (2005). In The Case Of Scientific Cognition Concerning, 3, 117-140.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Fanani, Z. (2018). *Strategi Pengembangan Soal Higher Order Thinking Skill (Hots) dalam Kurikulum 2013*. *Edudeena*, 2, (1), 57-76.
- Fatmawati, B. (2013). Menilai Keterampilan Proses Sains Siswa Melalui Metode Pembelajaran Pengamatan Langsung. In *Proceeding Biology Education Conference: Biology, Science, Enviromental, and Learning* (Vol. 10, No. 1).
- Garcia, L. C. (2015). Environmental science issues for higher-order thinking skills (HOTS) development: a case study in the Philippines. In *Biology Education and Research in a Changing Planet* (pp. 45-54). Springer, Singapore.
- Lailly, N. R., & Wisudawati, A. W. (2015). Analisis Soal Tipe Higher Order Thinking Skill (HOTS) dalam Soal UN Kimia SMA Rayon B Tahun 2012/2013. *Jurnal Kaunia*, 11(1), 27-39.
- Kehoe, J. (1995). Basic item analysis for multiple-choice tests. *Practical assessment, research & evaluation*, 4(10), 20-4.
- Rizta, A., Zulkardi, Z., & Hartono, Y. (2013). Pengembangan Soal Penalaran Model TIMSS Matematika SMP. *Jurnal Penelitian dan Evaluasi Pendidikan*, 17(2), 230-240.
- Saido, G. M., Siraj, S., Nordin, A. B. B., & Al_Amedy, O. S. (2018). Higher order thinking skills among secondary school students in



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- science learning. *MOJES: Malaysian Online Journal of Educational Sciences*, 3(3), 13-20.
- Sulaiman, T., Muniyan, V., Madhvan, D., Hasan, R., Syrene, S., & Rahim, A. (2017). Implementation of higher order thinking skills in teaching of science: A case study in Malaysia. *International Research Journal of Education and Sciences (IRJES)*, 1(1), 2550-2158.
- Suprpto, N. (2016). What should educational reform in Indonesia look like?-Learning from the PISA science scores of East-Asian countries and Singapore. In *Asia-Pacific Forum on Science Learning & Teaching* (Vol. 17, No. 2).
- Velasufah, W., & Setiawan, A. R. (2019). Science Motivation Questionnaire II (SMQ-II): Analysis on Validity and Reliability of Bahasa Indonesia Version Through Various Learning Context.