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Development of Learning Tools Based on the TPACK Framework on Reaction Rate Material to optimize Student HOTS

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Abstract
This kind of research is development research. The subjects of research are 31 students of class XI IPA 2 SMAN 8 in Muaro Jambi. The instrument used a questionnaire responses of students, teachers' questionnaire responses, observation sheet of learning activity, HOTS assessment instruments, and TPACK integration instruments of teachers. The results are indicated on learning activities at the meeting I 96.15%, meeting II 96.68%, meeting III 97.22%, and meeting IV 97.22% , all of them belong to the category of "highly optimized". Student test scores on average 66 which includes the category of "good".

Keywords: HOTS; Learning Activities; Rates Reaction, TPACK Workframe

INTRODUCTION

Specifically, the subject of reaction rate is material given to students in class XI Science in the odd semester of high school. The basic competency to be achieved in this material is to describe the meaning of reaction rate by conducting experiments on the factors that influence the reaction rate, as well as understanding collision theory to explain the factors that determine the rate and order of reactions and their application in everyday life.

Information and Communication Technology provides broad access to education, such as using animation programs to explain abstract objects, simulation programs in the learning process, and using virtual laboratories as a medium to replace the role of real laboratories. The use of this technology can be freely accessed via the internet.

Information and Communication Technology (ICT) provides many opportunities and challenges to answer this problem, one of which is by integrating ICT in learning. The form of integrating ICT in learning is by combining material, pedagogy and technology, better known as the TPACK framework (Technology, Pedagogy, and Content Knowledge) by utilizing animation programs, simulations and virtual laboratories as learning media and resources. TPACK is a complex and interconnected framework between its constituent components, namely (T), (P), and (K) in the learning process. This emphasizes the relationship and complexity between the three components so that there is a link between (PCK), (TCK) and (TPK) (Sutrisno, 2011:93). The link between these three components makes a huge contribution to changes and learning paradigms.

Inquiry-based learning (IBL) is defined as a teaching method that combines work activities with student-centered discussions and the concept of discovery. Spronken-Smith et al., (2007:2) define IBL as the best learning that allows students to experience the process of creating knowledge. The ultimate goal of IBL is for students to develop valuable scientific research skills and prepare for lifelong learning. Students must achieve outcomes including critical thinking, inquiry skills, responsibility for their learning, and intellectual development and maturity. Activities or learning activities are a series in the learning process. Learning activities can be arranged systematically so that learning can run optimally. Sutrisno, (2012) learning activities can be carried out individually and in groups where learning activities are carried out flexibly and of course followed by creative and fun learning models.

Higher order thinking or better known as Higher Order Thinking Skills (HOTS) is a level of thinking in the area of analyzing, evaluating and creating in Bloom's taxonomy thinking structure. These high-level thinking skills are critical thinking, logical thinking and creative thinking. Sutrisno (2012:68) HOTS can foster students' critical attitudes to argue, draw conclusions, plan and assess. The success of implementing HOTS can be seen in the form of students' skills in explaining, deciding and ultimately arriving at students performing validly in accordance with their experience..

RESEARCH METHODS

The device development model used in this research is the 4D model suggested by Thiagarajan, Semmel, and Semmel (1974). The reason for using this model is because the stages are systematic and more detailed. This development model consists of 4 stages as the name suggests, namely define, design, develop, and disseminate. The 4D learning device development model consists of 4 stages, namely the define stage consisting of 5 main steps: front end analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives; the design stage includes 3 steps: preparation of benchmark tests, selection of appropriate media, and selection of format; the develop stage consists of validation by a team of experts followed by revisions, limited trials followed by revisions, and field trials and further revisions; and the disseminate stage (spread).

RESULTS AND DISCUSSION

The results of this research are learning tools based on the Technological, Pedagogical, and Content Knowledge (TPACK) framework which consists of a Learning Implementation Plan (RPP), Student Activity Sheets in the form of a flip page ebook containing teaching materials, simulations, virtual laboratory applications, steps practical work, and practice questions, and Higher Order Thinking Skills (HOTS) assessment instruments. After the product is completed, it is then validated, this product is validated by two experts, and then revised according to the expert's advice.

The trials carried out started with individual trials, then small group trials, and continued with large group trials (field trials). After the product was revised according to the advice of the expert who carried out the validation, an individual trial was carried out involving 3 students to obtain suggestions and input in order to improve the quality of the product. The suggestion from the first student was that the letters on the worksheet be enlarged, so the worksheet was revised by enlarging the letters from 12pt to 14pt, the suggestion from the second student was that if possible, the worksheet should be given lots of animations, so from this suggestion, add more animations from the existing animations. there is, while the third student's suggestion is to provide instructions for use first. This student's suggestion is applied in classroom learning, but the LKS does not need to be revised.

The results of the small group trial are in the form of data from student response questionnaires with questions whose answer choices are "Yes" or "No" accompanied by reasons for each answer. This trial involved 7 students, consisting of 2 students with high abilities, 3 students with medium abilities , and 2 students with low abilities. From small group trials, data was obtained that out of seven students, six students gave positive responses, and one student gave negative responses to learning.

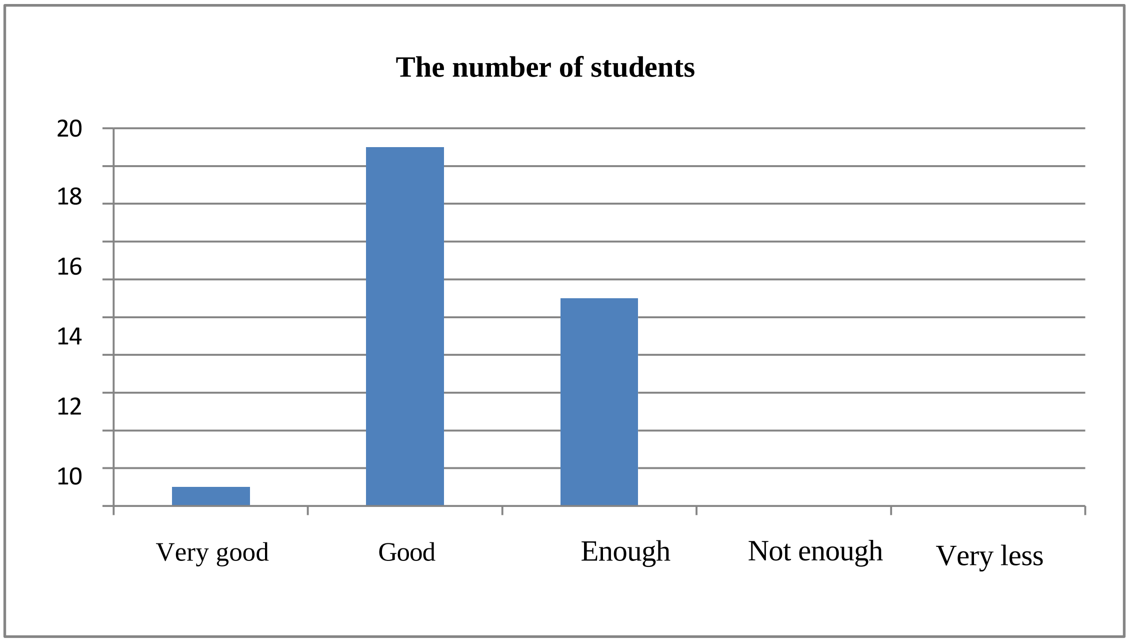

Figure 1. Graph of test score categories in large group trials

Large group trials were carried out over 5 meetings, 4 learning meetings, while 1 meeting worked on test questions. The students involved were 31 students from class Data from the student response questionnaire on learning showed that 22 students gave responses in the "very good" category, 8 students gave responses in the "good" category, 1 student gave responses in the "fair" category, regarding learning with TPACK.

The results of observations of student learning activities show that students' science learning activities run optimally. Students' science learning activities measured at the first meeting amounted to 19 activities consisting of 8 activities building conceptual knowledge, 6 activities building procedural knowledge, and 5 activities building expressions of knowledge. Students' science learning activities measured at the second meeting amounted to 20 activities consisting of 8 activities to build conceptual knowledge, activities to build procedural knowledge, and 6 activities to build expressions of knowledge. At the third meeting, students' science learning activities measured were 20 activities consisting of 8 activities to build conceptual knowledge, 6 activities to build procedural knowledge, and 6 activities to build expressions of knowledge.

Meanwhile, at the fourth meeting, the students' science learning activities measured were 20 activities consisting of 8 activities building conceptual knowledge, 7 activities building procedural knowledge, and 5 activities building expressions of knowledge. The percentage of students' science learning activities at the first meeting was 96.15%, the second meeting was 96.68%, the third meeting was 97.22%, and the fourth meeting was 94.86%. At the fifth meeting, students worked on questions to test high-level thinking skills, totaling 8 essay questions, with questions at levels C3, C4, C5, and C6. The scores obtained by students varied, from the lowest 50 to the highest 83. The average student score was relatively low, namely 65.93. The number of students who got scores above the average was 18 people, while those who got scores below the average were 13 people.

Student test results vary quite widely, from the lowest 50 (fair) to the highest 83 (very good). There was 1 student with grades included in the "very good" category, 19 students with "good" and 11 students with "fair" scores. The average test result with questions at levels C3, C4, C5 and C6 is 65.93 and is included in the "good" category. This means that the product developed facilitates students' achievement of Higher Order Thinking Skills (HOTS).

Data from filling out the TPACK integration questionnaire by chemistry teachers was analyzed using path analysis with the help of the SPSS 19 program. The results can be seen in the correlations table. It can be seen that TCK has a significant relationship, this can be seen from the Sig value (2-tailed) value smaller than α (0.05) is TPK 0.007(0.608). Next, PCK has a significant relationship with a Sig (2-tailed) value smaller than α (0.05), namely CK 0.035(0.500), while TPK has a significant relationship with TCK 0.007(0.608). From the correlation table obtained, it can be seen that all TPACK variables have a significant relationship with other variables. To see whether the relationship is linear or not, regression analysis can be carried out in path analysis on the 4 forms of path chains used, so that the resulting table is:

In the model summary table, the R square value or what is called the termination coefficient is 0.202 or 20.2%. This value shows that the magnitude of the influence of Technology (TK), Pedagogy Knowledge (PK) on Technology Pedagogy Knowledge (TPK) is 20.2%, while the rest is influenced by other variables (e1), namely 100% - 20.2% = 79.8 %. In the model summary table above, the R Square value or termination coefficient is 0.029 or 2.9%. This value shows that the influence of the CK and TK variables on TCK in learning is 2.9%. In other words, the magnitude of the influence of other variables (e2) is 100%-2.9% = 97.1%.

In the model summary table above, the R Square value or termination coefficient is 0.257 or 25.7%. This value shows that the influence of the CK and PK variables on PCK in learning is 25.7%. In other words, the magnitude of the influence of other variables (e3) is 100%-25.7% = 74.3%. In the summay model table above, the R Square value or termination coefficient is 0.331 or 33.1%. This value shows the magnitude of the influence of all variables on TPACK in learning is 33.1%. In other words, the magnitude of the influence of other variables (e4) is 100%-33.1% = 66.9%. The coefficient table in the beta column shows that the influence of the CK (Content Knowledge) variable is very large, namely 0.337, while the other variables do not have much influence on TPACK. From the data above, the resulting path diagram is as below.

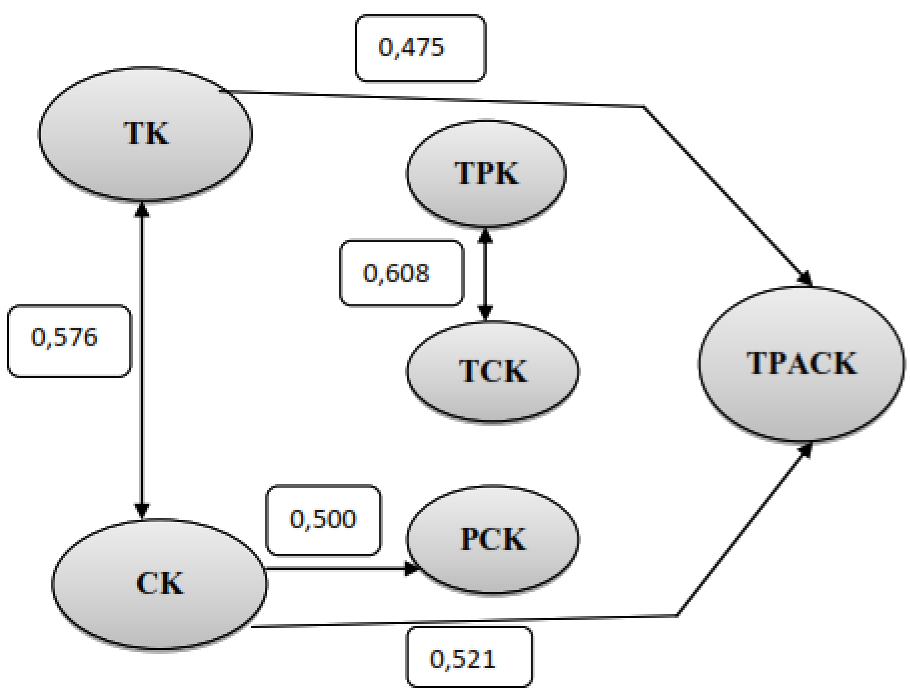

Figure 1. Path diagram

CONCLUSION

Based on the research results, it can be concluded that the learning tools based on the TPACK framework developed have optimized student learning activities on reaction rate material and are "good" to encourage optimal student HOTS. Learning device products based on the TPACK framework in the form of lesson plans, electronic worksheets and HOTS assessment instruments on reaction rate material can be tested in schools that have adequate ICT facilities.

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