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by Suharto Linuwih

DEVELOPMENT OF E-DIAGNOSTIC TEST TO IDENTIFY THE LEVEL OF UNDERSTANDING OF THE CONCEPT OF JUNIOR HIGH SCHOOL STUDENTS ON TEMPERATURE AND HEAT

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ABSTRACT

The development research aims to develop a web-based diagnostic test product that fit for use to identify students' understanding of the concept of temperature and heat. Results of the analysis of the acquisition the value of seventh grade students in science subjects at SMPN 2 Kendal, shows that on the material temperature and heat, only 59% of students who meet the completeness criteria. This suggests the need for test device that can diagnose students' level of understanding on temperature and heat material. The testing product through several stage of limited-scale, wide-scale testing, and implementation. Result of product validation by testing instrument and media expert, show that the e-diagnostic test has been properly used because the product has been fill the properly contents, language, construct, software engineering, and visual communication aspect. The results showed that students who achieve a minimum passing criteria only 3 out of 22 students. Result the percentage of students' level of understanding that is included in the relational criteria understanding of each indicator is the indicator 1 (knowing the definition of temperature and heat) 40%, indicator 2 (understand the scale of the temperature on the thermometer) 32%, indicator 3 (Understand and explain the phenomenon of the expansion) 38%, and the indicator 4 (understand heat and temperature changes as well as the heat transfer) 37%. Result from this research indicates that the e-diagnostic test has been properly used to diagnose the level of students' understanding of the concept.

Keywords: e-diagnostic test, understanding the concept of temperature and heat.

INTRODUCTION

Group of subjects in science and technology intended to acquire basic competencies in science and technology as well as cultivate scientific thinking critically, creatively, and independently (MONE, 2006). Thus, a group of science subjects in addition to improving knowledge also can improve the skills of learners.

Natural science has a very important role in all aspects of life. Physics is part of the natural sciences, where the physics is also studying the phenomena that occur in nature. In addition, natural science (IPA) is obtained from theoretical reasoning derived from observation and experimentation to natural phenomena (Ribkahwati, 2012). Based on this, the physics as one of the natural sciences should be taught to students to improve the way of thinking.

Result of preliminary observations made in SMPN 2 Kendal is obtained regarding student learning achievement. Acquisition of the learning outcomes of the daily test results in SMPN 2 Kendal. Daily test values seventh grade students of SMPN 2 Kendal, material temperature and the result is the lowest heat if compared with other material which is only about 16% of third grade students who achieve a minimum completeness criteria. Based on these results needed further information on the basic concepts of temperature and heat in the material that students have not mastered resulting in low acquisition of student learning outcomes, the researchers assumed that the diagnostic tests can identify learning problems experienced by students.

Diagnostic tests are tests performed to diagnose learning problems experienced by students for example, the problems associated with the understanding of the concept. Besides functioning to diagnose students' learning problems this test is also useful for educators one of which educators can plan appropriate action in the

form of efforts to solve the problems that have been identified. Media test or diagnostic test kits in fact still a lot that is presented in the form of manuals, of course it is not easier for students to perform diagnostic tests at the same educators will also be difficult to identify the weaknesses in students' mastery of concepts. Seeing these conditions, researchers are interested in developing a web-based diagnostic tests. Process of diagnostic tests that students can do online and requires a computer device.

Pradika research results (2014) indicate that the two levels of diagnostic tests developed a web-based SMP 2 Magelang can identify students' understanding of concepts in Optics and Vision theme. Based on the above, the authors chose the title "Development of E-Diagnostic Test to Identify Level Concept Training Junior High School Students In Temperature Materials and Heat".

METHODS

The experiment was conducted in March-April 2015, at the Junior High School 2 Kendal in the second semester. The research method was developed refers to the approach to research and development (research and development) which was adapted from Sugiyono. Results and identification of potential problems in the field and then supported by the literature, for subsequent use to design e-diagnostic test. Design validation process carried out with the involvement of two experts, the media expert and test instruments, each of which consists of two lecturers and two teachers. The tests determine the appropriateness of e-diagnostic test for use in research. Limited scale trial involving eight students of class VII D carried out after the e-diagnostic test is declared feasible by experts. On a limited scale testing students give feedback to be used as material further improvement before entering the large-scale trials (22 students of class VII B). And so on until well into the implementation phase (22 students of class VII C), so that the resulting e-viable diagnostic test used.

RESULTS AND DISCUSSION

The results of the feasibility study include e-diagnostic test by experts, the feasibility of e-diagnostic test by the respondent, and the level of understanding of students on the material temperature and heat.

A. Eligibility e-diagnostic test

The eligibility criteria of e-diagnostic test based on the assessment of the feasibility of junior high school textbooks by BSNP that has been modified. Aspects

assessed among others, feasibility aspects of content, construct, languages, software engineering, and visual communication. Results of a feasibility assessment e-diagnostic test by expert test instruments are presented in Table 1.

Table 1. Results of Feasibility e-diagnostic test by Test Instruments Expert

Assessor	% Acquisition Score		
	Contents	Construct	Language Assesment
Validator 1	100	100	100
Validator 2	100	100	87,50
Validator 3	100	87,50	87,50
Average	100	95,83	91,66
Criteria	very decent	very decent	very decent

Results of a feasibility assessment e-diagnostic test by expert test instruments are presented in Table 2.

Table 2. Results of Feasibility e-diagnostic test by Media Expert

Assessor	% Acquisition Score	
	Device Engineering	Visual Communication
Validator 1	100	100
Validator 2	100	91,66
Validator 3	100	91,66
Average	100	94,44
Criteria	very decent	very decent

Results of a feasibility assessment e-diagnostic test by the respondent are presented in Table 3.

Table 3. Results of Feasibility Assesment e-diagnostic Test by respondent

Phase	% Acquisition Score				
	A	B	C	D	E
limited scale test	84	80	78	83	78
wide scale testing	85	81	81	84	80
Implementation	87	82	83	86	81
Average	85	81	81	84	81
Criteria	SL	L	L	SL	L

Description:
SL = Very Worthy
L = Worth
A = Feasibility contents
B = Feasibility construct
C = Feasibility language
D = Engineering device
E = Visual Communication

B. Concept Training

Understanding of the material temperature and heat by the students in this study, it is known from the combination of the students' answers on the grounds that have been in working on e-diagnostic test. Table 4 shows the assessment criteria for diagnostic tests, with the level of understanding of the concepts that have been proposed by Skemp (1976).

Based on the result and explanation above, it can be concluded that teachers are already planning a science learning with guided inquiry. However, at stages guided inquiry has not been fully carried out by teachers in teaching physics class XII. The learning process includes initial, core activities and closing activities. Initial activities carried out by teachers with open lessons, organized presence, giving apperception and mention learning objectives. Core activities ie orientation, formulating the problem, formulating a hypothesis, test the hypothesis and drawing conclusions. Cover the activities carried out by the teacher held a reflection of learning materials, providing evaluation questions and close the learning activities. Evaluations are conducted by teachers so far with the evaluation of the written test that includes only cognitive students.

Table 4. Criteria for Assessment E-diagnostic Test

Profile Indicator 1 (knowing the definition of temperature and heat)

Indicator 1 consists of 4 items. Problem No. 1 presents questions about the changes in temperature, No. 2 presents question about the definition of temperature, no 3 presents question about microscopic of temperature, no. 4 presents question about the liquid filler on thermometer. Detailed data regarding the first indicator presented in Table 5.

No	Condition	Type Response	Score
1	Misunderstanding	Answer wrong and wrong reasons	0
2	Instrumental Understanding	Answer right and wrong reasons	1
		Answer wrong and right reasons	1
3	Relational Understanding	Answer true and correct reasons	2

Table 5. Profile Understanding Indicator 1

Quest no	A Number of students	B Number of students	C Number of students
1	4	2	16
2	14	5	3
3	2	12	8
4	15	4	3

Description:
A = Relational Understanding
B = Instrumental Understanding
C = misunderstanding

Based on Table 5 shows that the item number 4 is the most widely items students answered correctly and item number 3 only a small fraction of students that can answer correctly.

The results of analysis performed on the indicator 1 indicate that the item number 4 is the most widely items students answered correctly. This indicates that the student has understood the liquid is either used for filler thermometer and students are able to explain the reason why the liquid is either used as filler thermometer. Item number 3 only a small percentage of students who can answer correctly. This shows that students do not understand the concept of the state of atoms and molecules of a substance when the temperature is raised.

Many students are able to give a precise answer to the item number 4 and only a few students who can answer appropriately item number 3. This is because the question presented in item number 4 is a matter that is related to things that are often encountered in life. Mudjiono (2006) argues that knowledge is shaped by the individual because the individual conduct continuous interaction with the environment. Thermometers are objects that are familiar to junior high school students because the majority of junior high school students have had the experience of interacting with a thermometer.

Profile Indicator 2 (understand the scale of the temperature on the thermometer)

Indicator 2 consists of two items. Problem No. 5 presents questions about the fixed point of thermometer, question no 7 the thermometer measuring on area. Detailed data regarding the first indicator presented in Table 6

Table 6. Profile Understanding Indicator 2

Quest no	A Number of students	B Number of students	C Number of students
5	3	14	5
7	11	8	3

Description:
A = Relational Understanding
B = Instrumental Understanding
C = misunderstanding

Based on Table 6 shows that the indicator 2, item number 7 as much as 50% of students had answered correctly and item no. 5 only 3 students who answered correctly.

In the second indicator, item number 7 as much as 50% of students have answered correctly. The analysis results showed that students in understanding the area of measuring the clinical thermometer. Students have a good understanding of the clinical thermometer due to the function of the use of clinical thermometer is to measure body temperature.

Profile Indicator 3 (Understand and explain the phenomenon of the expansion)

Indicator 3 consists of 4 items. Problem No. 6 presents questions about the events of the expansion point, question no 8 on expansion on the glass, a matter of no 9 and 10 of the expansion in the bimetal. Detailed data regarding the first indicator presented in Table 7.

Table 7. Profile Understanding Indicator 3

Quest no	A Number of students	B Number of students	C Number of students
6	6	4	12
8	7	10	5
9	9	7	6
10	11	8	3

Description:
A = Relational Understanding
B = Instrumental Understanding
C = misunderstanding

Based on Table 7 it can be seen that the numbers 6-10 about the average percentage of students are relatively equal in understanding relational and instrumental understanding on the matter of numbers 8, 9, and 10 relatively the same.

In the third indicator, item numbers 6-10 the average percentage of students are relatively equal in relational understanding. The analysis results showed that the students have understood the correct item No. 6-10. This is shown by the students can give the right answers and reasons.

In addition, it can be seen that the instrumental understanding in a matter of numbers 9 and 10 are relatively similar, but the question number 8 shows the results of the most high. It is because students merely memorize without a deeper understanding of the concept. This is indicated by

Profile Indicator 4 (understand heat and temperature changes as well as the heat transfer)

Indicator 4 consists of 11 items. Problem No. 11 presents questions about the transfer of heat, question no 12 on heat transfer, question no 13 on the transfer kaor,

question no 14 on heat transfer, question no 15 on heat transfer, question no 16 on the incident radiation, question no 17 on the events conduction, question no 18 on convection, question no 19 and 20 about the incident radiation, question no 21 on heat transfer. Detailed data regarding the first indicator presented in Table 8.

Based on Table 8 can be seen that the question of numbers 11, 13, and 15, students who answered correctly achieve high results. Based on Table 4.13 it can be seen that the question of numbers 11, 13, and 15, students who answered correctly achieve high results. this is because the numbers are present events that exist in everyday life, so that students are used and therefore the explanation to better answer the question as well. This is consistent with the explanation by Rifa'I and Anni (2011) that the learning outcomes of students obtained learners after experiencing learning activities and depending on what is learned by students.

Table 8. Profile Understanding Indicators 4

Quest no	A Number of students	B Number of students	C Number of students
11	12	6	4
12	5	11	6
13	13	2	7
14	10	10	2
15	12	6	4
16	4	11	7
17	7	11	4
18	1	14	7
19	9	9	4
20	7	13	2
21	10	9	3

Description:
A = Relational Understanding
B = Instrumental Understanding
C = misunderstanding

CONCLUSION

Based on the analysis that has been done, e-diagnostic test materials and heat temperature for junior high school students of class VII declared fit for use as a diagnostic test kits because it has met the eligibility aspects of the content, construct, languages, software and visual communication in accordance with the standards of eligibility by the National Education Standards. The average value of results of the test instrument validation phase 1 and phase 2 is 94.13%. Results of media validation phase 1 and phase 2 has met the minimum eligibility percentage with an average value of 94.52% with criteria very well. Furthermore, the profile of the

students in understanding the concept of temperature and heat the material has can be seen after the use of e-diagnostic test performed. 40% of students have understood the definition of temperature and thermometer, 32% of students have understood the temperature on the thermometer scale, 38% of students have understood and could explain the expansion of the event, 37% of students have understood the heat and change of temperature and heat transfer.

Therefore, the authors suggest those researchers who will conduct similar studies, preferably equipped with a remedial assignment in accordance with the material that has not been mastered by each student.

REFERENCES

Arends, R. I. 2013. Belajar untuk Mengajar. Salemba Humanika: Jakarta

Arikunto, S. 2009. Dasar-Dasar Evaluasi Pembelajaran. Jakarta: BumiAksara.

Banerjee, A. Teaching Science Using Guided Inquiryas the Central Theme: A Professional Development Model for High School Science Teachers. *Fall 2010, 19(2)*

Berg, C.A.R., Bergendahl C.V., Lundberg K.S. & Tibell L.A.E. 2003. Benefiting from an open-ended experiment? A comparison of attitudes to, and outcomes of, an expository versus an open-inquiry version of thesame experiment. *International Journal of Science Education, 25: 1-22.*

Buck, G.A, Latta, M.A & Pelecky, D.L. 2007. Learning How to Make Inquiry into Electricity and Magnetism Discernible to Middle Level Teachers. *Journal of Science Education.* 18: 377-397

Cheung, D. 2007. Facilitating chemistry teachers to implement inquiry based laboratory work. *International Journal Science Mathematics Education*, 6 (1): 107-130.

Deters, K. M. 2005. Student opinions regarding inquiry-based labs. *Journal of Chemical Education, 82,* 1178.

Furtak, M.E. 2006. The problem with answers: An exploration of guided scientific inquiry teaching. *Science Education*, 90 (3): 453-467.

Jack, G.U. 2013. Concept Mapping and Guided Inquiry as Effective Techniques for Teaching Difficult Concepts in Chemistry: Effect on Students' Academic Achievement. *Journal of Education and Practice*. ISSN 2222-1735 (Paper) ISSN 2222-288X (Online), 4 (5)

Kai, H.W., Krajcik, J.S. 2006. Inscriptional practices in two inquiry-based classrooms: A case study of seventh graders' use of data tables and graphs. *Journal of Research in Science Teaching*, 43 (1): 63-95.

Khishfe, R., Abd-El-Khalick, F. 2002. Influence of explicit and reflective versus implicit inquiry-oriented instruction on sixth graders views of nature of science. *Journal of Research in Science Teaching*, 39: 551-578.

Lim, B.R. 2004. Challenges and issues in designing inquiry on the Web. *British Journal of Education Technology*, 35(5): 627-643.

Linn, M. C., Davis, E. A., & Bell. P. 2004. Inquiry and technology. In M.C. Linn, E.A. Davis, & P. Bell (Eds.), *Internet Environments for Science Education (pp. 3-28).* Mahwah, NJ: Lawrence Erlbaum Associates.

National Research Council. 2001. Inquiry and the National Science Education Standards. Washington, DC: National Academy Press.

Saglam, M & Millar, R. 2006. Upper High school Students Understanding of electromagnetism. *International Journal of Science Education.* 28 (5): 543-566

Sanjaya, W. 2014. *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan.* Edisi 1 Cetakan ke 11. Jakarta: Kencana.

Saarelaeen, M. 2011. Teaching and Learning of Electric and Magnetic Fields at University level. Dissertation in Forestry and Natural Science. University of Eastern Finland.

Sugiyono. 2012. *Metode Penelitian Kuantitatif, Kualitatif dan R&D.* Bandung: CV Alfabeta.

Wallace, C.S. & Kang, N.H. 2004. An investigation of experienced secondary science teachers' beliefs about inquiry: An examination of competing belief sets. *Journal of Research in Science Teaching*, 41(9): 905-935.

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PRIMARY SOURCES

1   Maufroy, E., E. Chaljub, F. Hollender, P.-Y. Bard, J. Kristek, P. Moczo, F. De Martin, N. Theodoulidis, M. Manakou, C. Guyonnet-Benaize, N. Hollard, and K. Pitilakis. "3D numerical simulation and ground motion prediction: Verification, validation and beyond – Lessons from the E2VP project", Soil Dynamics and Earthquake Engineering, 2016.
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