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Competency profile of junior high school teachers in developing high-level science thinking questions

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Abstract. The aim of this research was for descript about skill profile of Junior High School teachers in developed high-order Science thinking questions. It was quantitative descriptive research for Junior High School teachers from East Indonesia. Data was a collected of questions that the teacher made for five working days in the technical guidance activities. Data was analyzed by quantitative descriptive refers to criteria of cognitive levels and rules for wrote the right questions. Results of this research were 71% was higher order thinking question at the implementation level, 61% at the analysis level, 53% at the evaluation level and 38% at the creative level. Based upon the rules for wrote the right question only 54% that met the criteria for wrote the right questions.

Keywords: Competency of Junior High School teachers, high-level thinking questions, Science

1. Introduction

Four main problems in 21st century education were knowledge aspect, skill, character, and metacognitive (Bialik, 2015), was related with creative competency, critical thinking, communication, and collaboration (Scott, 2017). It was 21st century competitiveness demands. Three demands of 21st century skills were study and innovation skill, life and career skill, and information, media, and technology skill (Scott, 2017). Study and innovation skills were communication, collaboration, critical thinking, and creative skill (4CS). Creative thinking and critical thinking skill were higher order thinking skill (HOTS) (Miri, David, & Uri, 2007; Moseley, et al., 2005), was needed to solve problems in the 21st century (Brookhart, 2010).

HOTS was the highest level of ability in the cognitive dimension (analyse, evaluate, create), and 3 levels of the knowledge dimension (conceptual, procedural, metacognitive) (Anderson & Krathwohl, 2001, Thompson, 2008). In learning, HOTS must be trained in student through presented problems in a form that was presented through active and student-centered learning (Akyol & Garrison, 2011).

Active and student-centered learning can be applied by teacher with problem-based learning (PBL) (Mokhtar et al., 2013), project based learning (PjBL) (Vidergor el. al., 2015), inquiry learning (Orlich,

et. al., 2010, Wang et al., 2015). Teacher barriers were developed problem based on good HOTS that shown in learning content or questions (Retnawati, et al., 2017). This problem implication to lower order skill of students. Results of the PISA 2015 test was measure higher order thinking skill shown that Indonesia students in four number from last of 73 countries (OECD, 2013, 2014, 2016). Teacher's understanding of HOTS was still not good, because the technique mixed the meaning of HOTS as a thinking skill with the methods applied in managed learning (Retnawati et.al., 2015).

Based upon the description, effort were made to improve the quality of Junior High School teachers in developed questions that had HOTS cognitive levels (Sajidan et al., 2015).. Quality improvement was carried out through technical guidance by Directorate of Junior High School Development which was intended for teachers from schools whose students were selected to be the subject of the PISSA test. The aim of this research was for descript the competency profile of Science teachers in developed HOTS questions, and measured the effectiveness of technical guidance on the development of question by the Directorate of Junior High School Development.

Problem of Research

With this research, perhaps that can descript about competency profile of Science teachers in developed higher order thinking skill questions and measured the effectiveness of technical guidance on the development of questions by the Directorate of Junior High School Development.

2. Methods

This research was Pre-Experimental Designs with design "one shot case study" (Fraenkel, & Wallen, 2012; Creswell, 2014; Tuckman & Harper, 2012). This research was did by 92 Science teachers of Junior High Scholl from DI Yogyakarta, West Kalimantan, South Kalimantan, East Kalimantan, Lampung, Riau, Bali, Gorontalo, East Java, Central Kalimantan, West Nusa Tenggara, East Nusa Tenggara, North Maluku, Papua, Central Sulawesi, and Southeast Sulawesi. Teachers were given technical guidance were Science teachers that the school be a target in PISSA test at 2018.

This research was research which implemented a developed assessment instrument in technical guidance modeling process. Data was a collected developed question by member of technical guidance and data was analyzed by quantitative descriptive. The question was analyzed refers to criteria that relation with question structure and assessment content of question.

3. Results and Discussion

The result show that teacher can developed a question physic and biology subject. In physic subject, teacher can made a question with 14 topics, and in biology can made 20 question topics. A question that made was filter by cognitive level, a question such as applied level, analyzed, evaluate, and create. From the questions generated, identification of items was the right thing to measure each level. From the all the question, applied level was 71%, analyzed level was 61%, evaluate level was 53%, and create level was 38%.

The question was variation such as multiple choice, essay, matchmaking, and short fill. The question was made by literacy, such as the example in modeling. Below was the example question.

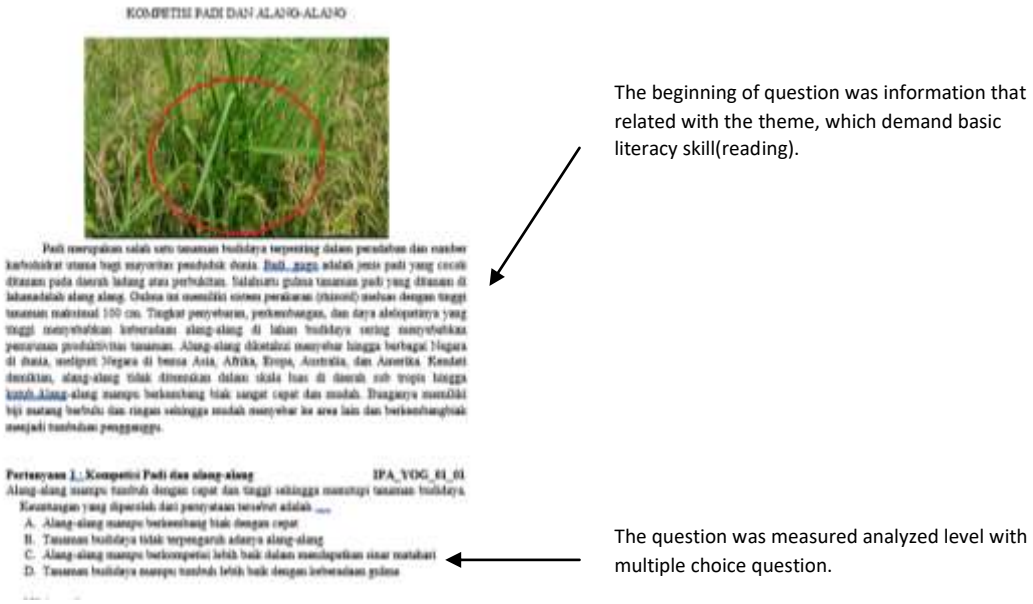

Figure 1. The example question which

The result show that all questions was literacy basic, and the question can to measured HOTS, in accordance with the 2013 Curriculum and relevant to Bloom's revised taxonomy (Anderson & Krathwohl, 2001). HOTS was three main components from dimensions of cognitive processes (analysis, evaluation, and create) with three main component knowledge dimensions (conceptual, procedural, and metacognitive). Based on the result, the teacher was understand about HOTS concept. The modelling can made the teacher understand concept and can implementation to make a question. Technical guidance very important to teacher, so the teacher can get more abilities and skills to understand about HOTS with this event.

Some problems was find in technical guidance, such as some interpretation in training and limited time so the material can't completely (Retnawati, 2015) was get answer from modelling activities of technical guidance.

HOTS was cognitive level that must be trained to solve problem, students can succeeded in school and give positive contribution to society (Conklin, 2012). Material content complexity give influence to arrange HOTS question (Djidu & Jailani, 2016).

This results of this study in more detail show the achievements of the questions that have been successfully arranged in the topic of biology and physic studies have a relatively similar spread, as shown in Figures 2 and 3.

Number Meaning:
1. Weed competition
2. Diversity of marine life
3. Marine biota food nets
4. Forest fires
5. Noise to marine biota
6. Ancient elephant
7. Dinosaurs
8. Bacteria
9. Anti poliomyelitis vaccine
10. Food digestion
11. Land use
12. Carbon oxygen cycle
13. Migratory bird
14. School park
15. Sea water pollution
16. Nutrition formula
17. Earth surface biota
18. Animal behavior
19. Plant pest control

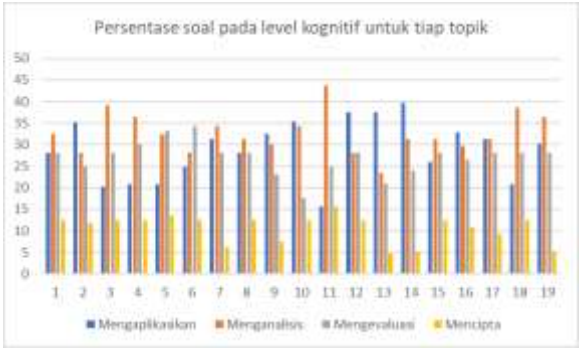

Figure 2. Profile chart of questions in the field of biological studies

Number Meaning:
1. Density
2. Sea water distillation
3. Mirror use
4. Star radiation
5. Villa construction
6. Geothermal power plant
7. Nano particle
8. Tornado
9. Electrical equipment
10. Bionic robot
11. The influence of motorized vehicles
12. The shape of the earth's surface
13. Solar cell panel
14. Motorcycle tires

Figure 3. Profile chart of questions in the field of physics

The aim of science learning that HOTS oriented was to improve students HOTS. Measured of students HOTS in science was important because can help to know the aim of learning was success or not success. Students HOTS can measured with task and test which arranged by HOTS aspects and indicators. The tasks can implementation with arranged a rubric, but testing can did with some testing, such as multiple choice or essay. Task and test have specification to measured students' thinking skills. Multiple choice was good to measured analysis and evaluate skills, while essay was good to measured create skill. Other than, Watson, Collis, Callingha, dan Moritz (1995) was recommended a opened question to measured students' knowledge. Ability was followed by assessment system. This research was conducted on 25 science teacher candidates in Turkey, comes with the finding that the teacher was still making mistakes in assessing students' thinking skills in making a science model of the problem given (Didis, Erbas, Cetinkaya, Cakiroglu, & Alacaci, 2016). They also show that many

teachers who only assessing students' thinking skills based on last results (only give true or false assessment, matching or not matching).

Meanwhile, only some students who assessing with observation of settlement process. Teacher's knowledge about higher order thinking skills and learning strategy can be concluded that teachers have good understanding in assessing of students' thinking skills. It can see from teaching responses ers ' that measured HOTS can did with essay which contain contextual problem. Assessment not only focus in students' last answer but in settlement process too. This results was relevant with Altun dan Akkaya (2014), most teachers thought that the reason for students' low ability to answer questions such as PISA was that the dentist was familiar with them. Teachers be a respondent to give recommendation that evaluate of learning outcomes must be did with essay and contextual question. Some researches in some country (Altun & Akkaya, 2014; Stahnke, Schueler & Roesken-Winter, 2016) said that one of the determinants of student success in improving competency and thinking skills was teacher competence and teacher mastery of learning content. Other than it, it was not just pedagogical science.

From the questions that made by teacher, the lower percentage was create cognitive level, it causes teachers' knowledge in material philosophically was still lack. The lack of mastery of material philosophically and the breadth of insight will prevent the teacher from directing students to create through a stimulus question.

4. Conclusion

Competency of Junior High School science teacher in developing HOTS problems have a tendency similar to the study of biology and physics. It can be explained that 71% of questions were categorized as high-level thinking problems at the implementation level, 61% at the analysis level, 53% at the evaluate level and 38% at the create level. Topic characteristics determine the percentage of successful questions arranged at the cognitive level.

5. Referensi

Akyol, Z., & Garrison, D. R. (2011). Understanding cognitive presence in an online and blended community of inquiry: Assessing outcomes and processes for deep approaches to learning. British Journal of Educational Technology, 42 (2), 233–250.

Altun, M., & Akkaya, R. (2014). Mathematics teachers' comments on PISA math questions and our country's students' low achievement levels. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 29 (1), 19–34.

Anderson, O. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York, NY: Longman.

Apino, E., & Retnawati, H. (2017). Developing instructional design to improve mathematical higher order thinking skills of students. Journal of Physics: Conference Series, 812, 1–7.

Bialik, M., Bogan, M., Fadel, C., & Horvathova, M. (2015). Education for the 21st century: What should students learn? Center for Curriculum Redesign, 3 (4), 415–420. Retrieved from www.curriculumredesign.org.

Didis, M. G., Erbas, A. K., Cetinkaya, B., Cakiroglu, E., & Alacaci, C. (2016). Exploring prospective secondary mathematics teachers' interpretation of student thinking through analyzing students' work in modelling. Mathematics Education Research Journal, 28 (3), 349–378.

Djidu, H., & Jailani. (2016). Activity in mathematics teaching and learning that fostering students' higher order thinking skills. In A. W. Kurniasih, B. E. Susilo, & M. Kharis (Eds.), Mathematics National Seminar 10th Proceeding, (pp. 367–376). Semarang: Mathematics and Social Science Faculty.

Bialik, M., Bogan, M., Fadel, C., & Horvathova, M. (2015). Education for the 21st century: What should students learn? Center for Curriculum Redesign, 3 (4), 415–420. Retrieved from www.curriculumredesign.org.

Brookhart, S. M. (2010). How to assess higher-order thinking skills in your classroom. Alexandria, VA: ASCD

Creswell, W. J.(2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research 4th edition*. Boston: Pearson.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). How to design and evaluate research in education (8th ed.). New York: McGraw-Hill.

OECD. (2013). *PISA Result (Volume V): Creative problem solving: Students' skills in tackling real-life problems.* Paris : OECD Publishing.

OECD. (2014). *PISA Results (Volume IV): What students know and can do – student performance in mathematics, reading and science.* Paris : PISA OECD Publishing.

OECD. (2016). *PISA Results (Volume I): Excellence and Equity in Education*, Paris : OECD Publishing.

Miri, B., David, B. C., & Uri, Z. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. Research in Science Education, 37 (4), 353–369.

Orlich, D., Harder, R., Callahan, R., Trevisan, M., & Brown, A. (2010). Teaching strategies: A guide to effective instruction. Boston, MA: Wadstworth.

Pangestika, R., & Alfarisa,A. (2015). *Pendidikan profesi guru (PPG) : Strategi pengembangan profesionalitas guru dan peningkatan mutu pendidikan indonesia*. Naskah Prosiding Seminar Nasional di Universitas Negeri Yogyakarta.

Retnawati, H., Hadi, S., & Nugraha, A. C. (2016). Vocational high school teachers' difficulties in implementing the assessment in curriculum 2013 in Yogyakarta Province of Indonesia. International Journal of Instruction, 9 (1), 33–48.

Stahnke, R., Schueler, S., & Roesken-Winter, B. (2016). Teachers' perception, interpretation, and decision-making: A systematic review of empirical mathematics education research. ZDM - Mathematics Education, 48 (1–2), 1–27.

Thomas, A., & Thorne, G. (2009). How to increase higher order thinking. Retrieved January 2, 2017, from http://www.readingrockets.org/article/how-increase-higher-order-thinking

Scott, L. A. (2017). 21st century skills early learning framework. Partnership for 21st Century Skill (P21). Retrieved from http://www.p21.org/storage/documents/EarlyLearning_Framework/ P21_ELF_ Framework_Final.pdf.

Sajidan, S. Widoretno, M. Ramli, Joko A. (2015). Kualitas Dan Kuantitas Pertanyaan Guru Dan Peserta Didik Sebagai Indikator Proses Berpikir Pada Pembelajaran Biologi Di SMA Surakarta. Laporan Akhir (unpublished)

Tuckman, W. B. & Harper, E. B. (2012). *Conducting educational research*. USA: Rowman & Littlefield Publishers

Wang, J.-Y., Wu, H.-K., Chien, S. P., Hwang, F. K., & Hsu, Y. S. (2015). Designing Apps for science learning: Facilitating high school students' conceptual understanding by using tablet PCs. Journal of Educational Computing Research, 51(4), 441-458. *http://dx.doi.org/10.2190/EC.51.4.d*

Watson, J. M., Collis, K. F., Callingham, R. A., & Moritz, J. B. (1995). A model for assessing higher order thinking in statistics. Educational Research and Evaluation, 1 (3), 247–275.