The development of student worksheets with PhET assisted to improve student science process skill

Arifullah¹, A Halim², M Syukri² and E Nurfadilla¹
¹Departemen of Science Education, Postgraduate Program, Universitas Syiah Kuala, Banda Aceh, 23111, Indonesia
²Departemen of Physics Education, Universitas Syiah Kuala, Banda Aceh, 23111, Indonesia

E-mail: syukri.physics@unsyiah.ac.id

Abstract. The purpose of this study is to develop worksheet based on computer simulation (PhET), and to investigate the contribution of that worksheet in increasing students’ science process skill in learning physics especially for Hooke law concept. Worksheet developed for senior high school level used Research and Development approach with ADDIE model, and has already declared by the validator. Design and method used in this research was with matching pretest-posttest one group design. The research population conducted in one of private Senior High School located at Public Senior High School 1 Peukan Baro Pidie, this random sampling for research is done in grade eleven. As a result of this research, it was found that the science process skill of the experimental group was significantly higher than before, it means the developed worksheet can be effectively used to increase students’ science process skills.

1. Introduction

Based on the results of the observation conducted by researchers in Public Senior High School 1 Peukan Baro district, learning of Hooke law concept was using the lecture methods and teaching concepts form text book, students only listen and take notes, therefore it makes the ability of students’ science process is lows. So Learning will be more effective used scientific approach compared to the conventional because learning is more focused on learners [1]. Hooke concept learning should be presented using evidence and practicum or using simulated media, so that the learning process centered on students to find the concept of physics.

Science process skills is a skill to apply scientific methods in understanding, developing and discovering science, these skills are very necessary in physics learning where students are able to develop theories in their application in life. The students process skills can be measured using experimental methods either real or virtual [2,3]. The experimental method is one method of teaching involving experimental activities by inviting students to experiment as proof or check about theory that has been discussed. This method can present a specific process if students follow or try to do the activity, so students can experience and discover the concept of physics by conducting experiments to make them understand or memorized about the concept or lesson well [4].

As technology progresses, practical activities can be conducted in simulation using virtual lab operated by computer. One of the virtual labs that can be used is PhET. PhET is an interactive physics simulation software available on sites that can be downloaded free of charge and can be run online or offline. The Software can be run by students to perform practical simulations to replace real experiment which able to increase the achievement of student concept mastery and also to increase the
science process skills [5,6]. Students need worksheet as a practical instruction for experiments in the implementation of physics practicum, so it is necessary to develop the experimental worksheet to improve student science process skills and concept mastery. This means that the existence of media and teaching concepts in learning can help improve student science process skills, so that PhET simulation is one of the solutions that researchers want to offer in answering these issues [7,8].

The process of learning and practicum with PhET requires guidance such as student activity sheet that can guide students to find the concept independently, so the science process skills begin to be formed in students, but not apart from the control and communication of a teacher as a facilitator.

2. Method
The research applied in one group pretest-posttest design. The results of the pretest and posttest were compared to find out students’ development within the application of PhET and worksheet. The research population is all student of grade eleven Public Senior High School 1 Peukan Baro in 2018-2019 Academic Year. The samples are selected by random technique about 21 students from grade eleven 4.

Data collection techniques were carried out with multiple choice. Data were analyzed through the percentage. It projected about the improvement of students’ Science process skill. The instruments were validated by the expert with very decent category for is 0.5 the difficulty index, in the medium category. Then, the difference in power index was 0.5 in the good category, the validation index was 0.8 in the moderate category, and the reliability index was 0.76 in the good category.

Science process skills that measured were determined in seven indicators. The indicator were observation, clarification, estimation, prediction, giving question, experimental design, and communication.

3. Result and Discussion
The value of each science process skill indicator for pre-test and post-test have shown in Figure 1.

From the Figure 1 can be seen that the indicator that has increased the least is clarification about 35.71, after that estimation about 59.52, then prediction about 64.28, observation about 64.34, communication about 73.81, giving question about 76.19, and the highest increased is making experimental design about 80.95. While the average score of pre-test and post-test can be seen in Table 1.
Table 1. Average score of pre-test and post-test

|        | Pretest  | Posttest | N-gain |
|--------|----------|----------|--------|
|        | 22.47    | 87.41    | 64.97  |

From the data in table 1 can be seen that students’ science process skills increased about 64.97, so it means developed worksheet has already effectively increased the science process skills on the student. The indicators significantly increased against the aspect of the science process skill. This is because practicum implementation using virtual laboratories is more effective, interesting, and can reduce errors when practicum and students can easily repeat the experiment [9]. Then the existence of learning with a virtual lab allows students to easily make reports or report the results of experiments and the experiment process [10], so using this virtual lab (PhET) with a good guidance can easily increase student science process skills.

4. Conclusions
Based on the results of data analysis can be concluded that the development of worksheet with PhET has been able to improve the students' science process skills in Hooke's law concept.

References
[1] Jeffrey F and Nancy S 2008 student-centered learning addressing faculty questions about student centered learning Course, Curriculum, Labor, and Improvement Conference, Washington DC 30(1) 1-11
[2] Supahar, Dadan R, Marina R and Deby K D 2017 Performance assessment instrument of science process skills conform the nature of science Cakrawala Pendidikan 3
[3] Veljko J, Micheal G, Victor C, Pasi M, Christian G, Vladimir M P and Kosta J 2016 Virtual laboratories in education science, technology, and engineering: A review Computers & Education 95
[4] Yuliana S and Ariswan A 2016 Pembelajaran fisika dengan metode eksperimen untuk meningkatkan hasil belajar kognitif dan keterampilan proses sains Jurnal Inovasi Pendidikan IPA 2(2) 252-261
[5] Fathiah A 2018 Peningkatan keterampilan proses sains mahasiswa menggunakan media laboratorium virtual pada mata kuliah termodinamika Jurnal Pendidikan Fisika 6(3) 269-278
[6] Mitha A, Sri F and Hadma Y 2019 Penerapan model pembelajaran inkuiri terbimbing dengan media laboratorium virtual (PhET) untuk meningkatkan hasil belajar, keterampilan proses sains dan minat belajar siswa pada pokok bahasa elastisitas EduFisika 4(1)
[7] Teguh B R E S, Mohammad N and Tarzan P 2019 Pengembangan pembelajaran inkuiri berbasis PhET untuk melatih keterampilan proses sains Journal of Science Education and Practice 1(1)
[8] Ike K S 2017 Pengembangan lembar kerja siswa berbasis guided discovery pada materi fluida statis untuk melatihkan keterampilan proses siswa kelas X di SMAN 1 Puri Mojokerto Jurnal Inovasi Pendidikan Fisika 5(3)
[9] Tüysüz C 2010 The Effect of the Virtual Laboratory on Students’ Achievement and Attitude in Chemistry International Online Journal of Educational Sciences 2(1)
[10] Zaynab T and Alipasa A 2010 Virtual laboratory applications in chemistry education Procedia Social and Behavioral Sciences 9