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DEVELOPMENT OF CONSTRUCTIVISM-BASED PHYSICS TOOLS TO BUILD GENERIC SCIENCE SKILLS FOR HIGH SCHOOL STUDENTS

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Abstract: This research and development aim to develop constructivism-based physics teaching aids to build students' generic science skills on static fluid material. The research subjects chosen were class XI Senior High School 2 Kilo, semester I, studying static fluid material for the 2022/2023 academic year. The validation results for the development of constructivism-based physics teaching aids to build Generic Science Skills for high school students on static fluid material show an average score of 0.75 with a percentage of 22.43% for very good criteria, an average score of 2.75 with a percentage of 78.57% for good criteria. At the same time, the categories are sufficient, lacking, and very unfavorable, each with an average score of 0 with a percentage of 0.00%. It indicates that the validator assesses the aspect of the teaching aids as good. The development of constructivism-based physics teaching aids on static fluid material can build students' Generic Science Skills, shown in the N-Gain percentage of 70.65% with the high category. Students also responded positively to the development of constructivism-based teaching aids in building Generic Science Skills. It was indicated by the average student responding strongly agree 37.60% and giving a response of agree 44.00% while responding disagree 9.80%, strongly disagree 8.60%.

Keywords: *Development, Teaching Aids, Science Generic Skills, Static Fluids.*

INTRODUCTION

Physics learning in high school aims to develop the ability to think inductively and deductively in explaining various natural events and solving problems. This ability is formed through experience formulating problems, proposing and testing hypotheses through experiments, designing and assembling experimental instruments, collecting, processing, interpreting data, and communicating experimental results. In line with these activities, scientific attitudes such as honesty, objectivity, resilience, criticalness, and collaboration with others will also be attached to students [1].

The essence of learning physics is a science that studies symptoms through a series of processes known as scientific processes that are built based on a scientific attitude, and the results are realized as scientific products composed of the three most important components in the form of universally applicable concepts, principles and theories [2].

These components represent learning that can be applied to achieve physics learning objectives using a constructivism-based approach [3].

The constructivism-based learning approach is a learning process that explains how knowledge is structured in students' minds. The students actively develop knowledge and do not receive it passively from their environment. It means that learning is the result of the student's efforts and not transferred from the teacher to the student, as can be extracted from the basic assumptions of constructivism revealed. The basic assumptions of learning physics, such as facts, concepts, and principles, are a learning process [4].

In the learning process to show facts, concepts, and principles in physics, students should only be accepted procedurally with understanding and reasoning. Physics learning like this emphasizes (2) the active role of students in constructing knowledge meaningfully, (2) the importance of making connections between ideas in meaningful construction, and (3) linking ideas with new information received. Learning like this is a constructivist learning approach [5].

The constructivist learning approach in the implementation of learning emphasizes students constructing knowledge by integrating their ideas; learning becomes more meaningful because students understand, students' strategies are more valuable, and students can discuss and exchange experiences and knowledge with friends. So knowledge in constructivism-based physics learning can achieve high-level thinking and be implemented through generic science skills [6].

Science (physics) learners at the highest level are scientific (physics) thinking activities, which are essentially high-level thinking, Higher Order Thinking Skills (HOTS). Higher-order thinking in physics can be achieved by building generic science skills, which can later be used across scientific disciplines. However, in learning physics to build, there are still many obstacles [7].

Learning is the result of the student's efforts and is not transferred from the teacher to the student, as can be extracted from the basic assumptions of constructivism [8].

The basic assumptions of learning physics, such as facts, concepts, and principles, are a learning process [9]. Constraints in learning physics at the high school level still use the old, conventional, and monotonous paradigm; teachers also revealed that apart from the unavailability of teaching aids and incomplete student worksheets, abstract physics material is often an obstacle in building generic science skills. The gap can be overcome by choosing a learning approach and developing constructivism-based physics teaching aids [10].

Generic science skills can be applied in the professional world, one of which is a teacher in biology because generic skills are produced from intellectual abilities combined with psychomotor skills to produce attitudes that are inherent throughout life [11]. Generic science skills are thinking and acting according to scientific knowledge. In contrast, these generic skills are closely related to scientific attitudes derived from science process skills in general [12].

Students must have this skill because generic science skills are general and oriented towards higher science. Generic skills are also referred to as skills. There are several components in generic science skills: direct and indirect observation, awareness of scale, symbolic language, frame logic, logical consistency, causation, modeling, logical inference, and abstraction [13]. Physics learning will be more meaningful if students actively observe, understand, and utilize natural phenomena in their surroundings. In this process, students are trained to have observation and experimentation skills with more emphasis on training the ability to think and work scientifically [14].

Several studies have shown that the development of constructivism-based physics teaching aids can build with Generic Science Skills on static fluid material [15]. Cognitive learning outcomes increased by 30% after the learning process using generic science-integrated inquiry worksheets [16].

The development of teaching aids can improve students' critical thinking skills and cooperative learning with a program-assisted constructivism approach-*goat 3d* significantly influences high school students' mathematical connection abilities [17]. Science teaching aids measurements that can improve students' understanding of physics concepts [18].

RESEARCH METHODS

This research is classified as development research, Research and Development (R&D). Research and development methods (R&D) are used to produce certain products and test the effectiveness of these products [19].

This research and development aims to develop constructivism-based physics teaching aids to build students' generic science skills on static fluid material using this method*Research & Development (R&D*) [20].

RESULTS AND DISCUSSION

The research and development results of a constructivism-based physics practice tool aim to build Generic Science Skills for high school students in a static fluid material. The physics praga tool that was developed was declared feasible for use based on validation by material experts, validation of tool experts, and results of trials by teachers' and students' responses to the development of the tool.

The development of this physics praga tool refers to Sugiyono's development stages, namely the potential and problem stages, data collection, product design, design validation, design revision, product testing, revision of products, trial use, and mass production.

Researchers in designing physics teaching aids designed the development of constructivism-based teaching aids to build Students' Generic Science Skills that can be understood and facilitate students in understanding static fluid material, namely the properties of static fluids, related vessels, Hydrostatic law, Pascal's law, and Archimides' law. With the design of the teaching aid product, students can understand these materials more easily to build Generic Science Skills that students need in crossing other scientific disciplines or everyday life.

The pressure at any point that lies on a flat plane in a liquid in a state of equilibrium is the same; the tools and materials are as follows: 2) straight tube, 2) curved tube, 3) inclined tube, and 4) smaller tube.

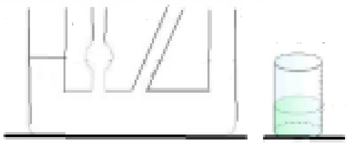

Figure 1. Hydro Static Paradox

Hydrostatic pressure is the pressure that occurs in a fluid at rest. In the picture, the parts of the tool are 2). Supporting boards or holders, 2) U-pipes A and B sections, 3) straight pipes/tubes, 4) funnels filled with balloons, 5) tubes filled with fluid, and 6) rulers/meters.

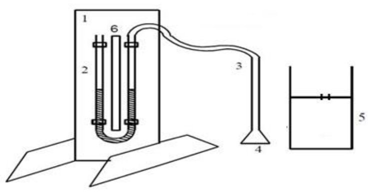

Figure 2. Hydro Static Pressure

A contact vessel is a tool for determining the density of a liquid fluid, tools, and materials,

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namely, 2) a contact vessel, 2) a glass filled with water, 3) a glass filled with fluid X, and 4) a funnel.

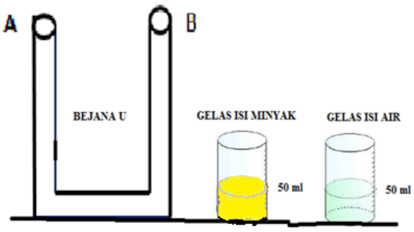

Figure 3. Associated Vessels

Post's law is that the pressure exerted on a liquid in a closed space is transmitted equally in all directions, tools, and materials, namely, 2) holders, 2) small syringes, 3) large syringes, 4) connecting pipes, and 5) different loads different.

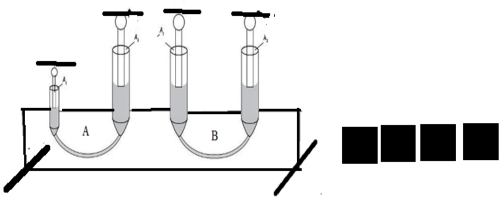

Figure 4. Pascal's law

Arcimides' law is that any object partially or completely immersed in a fluid will get an upward buoyant force. The magnitude of which is equal to the weight of the fluid displaced by the object, tools, and materials 1) static, 2) spring balance, 3) tube glasses, 4) weights attached, and 5) scales.

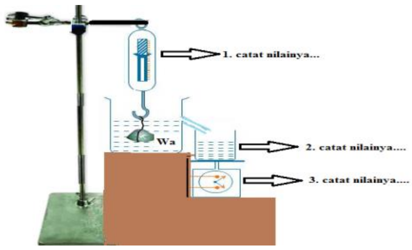

Figure 5. Archimedes' Law Toolkit

Before doing the trial, constructivism-based physics teaching aids are validated in advance by the validator; the validation of physics teaching aids aims to get criticism, suggestions, and input in the development of the teaching aids that researchers develop constructivism-based teaching aid validation.

The validation results for the development of constructivism-based physics teaching aids to build senior high school Generic Science Skills on static fluid material show an average score of 0.75 with a percentage of 22.43% for very good criteria, an average score of 2.75 with a percentage of 78.57% for good criteria, while the category sufficient, insufficient, and very poor each with an average score of 0 with a percentage of 0.00%, this indicates that the validator assesses the aspect of the equipment as good.

The results of testing the effectiveness of constructivism-based physics teaching aid to build Science Generic Skills for high school students on static fluid material can be stated to be effective based on the results of the N-gain percentage on physics learning outcomes in building Generic Science Skills of 70.65% in the high category. It shows tools the visual aids that the researchers developed were effective in building students.

In general, the description of the results of building students' Generic Science Skills on static fluid material with the development of constructivism-based physics teaching aids. The development of constructivism-based physics teaching aids on static fluid material for high school students can build students' Generic Science Skills, shown in the N-Gain percentage of 70.65% with the high category.

Comparison of the average scores of students' Generic Science Skills before learning using constructivism-based physics teaching aids and after using constructivism-based physics teaching aids. In addition to the results of building students' Generic Science Skills. Students' Generic Science Skills Scores on each indicator showed that the average final test score after using physics teaching aids was better than before using constructivism-based physics teaching aids [21-22].

The value of building students' Generic Science Skills was better after using constructivism-based physics teaching aids than before using constructivism-based physics teaching aids, as shown in the building values of Students' Generic Science Skills in each indicator [23-24].

A student response questionnaire was carried out, which contained 20 statement indicators regarding the development of constructivism-based physics teaching aids.

Students responded positively to the development of constructivism-based teaching aids in building Science Generic Skills; this was indicated by the average student responding strongly agree 37.60% and gave a response of agree 44.00% while giving a response disagree 9.80%, strongly disagree 8.60%. In this case, students find it helpful to understand static fluid material with the help of constructivism-based teaching aids to build their Generic Science Skills.

CONCLUSION

The development of constructivism-based physics teaching aids can build students' Generic Science skills on static fluid material, shown in an increase in the average final test score, Students' Generic Science Skills can be built using the development of constructivism-based physics teaching aids shown in percentage of N-gain of 70.65% in the high category besides that students

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gave a positive response with a good category in the development of constructivism-based physics teaching aids shown in the average percentage of student response scores of 84.29%.

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