PHYCCTM Development Based On KKNI On Impuls And Momentum Material To Increase HOTS And Independent Character

Soeharto
Yogyakarta State University
Soehartopfisika@gmail.com

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Abstract: This study aimed to: (1) Produce KKNI-based PhyCCTM learning tool to improve HOTS and independent character Learners, (2) to know the result of HOTS improvement in Physics learning by using KKNI-based PhyCCTM Learning Tool developed, (3) to know the level of character category self-supporting Learners in Physics learning using KKNI-based PhyCCTM learning tools developed, and (4) to know the effect of applying learning using KKNI-based PhyCCTM learning device to control class and experiment on HOTS and Independent character of Learners. The developed product uses R & D method in the form of KKNI-based PhyCCTM learning device on impulse and momentum materials covering Syllabus, RPP, Teaching Material, LKPD, HOTS Evaluation Test and Self Character Sheet. The study was conducted in SMAN 8 Yogyakarta and SMAN 1 Kasihan. The results showed that (1) PhyCCTM-based learning tools KKNI worthy of the category "Good and Very Good". (2) KKNI-based PhyCCTM learning tools can improve HOTS for learners (Sig. 2-tailed by 0.001). (3) KKNI-based PhyCCTM learning tools can enhance the independent character of learners with the category "Fair". (4) KKNI-based PhyCCTM-developed learning tools effectively improve HOTS and independent character of learners (Sig. 0.000).

Keywords: PhyCCTM, HOTS, Independent Character

INTRODUCTION

Indonesia's achievement of science in international level can be seen based on two world-level survey results that need to be observed, namely: The Learning Curve 2014 Report and The PISA 2012 Report. The Learning Curve 2014 Report (November 28, 2012) showed education outcomes in Indonesia were in the bottom 10 (Z-score = -2.03). Indonesia was in about 2-3% of the lowest group. In addition, findings from member countries and partners of The Organization for Economic Co-operation and Development'-OECD on December 4, 2013, launched PISA survey results on 15-year-old students' abilities in math, language (reading: reading) and science. The result put Indonesia at 64th in mathematics and science and the 61st in reading. The lowest position was the 65th. It was also reported that most (75.7%) of Indonesian students' ability to participate in the survey was in the below-level 2 group (OECD, 2014). That meant they were only able to work on the questions that the information had been available

complete and could be answered directly without having to do inference such as issues that require high-order thinking skills[1].

Lack of ability of learners in doing physics problems seen from the results of National Examination High School Students in Yogyakarta Special Region showed that the lowest physics value was 3.40 and the highest value 9.70 and the average value was 6.90. Compared with other science subjects such as chemistry and biology, the lowest physics score compared to chemistry 7,88 and biology 7.62.[2] Weak ability to think high-level physics learners also can be seen on the findings by Istiyono[3] who had examined the ability of high-order thinking or Higher Order Thinking Skills (HOTS) Physics High School students in Yogyakarta. The percentage of HOTS Physics ability of SMA students in Yogyakarta in the order of very low, low, medium, high, and very high category was 1.91%, 16.03%, 61.11%, 20.75% and 0.19%. These findings showed that physics HOTS physics ability of learners only in the category of medium (61.03%), while in the high category and very high only 20.94%. The two schools included in the high and very high HOTS category are SMAN 6 Yogyakarta (6.07%) and SMAN 1 Bantul (2.23%), and five schools that belong to low and very low category were SMAN 1 Kasihan (4, 28%), SMAN 1 Godean (1,98%), SMAN 1 Sewon (1,66%), SMAN 8 Yogyakarta (1,53%), and SMAN 2 Yogyakarta (1,41%).

Preliminary survey that had been done by researcher related to HOTS ability of students on impulse and momentum also found that average HOTS ability in SMAN 8 Yogyakarta (49.37%), SMAN 2 Sleman (46.15%), SMAN 1 Poor (45.38%), SMAN 1 Sentolo (48.26%), and SMAN 1 Playen (53.37%) showed the physics HOTS capability was still relatively low.

HOTS enhancement efforts have also been done by Richland & Simms (2015)[4] using analogy to improve the HOTS of learners demonstrating that the key to developing HOTS in mathematics, science, and history is interrelated conceptual learning. Simon (2015)[5] conducted a study to increase HOTS learners with a virtual lab that shows the media can increase 60% HOTS Learners. Kapler et al (2015)[6] examined the class semester simulations for increasing HOTS Learners who demonstrate effective classroom simulation programs to improve HOTS. Kuldas et al (2014)[7] examined the importance of Malaysian learners to improve HOTS, against risk factors and academic demonstrations to find that the background of learners greatly influences

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[1] Devit Etika Sari and Muh Barid Nizarudin Wajdi, "The Effectiveness Of The Method of GI With Electronic Workbench Study To Improve Activities and Results Student," *Educatio : Journal of Education* 2, no. 1 (2017): 136–150, http://www.ejournal.staimnglawak.ac.id/index.php/educatio/article/view/22.

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[3] Edi Istiyono, Djemari Mardapi and Suparno, "Pengembangan Tes Kemampuan Berpikir Tingkat Tinggi Fisika (PhysTHOTS) Peserta Didik SMA," *Jurnal Penelitian dan Evaluasi Pendidikan* 14, (2014): 1-12.

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[5] N. Simon, "Improving Higher-Order Thinking Skills Using Virtual and Simulated Science Laboratory Experiments," *Springer: New Trends in Networking, Computing, E-Learning, Systems Science, and Engineering* 312, (2015): 187-192.

[6] I. V. Kapler et al., "Spacing in a Simulated Undergraduate Classroom: Long-Term Benefits for Factual and Higher-Level Learning," *Science Direct: Learning and Instruction* 36, (2015): 38-45.

[7] S. Kuldas et al., "Malaysian Adolescent Students' Needs for Enhancing Thinking Skills, Counteracting Risk Factors and Demonstrating Academic Resilience," *International Journal of Adolescence and Youth* 20, (2014): 32-47.

their ability to complete cognitive tasks. Harrison (2013)[8] examined the use of interactive whiteboards to enhance the teacher HOTS' ability.

Improvement of HOTS in science had been done by Hugerat & Kortam (2014)[9] researching about HOTS improvement through science approach and inquiry found that average 82% ability of HOTS learners increase. However, from various research reviews found related to HOTS, it had not been seen that research studies on efforts to improve HOTS physics ability with teaching materials were still rare. Thus, the research undertaken focuses on improving physics HOTS on impulse material and the momentum of learners in SMAN 8 Yogyakarta and SMAN 1 Kasihan which fall into the low category in physics HOTS.

In addition to improving the ability of HOTS Learners, the world of education can also be a means to exemplify, instill and familiarize positive behaviors in learners as well as on all the individuals involved in it. Realizing this, the Ministry of National Education has compiled a grand design of national education in 2010 which states that the success of character education needs to be supported by (1) the commitment of all stakeholders in the success of character education; (2) consistency of policy and implementation of character education policy; (3) integrity and sustainability of the development of character education programs and activities; (4) prioritizing character education in the national education system; (5) guarantee the quality of character education; and (6) active participation of the community and business world in character education. So that in good learning should emphasize character education. one of the characters developed in this study is an independent character. Self-help characters assist students in developing cognitive knowledge. Independent characters help students to prepare the knowledge they learn before the learning activities so that the independent character is a very important character for learners[10].

Human Resource Issues are also a constraint in Indonesia. The actions were taken by Indonesia to improve competence and make equalization of Human Resource qualification are forming the Indonesian Qualification Framework (IQF) or commonly known as the Indonesian National Qualification Framework (KKNI)[11]. KKNI is designed to adapt the National Qualification Framework (NQF) globally where each level can be pursued in a variety of different ways informal education, informal education, training and work experience. High School or Vocational High School (SMA/SMK) is at level 2 KKNI. Competencies that must be mastered for high school graduates based on KKNI level 2 are (1) able to carry out a specific task, using the tools, information, and work procedures that are commonly performed and show performance with measurable quality, under the supervision of his supervisor directly (2) have basic operational knowledge and factual knowledge of specific areas of work, so as to be able to choose available solutions to common problems and (3) be responsible for self-employment and

[8] N. Harrison, "Using the Interactive Whiteboard to Scaffold a Metalanguage: Teaching Higher Order Thinking Skills in Preservice Teacher Education," *Australasian Journal of Educational Technology* 29, (2013): 55-65.

[9] M. Hugerat and N. Kortam, "Improving Higher Order Thinking Skills among Freshmen by Teaching Science through Inquiry," *Eurasia Journal of Mathematics, Science & Technology Education* 10, (2014): 447-454.

[10] Muh Barid Nizaruddin Wajdi, "Arabic Learning Skill," *AT-Tahdzib: Jurnal Studi Islam dan Muamalah* 3, no. 2 (2016): 32–47.

[11] Muh. Barid Nizarudin Wajdi, " المناهج التعليمية للغة العربية في تطوير المفردات لغير الناطقين بها," *At-Tajdid: Jurnal Ilmu Tarbiyah; Vol 5 No 1 (2016): January 2016* (2016), http://ejournal.stitmuhpacitan.ac.id/index.php/tajdid/article/view/15.

be responsible for guiding others. This competency should be developed in the learning tools and curriculum in schools.

KKNI is the basic development of Curriculum 2013. Problems that occur in the effort to prepare and implement the Curriculum 2013 is the absence of teaching materials that can precisely achieve competence in the curriculum and can improve the ability to think critically and analyze the students, so it needs to be made competent teaching materials developed from KKNI and Curriculum 2013.

Based on the problems and findings of research results that have been presented, preliminary research and literature review, the research conducted in the development of Physics Comprehensive Contextual Teaching Material (PhyCCTM) based on KKNI on impulse and momentum materials to improve HOTS ability and independent character of high school students.

The objectives of this research were; (1) Produce KKNI-based PhyCCTM learning tool to improve HOTS and independent character Learners, (2) to know the result of HOTS improvement in Physics learning by using KKNI-based PhyCCTM Learning Tool developed, (3) to know the level of independent character categories Learners in learning Physics by using KKNI-based PhyCCTM learning tools developed, and (4) knowing the effect of applying learning using KKNI-based PhyCCTM learning device to control and experiment class on HOTS and Independent character of Learners.

The expected benefits of the research results in terms of theoretical can be one reference learning tool in improving HOTS and Character Independent Learners. Meanwhile, in terms of applicative, is expected to be a stock of teachers, especially in the field of Physics education at high school level that is improving HOTS and Self Character Learners in Physics learning.

RESEARCH METHOD

This research was an R & D (research and development) research with Borg & Gall development model whose steps are modified include preliminary study and planning, development stage and evaluation phase. This research used qualitative and quantitative approach. Qualitative approach specializes to analyze the feasibility of the product, questionnaire responds an independent character of learners. The quantitative approach was used to analyze the HOTS improvement and the effect of the resulting product on the HOTS enhancement and the independent character of the learner.

The study was conducted on January 1, 2016, until April 30, 2016. The preliminary study of HOTS survey was conducted in five schools in Yogyakarta namely SMAN 8 Yogyakarta, SMAN 2 Sleman, SMAN 1 Kasihan, SMAN 1 Sentolo, and SMAN 1 Playen. After conducting the survey in the school is done limited test class XI MIPA 7 SMA N 8 Yogyakarta. The broad test was conducted in class XI MIA 3 SMA N 1 Poor as an experimental class and grade XI MIA 6 SMAN 1 Poor as a control class.

In the preliminary study conducted a survey of 5 schools in Yogyakarta to know the distribution of the ability of HOTS in 144 high school students. Furthermore, a limited test was conducted on 19 students at SMA N 8 Yogyakarta and extensive test on 60 students at SMAN 1 Kasihan. The total sample in this study was 223 high school students.

The initial stage of this research was product development in accordance with the R & D research steps of the Borg and Gall development model. After that, the initial product that was vetted was validated by two expert Lecturers and two Physics Teachers. After the final product was validated and improved according to the validator's suggestion, a preliminary survey was conducted to find out the distribution of HOTS in DIY. The limited test was conducted in SMAN 8 Yogyakarta. After a limited test, the product was repaired so as to produce product 1. Furthermore, extensive test conducted in SMAN 1 Kasihan. After extensive test, repairing and producing product 2. Product 2 was the final product of the results of research conducted in the first year.

Survey data analysis was done quantitatively with the helped of Rasch Model to know reliability, empiric validity, and difficulty level of problem. The analysis of research data was done qualitatively and quantitatively. Qualitative analysis was conducted to find out the category of product feasibility, questionnaire response and independent character of learners. Quantitative analysis was performed using SPSS 17 assistance to determine the HOTS increase in the limited test with t-test and score gain. Meanwhile, to know the effect of the resulting product on HOTS and independent characters Learners used Manova.

RESULT AND DISCUSSION

The preliminary survey results showed the validity and reliability of the HOTS Evaluation Instrument used. Based on the analysis of Rasch model it was known that Cronbach alpha value (measure reliability) shows the value of 0.93 and 0.94 on the item stated that the reliability of the instrument was classified as "Excellent." INFIT MNSQ and OUTFIT MNSQ values on the items are 0.99 and -0.3 respectively that the instrument has a good validity as it approaches its ideal value was 1.00 MNSQ INFIT and OUTFIT MNSQ values in person in sequence were 1.04 and -0.1 indicated that the instrument has good validity as it approaches its ideal value was 0.00.

Product Feasibility Result based on validation of expert lecturer and physics teacher in Table 1.

Table 1. Product Feasibility by Validator

Validator	Average Value	Score
Expert Lecturer	3.42	Good
Physics Teacher	3.81	Very Good

Based on Product validation results. The product was said to be eligible with a good category of 3.42 by Expert and Excellent lecturer of 3.81 by the physics teacher.

Student response to LKPD, teaching materials, and learning process was shown in Table 2.

Table 2. Student's Response to LKPD, Teaching Materials, and Learning Process

Test	Average Value	Skor
Limited Test	3.04	Good
Wide Test	2.95	Good

From the result of limited test and wide test known to learners' response to LKPD, Teaching Materials and Learning Process categorized both equal to 3.04 and 2.95.

In the limited test known increase HOTS with Gain Score in Table 3.

Table 3. Gain HOTS score of learners on a limited test

	Pre	Post	Gain	Category
Average	52.30	62.93	0.195	Low

While based on t-test known that there was significant difference in Sig value. (2-tailed) of 0.001 <0.05 which indicates that there was a significant difference between the pretest and posttest HOTS evaluation tests.

On the Test, Area was also known Gain score HOTS learners. Table 4 shows Gain HOTS score of learners on a broad test.

Table 4. Gain HOTS score of learners on a limited test

	Pre	Post	Gain	Category
Average	42.98	66.38	0.397	Medium

In the broad test results obtained better than the limited test in terms of the increase in HOTS learners and Gain score. This might happen because the learning that occurred because the product had been improved based on data from the limited test.

Enhancement and self-contained learner categories were known in the test area because they could be compared between the control and experimental classes. Table 5 showed the character enhancement of independent on wide test.

Table 5. Average Self-Character on Extensive Test

Group	Average Value	Category
Control	2.67	Fair
Experiment	2.76	Fair

Based on Table 5, the control class and the experimental class on the broad test had sufficient categories on the standalone characters, but the mean standalone character values in the experiment class were higher than the control class. These data showed that the treatment provided effectively improves the independent character of the learner.

The effect of the application of the products produced on the control and experimental class in terms of HOTS and the independent character of the learners was known through the Manova test with the help of SPSS 17. Based on the Manova test it was known that Sig. of F from Wilks' Lambda, Pillai's Trace, Hotelling's Trace and Roy's Largest Root is 0.000 <0.05, then Ho was rejected. So, in conclusion: There were a significant difference in effectiveness on the average HOTS (Y1) and independent characters (Y2) between learners who were taught by PhyCCTM-based KKNI-based learning tools and learners who are taught with Teacher learning tools. So, it could be said PhyCCTM Learning Tool developed to improve HOTS and Character Independent learners.

CONCLUSION

Based on the research that had been done could be concluded that: (1) The Product has been produced in the form of PhyCCTM based on KKNI on impulse material and decent momentum with "Good" category by expert lecturer and "Very Good" by physics teacher. (2) Learning Tools PhyCCTM based KKNI able to increase HOTS Learners on the material impulse and momentum. This had seen from the average gain of HOTS score of learners in the experimental class of 0.39 and control class of 0.15. In addition to the t-test was known that there was a significant difference in the value of Sig. (2-tailed) of 0.001 <0.05 which indicated that there was a significant difference between the pretest and posttest HOTS evaluation tests. (3) Learning Tool PhyCCTM able to improve the autonomous character of learners with the average questionnaire value and observation of independent characters of learners in the experimental class in sequence of 2.76 and 2.74 are sufficiently categorized. But the average experiment class was higher than the control class. (4) There was a significant difference in effectiveness on the average HOTS (Y1) and independent characters (Y2) between learners who were taught by PhyCCTM-based KKNI development tools and learners who were taught with Teacher learning tools. Could be concluded Learning Kit PhyCCTM-based KKNI able to improve HOTS and Character Independent learners. Based on the Manova test it was known that Sig. of F from Wilks' Lambda, Pillai's Trace, Hotelling's Trace and Roy's Largest Root was 0.000 <0.05.

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