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Design of the CLT-HOTS Learning Model to Improve Physics Problem-Solving Skills Across Interests

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Abstract

The low problem-solving skills of students in physics learning, especially in cross-interest physics learning. To overcome this problem, a learning model was developed that can improve students' problem-solving skills while still paying attention to the learning principles and characteristics of high school students' cross-interest physics. This research is development research using the Plomp model which consists of three stages, namely: preliminary research, prototyping phase, and the assessment phase. The results of this study are the integrated HOTS cooperative learning model abbreviated as the Cooperative Learning Terintegrasi HOTS (CLT-HOTS). The design of the CLT-HOTS model has a model syntax consisting of seven stages, namely: 1) The teacher prepares several materials; 2) convey learning objectives and motivate students; 3) presenting information; 4) organize students into study groups; 5) presentation; 6) Evaluation; and 7) Awarding.

Keywords: Learning Model, CLT-HOTS, Physics, Problem Solving, Cross Interests.

INTRODUCTION

One of the latest things related to the implementation of the 2013 Curriculum is the integration of the concept of Higher Order Thinking Skills (HOTS) in the learning process, with the aim of conditioning students to think critically, logically, and systematically according to the characteristics of the subject and have high-level thinking skills (KEMENDIKBUD, 2014; Nachiappan et al, 2018).

Watson (2020) explains HOTS learning that is applied in schools can be seen from the planning, implementation, and evaluation made by the teacher. Learning planning that is characterized by HOTS appears in determining learning objectives, determining learning methods, as well as other elements contained in the Learning Implementation Plan (RPP). The implementation of learning uses methods that optimize the potential of students. In terms of learning evaluation, the questions given make students able to solve problems, think critically, and creatively.

The achievement of higher-order thinking skills or HOTS for students is very important, considering the current conditions that require students to be able to face and compete in global competitions. This demands the importance of the teacher's role to integrate HOTS in learning. The integration of HOTS will make students directly involved in real situations to gain knowledge, instill independent learning in students, so that students will be honed to identify problems and find solutions, as a provision for life in facing challenges in the 21st century, and the industrial era 4.0.

Several studies on HOTS were conducted, among others, by Carlgren (2013) who concluded that students face various barriers in communication skills, critical thinking, and problem-solving caused by three factors: the structure of the education system, the complexity of student skills, and the competence of teachers in teaching. Heong et al, (2012) in their research showed that students who have difficulty in generating ideas will cause students to experience technical problems in solving them, which will affect student achievement. Therefore, students need to learn HOTS to overcome difficulties in generating ideas. Another study conducted by Daryanti et al, (2019) showed that there was an increase in the problem-solving ability of students with HOTS-oriented learning by 44.08%.

The implementation of the 2013 curriculum also contains the importance of problem-solving skills as seen in the basic competencies of learning physics which states that "students are expected to be able to understand, apply, analyze factual, conceptual, procedural knowledge based on their curiosity about science, technology, art, culture, and humanities by insight into humanity, nationality, state, and civilization related to the causes of phenomena and events, as well as applying procedural knowledge in specific fields of study according to their talents and interests to solve problems" (KEMENDIKBUD, 2014). Based on this statement, in the learning process, students must be trained to be able to solve problems encountered through a process that requires high-level thinking to find solutions to solve them. In problem-solving, critical thinking skills are needed which are part of HOTS problems so that they can be resolved.

Problem-solving skills are one of the important competencies that students must have (Greiff et al,., 2013). This is because, through problem-solving skills, new experiences can be promoted in students by finding solutions and problem-solving processes (Lismayani et al, 2017). In addition, the development of problem-solving skills in students can have a positive impact on other skills such as science process skills (Yulianti & Khanafiyah, 2012); critical thinking skills (Zunanda & Sinulingga, 2015); communication skills (Yavuz & Guzel, 2020); scientific literacy (Thummathong & Thathong, 2016); and entrepreneurship skills (Kim et al,., 2018), so that developing students' problem-solving skills is an important thing for teachers to do, especially in the physics learning process.

Based on interviews conducted directly with fellow high school physics teachers, it can be seen that the problems experienced in learning physics in social studies specialization classes are the lack of students' skills in actively solving physics problems. This has an impact on the learning outcomes of students specializing in Social Studies which are still relatively low. The low student learning outcomes can be seen from the acquisition of the mid-semester average score (PTS) in the first semester of 65, this value is below the minimum learning completeness score (KBM) which is 75. The low score obtained by students can be an indicator of student failure in learning physics.

From the preliminary study conducted by distributing preliminary questionnaires to physics teachers at the Physics Teacher Forum meeting at the Kampar Regency Senior High School, it was found that 66.7% of teachers had never used the cooperative learning model. From the questionnaire data, it is also obtained an illustration that in the process of cross-learning physics in the Social Sciences demand class the teacher uses the Discovery Learning model by 27.8%, PBL by 16.6%, and conventional by 23.3%. This shows that the implementation of the cooperative learning model is not yet effective as a model that is considered appropriate for social studies students in studying physics as a cross-interest subject.

Furthermore, from the results of observations made with fellow physics teachers, it turns out that the physics learning device in the form of lesson plans used by teachers for students with social studies specialization is lesson plans which are also used for students with mathematics and natural sciences. The same opinion was also expressed by several physics teachers in Kampar Regency that to teach students with the Social Sciences specialization the same lesson plans were used for students in the Mathematics and Natural Sciences specialization. The same thing is supported by the statement of Kade et al, (2020) in their research which states that the implementation of physics learning still uses the same syllabus, lesson plans, and assessment in the science department. In addition, the RPP made by the teacher has not integrated HOTS into the learning model carried out. To improve students' problem-solving skills, a model is needed that can direct students to improve their problem-solving skills. One of the learning model designs that can improve problem-solving skills as well as support HOTS in physics learning is cooperative learning. So far, the model that is often used to improve problem-solving skills is the problem-based learning model (PBL). So this study used the Cooperative Learning model which is considered appropriate to the characteristics of social studies students. With the cooperative learning model students are actively involved in discussing in groups directing their higher-order thinking so that they can improve problem-solving skills in physics lessons.

Various studies on cooperative learning show results that cooperative learning can increase achievement, more positive interpersonal relationships, and higher self-esteem than competitive or individualistic efforts (Phipps et al, 2001). The results of Felder & Brent (1994) research state that cooperative learning increases motivation to learn, the memory of knowledge, depth of understanding, and appreciation of the subjects being taught. Another study conducted by Johnson et al, (1994), showed that cooperation to solve problems should be done to help all group members understand the task, students need to be encouraged to help each other and feel responsible for the success of the group (Cohen, 1994), with cooperation team, then students can solve complex tasks (Dishon & O'Leary, 1984). The HOTS Integrated Cooperative Learning Model, hereinafter abbreviated as CLT-HOTS, is expected to contribute to improving students' problem-solving skills.

METHODS

This research is development research using the Plomp model which consists of three stages, namely: preliminary research, prototyping phase, and the assessment phase. In the preliminary research stage, 1) needs and context analysis are carried out; 2) theoretical studies, and 3) conceptual and theoretical framework developed for research. Based on the results of the preliminary research, the design of the CLT-HOTS model complete with a support system will then be evaluated at the prototyping phase through 1) self-evaluation, 2) expert review, 3) one to one evaluation), 4) Small Group Evaluation, and 5) field tests. The Assessment Phase is carried out to see the effectiveness of the model (Plomp, 2013). Research data was obtained by observation, assessment sheets, questionnaires, and tests.

RESULTS

1. Results of needs and context analysis

Based on the results of the analysis of the implementation of physics learning as a cross-interest subject for students specializing in social studies conducted by teachers so far, it is necessary to have a learning design that can accommodate physics problem-solving skills by actively involving students.

Curriculum analysis: One of the learning models that can improve problem-solving skills as well as support HOTS in learning is cooperative learning. Learning with cooperative models is part of the concept of student-centered teaching. With the cooperative learning model, students are actively involved and work well together in groups to understand the physics concepts given, so that students can help each other to solve problems in physics lessons.

Analysis of student characteristics: Based on the analysis of student characteristics, the CLT-HOTS model can improve physics problem-solving skills according to the student's developmental stage. The use of this model is expected to develop students' problem-solving skills and mastery of students' knowledge in applying the concepts they have acquired.

Analysis of physics learning materials: Based on the material analysis carried out, it can be seen a general description of the appropriate model and approach to be used in straight motion material and the form of the learning support system that will be developed. The learning model that is considered effective to be applied to the straight motion material is the cooperative model. Characteristics according to the characteristics of this model are to improve the skills of working together in solving problems. Students are actively encouraged to construct their knowledge and overcome various barriers to integration so that students can convey ideas, express opinions, and contribute in groups.

2. Literature review results

Literature review is conducted by analyzing the theories and concepts that support the development of the CLT-HOTS model to improve cross-interest physics problem-solving skills. Based on the results of the needs and context analysis, as well as a literature review, it is known that learning physics is an effort to help students to construct concepts and principles of physics through active involvement and collaboration by presenting the real world to students in learning activities so that students' problem-solving skills can improve. However, based on the reality in the field, cross-interest physics learning has not been able to improve students' problem-solving skills and aspects of student knowledge, because the learning process has not fully involved students actively, has not used an appropriate model for social studies students and has not integrated HOTS into the learning process. With the CLT-HOTS model, students can solve physics problems related to everyday life critically, creatively, and innovatively.

3. Result of development or prototyping phase

The activity of designing a prototype begins with developing a CLT-HOTS model to improve cross-interest physics problem-solving skills. The design of the CLT-HOTS model to improve cross-interest physics problem-solving skills was developed based on the results of preliminary research through needs and context analysis as well as a literature review. The designed products are documented in the form of books which include model books, teacher books, and student books.

Model book: The CLT-HOTS model book to improve cross-interest physics problem-solving skills was compiled based on the principles of model development from Joyce & Calhoun (2015) and the Minister of Education and Culture of the Republic of Indonesia No. 37/2018. By the physical characteristics consisting of products, processes, and attitudes, the model suitable groups are information processing model groups and social groups. So this model was developed by modifying the two groups of learning models.

The CLT-HOTS model book to improve cross-interest physics problem-solving skills is designed with an attractive appearance and communicative language as well as the core parts of the model book. The introduction section discusses the rationale and nature of the model and contains the background on the need to develop the CLT-HOTS model to improve cross-interest physics problem-solving skills. In the second part, the learning theory that supports the CLT-HOTS model is discussed to improve cross-interest physics problem-solving skills. The next section of the model book is the CLT-HOTS component to improve cross-interest physics problem-solving skills covering syntax, social systems, reaction principles, support systems, and instructional impact and accompaniment impacts. The last part is the implementation of physics learning with the CLT-HOTS model to improve cross-interest physics problem-solving skills. The following discusses the specifications of the CLT-HOTS model book to improve cross-interest physics problem-solving skills. The book cover is designed to describe research-based learning. It also describes the components of physical material. The cover of the CLT-HOTS model book is shown below to improve physics problem-solving skills as shown in Fig 1 below.

Fig 1. *Model book cover design*

Model book components: The components of the CLT-HOTS model book to improve physics problem-solving skills are shown in Fig 2 below.

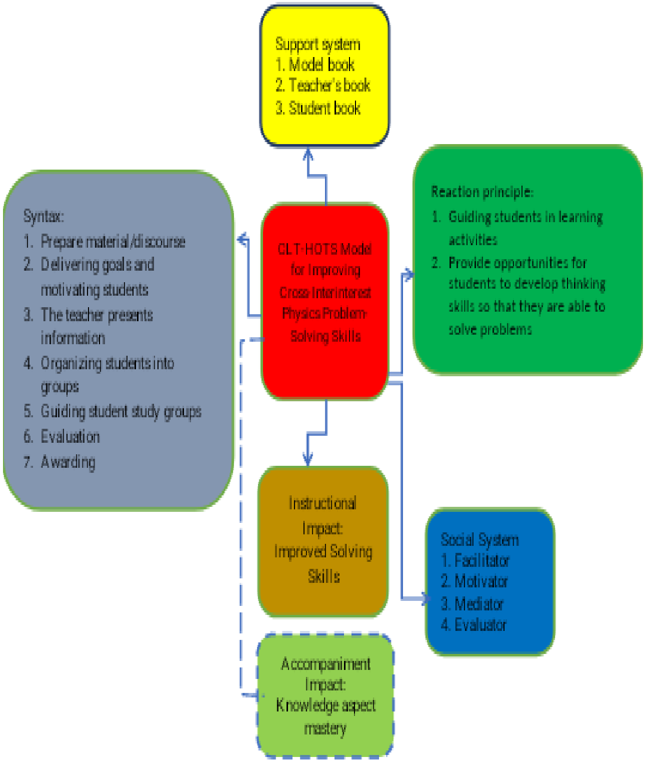

Fig 2. *Components of the HOTS Integrated Cooperative Learning Model to Improve Physics Problem-Solving Skills Across Interests*

Before developing the syntax of the CLT-HOTS model to improve cross-interest physics problem-solving skills, it was first compared to some of the existing cooperative learning model syntaxes. Some of the syntaxes of cooperative learning models are briefly described in Table 1 below.

Table 1. *Comparison of Some Syntax of Cooperative Learning Model*

Fase	***Johnson& Johnson***	***De Vries & Edward***	***Sharan & Sharan***	***Slavin***	***Cohen***
1	Presenting lessons	Class presentation	Grouping	Delivering goals and motivating students	Prepare materials
2	Form a group	Teams	Planning	Submit information	Group formation
3	Group throwing tasks	Games	Investigation	Group formation	Setting up role cards
4	Presentation	Tournament	organizing	Guiding groups	Students take role cards at random
5	Group award	Team reconditioning and awards	presentation	Evaluation	Presentation
6				Awards	Sharing teaching materials
7					Group discussion
8					Reflection and assessment

Based on some of the syntaxes of the cooperative learning model (Tabel 1), the researcher conducted a study analysis of the strengths and weaknesses contained in the syntax which was then used as the basis for developing an effective cooperative learning model syntax to improve cross-interest physics problem-solving skills. The syntax of the HOTS integrated cooperative learning model to improve the physics problem-solving skills developed is shown in Fig 3 below.

According to Joyce & Calhoun (2015) syntax is also called phases which describe the sequence of learning activities. The syntax is used as a guide for teachers in implementing a learning model and a guide for students in following the learning process. The syntax of the HOTS integrated cooperative learning model to improve students' problem-solving skills is implemented in a learning scenario that contains learning that contains teacher and student activities in each phase. The integrated cooperative learning syntax HOTS was developed adopting the cooperative learning activities of Johnson et al, (1994). The syntactic relationship of the cooperative learning model designed with problem-solving skills is shown in Table 2 below.

Table 2. *The Relationship of Each Stage of the Integrated Cooperative Learning Model HOTS Problem Solving Skills*

No	Model syntax	Problem solving skills
1	Phase 1 Preparing materials	Analyzing the given discourse by digging up information from various sources.
2	Phase 2 Delivering learning objectives and motivation	Convey goals and motivation by asking challenging questions and using prior knowledge.
3	Phase 3 Delivering information	Provide the widest opportunity for students to explore and submit information.
4	Phase 4 Organizing students into study groups	Discuss various settlement methods.
5	Phase 5 Presentation	Expressing the idea of completion to the completion plan.
6	Phase 6 Evaluation	Various solutions are analyzed to evaluate the strategy.
7	Phase 7 Awarding	Give conclusions with their own creativity.

The next component of the model is the support system. The support system for cooperative learning models designed with problem-solving skills consists of model books, teacher books, and student books. The quality of the learning model design is determined by the quality of the developed product. Esterlina et al, (2019). explained that the quality of the learning model is determined by several criteria which include: validity, practicality, and effectiveness. Joyce & Calhoun (2015) explained that the learning model is composed of several components of syntax, social systems, reaction principles, support systems, and instructional impacts and accompaniment impacts.

CONCLUSIONS

The model produced in this study is a cooperative learning model integrated with HOTS abbreviated as CLT-HOTS to improve cross-interest physics problem-solving skills. The design of the CLT-HOTS model has a model syntax consisting of seven stages, namely: 1) The teacher prepares several materials; 2) convey learning objectives and motivate students; 3) presenting information; 4) organize students into study groups; 5) presentation; 6) Evaluation; and 7) Awarding. The accompaniment impact that appears in the implementation of this model shows an increase in problem-solving skills and aspects of student knowledge.

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CONFLICT OF INTEREST STATEMENT

The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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