IMPACT OF PROCESS SKILL APPROACH TO SCIENCE PROCESS SKILL AND understanding of concepts

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**Abstrak**

Tujuan penelitian adalah untuk mendapatkan informasi tentang peningkatan ketrampilan proses sains (KPS) dan pemahaman konsep (PK) tekanan dengan pendekatan ketrampilan proses. Penelitian menggunakan pendekatan kuantitatif, metode kuasi eksperimen, dan menggunakan rancangan randomized pretest-postest groups. Populasin penelitian semua siswa kelas VIII sekolah MTsN Matang Glumpang Dua, Aceh Utara. Sampel diambil 2 kelas secara acak dengan kelas eksperimen sebanyak 40 siswa dan kelas kontrol sebanyak 40 siswa. Pengumpulan data SPS menggunakan Lembar Pengamatan Keterampilan Proses Sains (LPKPS) dan data PK menggunakan Tes Pemahaman Konsep Tekanan (TPKT) yang terdiri dari 30 item yang dikembangkan oleh peneliti. Hasil analisis data dengan persamaan N-Gain diperoleh 0,17 untuk KPS dan 0,27 untuk UC. Sedangkan analisis uji beda dengan rumus t-test diperoleh t-hitung 6,19 untuk KPS dan 7,90 untuk PK. Berdasarkan dua hasil ini dapat dikatakan bahwa penerapan pendekatan Keterampilan Proses dapat meningkatkan keterampilan proses sains dan pemahaman konsep tekanan. Kesimpulan dari hasil penelitian kepada guru sekolah menengah untuk menerapkan pendekatan keterampilan proses untuk mengajarkan konsep tekanan.

Kata kunci: *Sains, Keterampilan Proses, Pemahaman, Pendidikan Fisika, PISA*

Abstract

The aim of the study was to obtain information about improving science process skills (SPS) and understanding the concept (UC) of pressure with a process skills approach. The study used a quantitative approach, a quasi-experimental method, and used a randomized pretest-postest groups design. Populasin research of all class VIII students of Matang Glumpang Dua MTsN school, North Aceh. Samples were taken 2 classes randomly with an experimental class of 40 students and a control class of 40 students. SPS data collection uses the Science Process Skills Observation Sheet (SPSOS) and UC data using a Pressure Concept Understanding Test (TUPC) consisting of 30 items developed by researchers. The results of data analysis with the N-Gain equation were obtained 0.17 for KPS and 0.27 for UC. While the analysis of different tests with the t-test formula obtained t count 6.19 for KPS and 7.90 for UC. Based on these two results it can be said that the application of the process skills approach can improve science process skills and understanding the concept of pressure. Conclusions from the results of research to secondary school teachers to apply the process skills approach to teach the concept of pressure.

**Keywords**: ***Science, Process Skill, Understanding, Physics Education, PISA***

Introduction

The aim of national education is targeted at achieving educational goals in schools. The purpose of education in schools is re-isolated to be the goal of the subject. Especially for Natural Sciences subjects, the Education Unit Level Curriculum (KTSP) explains that the aim of science subjects is to instill scientific knowledge and concepts, curiosity, and positive attitudes towards science and technology, developing process skills to investigate nature around, solve problems, and make decisions and can maintain, maintain, and preserve the natural environment (Permendiknas, 2006).

Thus, science teachers must have the ability to choose, determine, and simultaneously use approaches that can spur students 'active participation, or in other words can create learning that is able to thrill students' intellectual, emotional, and social elements. Students must be trained to develop high-level thinking skills. This high level thinking includes the ability to think critically, creatively, and innovatively according to the level of development. In addition, the teacher must also be able to link learning material with everyday life (Forawi, 2016; Cargas et al, 2017; Yusrizal et al, 2017).

Pressure is one of the concepts in physics which belongs to a complex concept and this concept is often applied in the daily lives of students. But many students do not understand the concept of pressure, and the teacher also has difficulty explaining it to students. If this continues, physics learning achievement will be low. This is in accordance with what was stated by Blazely that "Students' learning motivation is difficult to grow and their learning patterns tend to memorize (Elifince et al, 2015; Rakbamrung et al, 2015).

Perhaps from the conditions above, the teaching and learning process of physics should emphasize process skills, so that learning focuses on students. This is consistent with the opinion of Mulyasa that "In order for students to learn actively, teachers need to create appropriate strategies in such a way that students have high learning motivation" (Mulyana, 2002; Turiman et al, 2012; Halim et al, 2018a).

Based on previous research about science process skills to improve students 'conceptual understanding show that the application of science process skills can improve students' conceptual understanding (Yustami, 2005; Hodosyova et al, 2015; Halim et al, 2018b) . Furthermore, other research results show that science process skills can improve students 'critical thinking skills showed that the application of science process skills approaches can improve students' critical thinking skills (Kurniati, 2001; Rustana, 2002; Zeidan & Jayosi, 2015). According to Ulfa, process skills are one of the approaches in addition to approaches that emphasize facts and conceptual approaches used in science learning which are based on the steps of activities in testing something that is usually done by scientists when building and proving a theory. Especially for basic process skills, continued Ulfa, the process includes the skill of observing, clarifying, measuring, communicating, influencing, predicting, recognizing numerical relationships (Ulfa, 2008; Halim et al, 2018c).

Based on the results of previous studies, as explained above, the process skills can be developed using experimental methods, because with the experimental method students can carry out activities such as those carried out by scientists. Besides that, by conducting experiments students can find their own knowledge and increase students' interest in learning. Through the process of finding their own knowledge by students can motivate and develop the ability of science process skills and understanding concepts.

Research Method

**Research approach**

The study used a quantitative approach, the quasi-experimental method and design method was randomized pretest-postest groups as shown in table 1. The experimental group was taught with a process skills approach, while the control group was taught by conventional methods (lectures and discussions).

 **Table** 1. Research design

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Groups | Technique | Pre-test | Treatment | Pos-test |
| Experiment | R | Q1 | X | Q2 |
| Control | R | Q1 | - | Q2 |

After each group was randomly selected (R), the initial test was carried out with the same test for both groups (Q1), then continued with the learning process using the process skills approach (X). In the final stage a final test (Q2) is carried out with the same questions as in the initial test but the structure or sequence of questions is changed. The treatment or learning process in the experimental and control groups is carried out by the same researcher or teacher with the same Learning Plan.

**Population and sample**

The target population is all first semester students at Matang Glumpangdua MTsN school, North Aceh. Samples were randomly selected from 8 classes VIII, so that there were 40 students for the control class and 40 students for the experimental class.

**Data collection**

The research data is in the form of quantitative data for variable process science skills and understanding the concept of pressure. Collecting data on science process skills and understanding the concept of pressure using test instruments.

**Instrument for science process skills**.

The instrument used for measuring science process skills is called the Science Process Skill Observation Sheet (SPSOS) that development by researcher. The SPSOS instrument was developed by researchers by adopting several items from some of the results of previous studies (Hodosyova et al, 2015; Cakir & Sarikaya, 2010). The SPSOS instrument was developed based on 9 aspects of science process skills, as shown in table 3. The validation and reliability instrument of SPSOS were carried out by 2 experts in their fields and the results were around 0.75 for validity and 0.86 for reliability with categories are high (Sugioyono, 2010; Demirdag et al, 2012). Whereas the process of learning skills and materials should be developed in the form of preparing practical tools and materials, compiling and conducting experiments, making observations and analyzing observations and making conclusions.

**Instrument for understanding the concept**.

Measuring the understanding of the concept of pressure on static fluid using a instrument called Test the Understanding of pressure concepts (TUPC) developed by researchers by adopting some of the results of previous studies (Yusrizal et al, 2017; Halim et al, 2016; Halim et al, 2017). The TUPC instrument is based on 5 indicators of the concept of static pressure and produces 30 items of questions or multiple choice questions. Before the TUPC instrument is used, the validity and reliability tests are carried out by experts in their fields and pilot test also are conducted. The results of expert validity and reliability were obtained 0.67 and 0.85 with categories are high (Sugioyono, 2010). The results of the TUPC instrument pilot test obtained the index of difficulty and the index of power difference of about 0.24 and 0.56 in the good category.

**Data analysis**

The research data are in the form of quantitative data collected with SPSOS instruments for science process skills and with TUPC instruments for data understanding of the concept of static pressure. Data analysis using descriptive statistics and also using the N-Gain formula to obtain information on improving science process skills and understanding the concept of static pressure after the learning process process skills approach has been applied. Interpretation of the results of data analysis for improving science process skills and understanding concepts refers to (Sugiono, 2010), as shown in table 2.

 **Table 2.** Classification of criteria for science process skills

|  |  |
| --- | --- |
| Percentage score | Classification of criteria |
| 75.45% - 100% | Very high |
| 50.45% - 75.44% | High |
| 25.45% - 50.44% | Sadang |
| 0% - 25.44% | Low |

 To get the information of improving science process skills and understanding students' concepts in static pressure material is used the N-Gain equation (Hake, 1998).

Result and Discussion

**Analysis of improving science process skills**

Improved science process skills based on N-gain analysis are categorized into 3 categories, namely high, medium and low. Improved learning outcomes are analyzed based on aspects of process skills. The aspects that are analyzed are: aspects of applying concepts, interpreting observations, determining tools and materials, making conclusions, asking questions, classifying observations, briefly in table 3.

**Table 3.** Results of the analysis of aspects of science process skills

|  |  |  |  |
| --- | --- | --- | --- |
| No | Aspects of Science Process Skills | N-Gain | Information |
| 1 | Interpret | 0,28 | Low |
| 2 | Predict | 0,46 | Medium |
| 3 | Determine tools and materials | 0,04 | Low |
| 4 | Make conclusions | 0,45 | Medium |
| 5 | Asking question | 0,24 | Low |
| 6 | Classify observations | 0,46 | Medium |
| 7 | Make observations | 0,25 | Low |
| 8 | Grouping | 0,50 | Medium |
| 9 | Applying the concept | 0,24 | Low |
|  | Average | 0.32 | Medium |

Based on the results of the analysis of science process skills data, as shown in table 3, there are several important findings that need to be disclosed and some arguments are sought that can support the truth of these findings. Among the science process skills aspects that have the highest contribution to the measurement results of science process skills variables are the ability to group, classify observations, form conclusions and predictability based on the results of experiments that have been done. Conversely also found some aspects that lack contribution to the measurement of science process skills variables, including aspects of students' ability to choose and determine tools and materials for practicum, ability to translate data, make questions and the ability to plan observation.

If a more in-depth study of the relationship between independent variables or process skills approaches with dependent variables or science process skills is examined more deeply, there are some indications that can be used as arguments to justify the findings of this study. Based on the results of several previous studies it was found that learning activities with process skills approaches focused on three main types of activities, namely formulating hypotheses (predicting), interpreting results, and making conclusions (Cigrik & Ozkan, 2015; Hodosyova et al, 2015). The pairing becomes one of the arguments to justify that the aspect of predicting (making hypotheses) and making conclusions has a high contribution to the results of measuring science process skills. While the ability to interpret the results of observation has a low contribution, even though it is one of the main types of activities in the process skills approach, this is because the time spent training the implementation of these aspects is still very short and so far students are rarely trained to translate measurement data.

In addition, some findings by previous researchers indicate that the ability and willingness of students to use process skills in the learning process is influenced by the type of school used as the research target (Gurses et al, 2015) and is also influenced by teachers' knowledge and willingness to implement process skills approaches in the teaching-learning process (Krue & Thonpenrm, 2014; Irwandi et al, 2018). The results of the study are in line with what was observed when the process skills approach was implemented. The observation results found that students are very difficult to motivate so that they want to do activities such as determining the type of tool / material, asking questions, designing observation activities and applying the concepts that have been learned. Based on the results of previous researchers and also some findings in the field when implemented the process skills approach can be said that the average N-Gain findings are relatively low (0.17) something that is quite reasonable. These results are in accordance with those obtained by previous researchers (Yusrizal, et al, 2017; Halim, et al, 2016; Halim, et al, 2017).

The difference in the improvement of process skills aspects found in this study shows that the skills approach has various advantages, as Samatowa (2006: 138) argues that the superiority of the process skills approach in the learning process includes:

1. Students are directly involved with real objects so that they can facilitate students' understanding of the subject matter
2. Students find their own concepts learned
3. Train students to think more critically
4. Train students to ask questions and engage more actively in learning
5. Encourage students to discover new concepts
6. Give students the opportunity to learn to use the scientific method

The process skills approach will be effective if it is in accordance with intellectual readiness. Therefore, the process skills approach must be arranged in a logical sequence according to the level of ability and experience of students. For example before carrying out research, students must first observe or observe and make hypotheses. The reason is certainly simple, namely that students can recreate concepts that are in mind and able to organize them. Thus, the success of children in learning Science using the process skills approach is a change in behavior of a child who does not understand the science problems that are being studied so that they understand and understand the problem.

Besides that, according to Moh. Uzer Usman (in Hafid, 1996, pp 13-16), there are seven process skills, namely: (1) observing, (2) classifying / classifying, (3) interpreting / interpreting, (4) predicting, (5) applying, ( 6) planning research, (7) communicating. The seven things are described as follows

1. *Observing* is the skill of collecting data or information through application with the senses such as seeing, hearing, feeling with the skin, feeling, and or tasting or tasting, listening, measuring, and or reading.
2. *Classifying* is the skill of classifying certain objects, facts, concepts, values, goals or skills. To make a classification it is necessary to review the similarities and differences between objects, reality or concepts. These equations and differences are the basis for comparing and contrasting.
3. *Interpreting* is the skill of interpreting something in the form of objects, facts, events, concepts or information that has been detected or collected through observation, calculation, measurement, simple research or experiment. Besides that, interpreting skills also include the ability to assess, give meaning / interpret, propose, look for relationships of space or time, find patterns, draw conclusions, and render (generalize).
4. *Predicting* is anticipating or concluding things that will happen in the future based on thoughts on certain trends or patterns or relationships between data or information.
5. *Applying* is to use learning outcomes in the form of information, conclusions, concepts, laws, theories, skills, attitudes or values ​​that students have in new situations or experiences, behavior in other environments, lab work in workshops or workshops, Field Experience Practices, or life daily. Besides that, implementing activities include also calculating, determining variables (change), controlling variables, connecting concepts, formulating research questions, composing hypotheses, and making modes.
6. *Planning Research* is a very important skill, because it determines the success or failure of conducting research. These skills need to be trained because so far they have generally been lacking in attention and lack of guidance. At this stage determine the problem, or the object to be studied, the purpose and scope of the research, the source of data or information, the way of analysis, tools, and material or library resources needed, the number of people involved, the steps of collecting and processing data or information , and procedures for conducting research.
7. *Communicating* is conveying the acquisition of both process and learning outcomes to others in the form of writing, drawing, motion, action or appearance. Thus discussing, telling stories, reciting, predicting, asking questions, formulating, composing, and reporting including communication activities

Besides that, Darmodjo and Kaligis (1992) further detail process skills in science education including; 1) observing skills which include the ability to be able to "distinguish," count "and" measure ", 2) classify skills, which include classifying on the basis of certain aspects, and a combination of classifying by sorting, 3) interpreting skills, including interpreting data, graphs, as well as looking for relationship patterns contained in data processing, 4) predicting skills, including making predictions of trends found in data processing, 5) hypothesis-making skills, including.

***Improved understanding of concepts***

The concept of pressure taught through this study covers the concepts of solid pressure, Pascal's law, hydrostatic pressure, Archimedes's law, and air pressure. The measurement results of increasing the understanding of the concept of pressure after being taught with a process skills approach are shown in table 4. Based on the data in table 4 it can be understood that the average number of students who are still low understanding the concept of pressure is higher than the average number of students who are moderate and high the concept of pressure. While subtopic which is very difficult to understand by students is Archimedes' law, air pressure, and solid pressure. The low understanding of some of these concepts is due to the process skills approach that prioritizes motoric activities rather than activities that lead to cognitive. This is consistent with the view of Conny (1992) who said that the process skills approach is the development of learning systems that involve students actively, develop skills, process for the acquisition of knowledge so that students will discover, develop their own facts and concepts and foster attitudes and values ​​demanded in specific learning goals.

**Table 4.** Understanding of the pressure concept

|  |  |  |  |
| --- | --- | --- | --- |
|  | Number of respondents  |  |  |
| Subtopic | Low | Medium | High | Average | Categories |
| Solid Substance Pressure | 12 | 25 | 3 | 32.47 | Low |
| Pascal's Law | 19 | 16 | 5 | 28.77 | Low |
| Hydrostatic pressure | 22 | 12 | 6 | 26.25 | Low |
| Archimedes' Law | 24 | 15 | 1 | 30.31 | Low |
| Air pressure | 22 | 17 | 2 | 26.27 | Low |
| Average | 19.80 | 17.00 | 3.40 | 27.78 | Low |

Besides that, Samana (1992: 4) also says there are six characteristics of process skills which include: "emphasizing the importance of learning to achieve adequate learning outcomes, emphasizing the importance of student involvement in the learning process, the emphasis on two-way learning, intellectual and emotional involvement , the creative participation of students in the teaching-learning process, and the teacher acts as a facilitator and coordinator of student learning activities ". Based on Samana's view it can be understood that increasing understanding of the concept of pressure is higher in subtopics that involve students actively, including subtopic hydrostatic pressure and Pascal's law practice.

Furthermore, based on the data in table 3 and table 4, it can be seen that there is a connection between the increase in understanding of concepts and the achievement of science process skills. Especially relates to grouping aspects and classifies the results of experiments with subtopic hydrostatic pressure and solid pressure. These findings are supported by the results of research that has been done too by Feyzioglu (2009), where it was found that there is a linear and positive relationship between science process skills and student achievement in the course. The findings of this study as a whole are in accordance with the results of research conducted by several previous researchers related to improving science process skills and understanding concepts (Darmawan et al, 2015, Demirdag et al, 2012; Zubaidah et al, 2017; Chebii et al, 2012; Mazlina et al, 2018).

Regarding the increasing understanding of the concepts of the results of this study, several other findings indicate that understanding concepts is not only influenced by the learning model used, but also by students' environment-based learning. With the application of constructivist-based learning accompanied by environment-based learning at the end of learning, it influences students' understanding of the science concept especially on ecosystem material. After calculating the effect size in the control class is in the medium category (Hartini et al, 2018).

Besides that, some relevant results also support the results of this study, including according to Yusrizal (2016), students still have difficulty understanding the concept of static fluid. Static fluid material has the characteristics of conceptual analysis that allows students to associate physics concepts with natural phenomena, so students are expected to think and reason until they apply it in everyday life. There are several topics which show that there are still many students experiencing difficulties in mastering the concept of static fluid material, namely the topic of hydrostatic pressure and Archimedes' law. Based on the research of Goszweski et al (2012), students have difficulty in understanding the hydrostatic pressure material, most students assume that the hydrostatic pressure in a closed vessel is greater than that of a non-closed vessel.

Another study related to hydrostatic pressure material is the more fluid in the container, the greater the hydrostatic pressure (Loverude et al., 2010; Goszewski et al., 2013; Berek, 2016) and students do not understand that hydrostatic pressure does not depend on the vessel shape and fluid volume (Sutarja, 2016; Yadaeni, 2016). According to Loverude et al., (2003), students cannot explain the state of floating and sinking objects. Students know the equations related to the state of floating objects and sinks, but when faced with problems related to the concept, students still experience confusion and are not right in applying the equation. The difference from previous research is the analysis of the percentage of student answer choices followed up by interviews with students and in this study using reasoned multiple choice questions, whereas in previous studies using MCQs and essays.

Conclusion

Based on the research data and description in the discussion above, it can be concluded that the process skills approach can be used as one of the learning strategies to improve science process skills and understanding science concepts. However, not all aspects of the science process skills can be improved by using a process skills approach, especially aspects related to the psychomotor field. Furthermore, the process skills approach can also improve the understanding of the concept of pressure, especially subtopics related to the practice of hand work, such as hydrostatic pressure, solid pressure and air pressure. Inference from the results of the study is expected that teachers are able and willing to use process skills approaches for certain physical concepts related to practical work and not abstract.

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