The development of students' worksheets based on a scientific approach on the heat transfer concept

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Abstract. This study is aimed to determine the product quality and students' responses toward heat transfer worksheets based on scientific approach. The research approach uses the R & D method with 4D model and pretest and posttest groups design. The population of the study was all BP2IP Malahayati Aceh students and the sample was chosen by purposive sampling about 61 students. Data collection used assessment sheets, teacher response sheets, and student response sheets. The result showed that the student learning outcomes have increased after using the student's worksheets based on the scientific approach, with an average score of N-Gain is 0.21 included in the low category. Still, the average value of students has increased in which the average score of the pretest is 3.97 to 6.77 in the posttest. It can be concluded that students' worksheets based on scientific approach are suitable and effective to be used in Physics learning, especially in heat transfer lesson to. Besides, the students also give a good response to the worksheets.

1. Introduction
The problem commonly occurred in Physics learning, is the weakness of the learning process in the classroom in which the students become passive and make the students are difficult to develop their skills [1]. To develop the knowledge of the students, it needs to involve the role of the student itself in increasing their learning outcomes. The implementation of the problem-solving model in the classroom is still weak, and several topics are difficult to be implemented since the limitation of laboratory instruments. Therefore, the students are hard to see the reality of learning, observe and conclude the concept [2]. Those conditions were based on the result of interview among the Physics teacher at BP2IP Malahayati Aceh. It was found that the learning environment was still passive, less of the interaction between teacher and students; the teacher is only explaining the material while the students pay full attention. While the learning process, the students seem less attractive in receiving the material. It happened because they addressed Physics as a boring subject. The problems which are presented above might be solved by applying one of the media in learning. The effective media is a media which can create the attractiveness among the students toward the learning concept [3]. To create the learning environment to be attractive, practical and motivating to the students, the teacher needs to develop one of the media, for instance, Students worksheet.
In 2013 Curriculum, mainly the formation of character, this is based on the reality of the declining quality of the community lifestyle both in terms of morality and mentality, specifically among younger generation [4]. Besides, the 2013 Curriculum is not only focused on academic competence but also includes aspects and character skills of students [5]. The 2013 Curriculum also has the advantage of using a Scientific Approach, character-based, and using a competency approach in a particular field of study [6].

Scientific Approach consists of 5M, and they are: observing, questioning, exploring, communicating, and associating [7]. 5M activities can encourage the students to be better in observing, questioning, logical thinking and communicating what they received after had got learning material. Scientific Approach demands the teacher being more active in the teaching-learning process to hook the learner creativity and give the chance to increase their ability in terms of creative, innovative, and critical thinking [8].

Development of teaching materials is quite important to facilitate the achievement of learning objectives so that students are more active and can improve their intelligence. It is because students will get meaningful learning experiences. Students who are involved in meaningful learning experiences, such as student-centred activities might improve intelligence [9]. Students' worksheet is a learning tool used by teachers to support their learning activities [10]. Some research results state that Students' Worksheets can improve the ability of students. [11,12] It was explained that learning outcomes for high school students in Turkey using teaching materials that are adjusted to the thinking level of students and are contextual in nature are far more than students who use ordinary teaching materials. [13] States that, the use of Student Worksheets that are in accordance with the characteristics of students can improve mastery of concepts in learning material. [14-16] State that the use of Students' Worksheets based on Scientific Approach in learning can develop students' character and enhance students' skills in practical class. [2,7] States that the development of Student Worksheets based on a Scientific Approach is very feasible to use in learning activities. The number of capabilities that can be improved through Students' Worksheets, so that it is an essential thing to develop a scientific Students' Worksheets-based product in learning science, mainly Physics.

In this study, the students' worksheets, based on the Scientific Approach, was applied to the concept of heat transfer. The concept of heat transfer is one of the Physics material learnt by DP III Nautical department students in the odd semester. This material is widely applied in daily life, but there are still many students who are less attractive in accepting the concept. The concept of heat has a high level of abstractness. Therefore experiments need to be carried out to understand it [17,18]. Based on the background stated before, the researchers conducted research by developing Students' Worksheets based on a Scientific Approach to the concept of heat transfer.

2. Method
The method used in this Student Worksheets development research is the R & D method. The process of developing Student Worksheets is carried out in stages according to the steps of the 4D model. The four stages are: define, design, develop and disseminate. The define stage is done by analyzing several things, including: initial analysis, students, assignments, concepts, and formulate learning objectives. The design phase is completed by arranging instruments, media selection, format selection, and initial product design. The develop phase includes the stage of expert assessment and development trials for students. Furthermore, the disseminating phase is carried out to other schools and other teachers.

The population taken in this study was all BP2IP Malahayati Aceh students with the sample of the study were students of DP III Nautical department at BP2IP Malahayati Aceh; they were 61 participants selected by purposive sampling. This development research was carried out at BP2IP MalahayatiAceh. The sampled students in this study were chosen to obtain data on the design, convenience, usefulness and effectiveness of Student Worksheets products would be developed. Based on the results of observations at the needs analysis stage, the school was chosen as the research site.
3. Results and discussion

The development of Students’ Worksheets based on this Scientific Approach goes through four stages, namely, define, design, develop, and disseminate. After the process of developing the 4D model, identify and design stages, the initial draft Students’ Worksheets based on the Scientific Approach was produced. It was called draft I. Furthermore, two supervisors validated the first draft. The results of the validation of the two supervisors obtained a mean percentage value of 73.3 as valid criteria with moderate revisions. Based on the direction of the supervisor, the draft I was revised and produced draft II.

Then, Draft II was assessed by material and media experts. The assessment was carried out on five aspects, namely material, language, presentation, impact on learning strategies and overall appearance. Material experts obtained scores in an average percentage in the material aspects, language, the impact of the media on learning strategies, respectively 74.7, 80.0, 71.1, with a reliable category for the overall presentation and display aspects obtained by 84, 4 and 83.3 with very reliable categories. The overall percentage of material experts as a whole for draft II was 78.7 with a reliable category. The results of the assessment of media expert due to diligence obtained an average percentage for linguistic aspects, presentation, the effect of strategies on learning and overall display respectively 93.3, 95.0, 95.0 and 88.9 with very reliable categories. The percentage of the average overall media expert for draft II was 93.1, with a very decent category.

Moreover, Draft II was also revised by a suggestion from the validator. The improvement for Students' Worksheets was by adjusting the material with the development of science and technology. Besides the appearance of the Students’ Worksheets starting from colour, image and language were also revised to make it more interesting, thus producing draft III. To get the Students' Worksheets that can be used optimally on limited trials, the Students' Worksheets draft was tested for its reliability by Physics teachers at BP2IP Malahayati Aceh. As a result, for each aspect of assessment, it was found that the average percentage category was very reliable, and there was no suggestion for revision from the Physics teachers at BP2IP Malahayati Aceh.

The next stage, the draft III was conducted with limited trials given to ten students to be assessed based on the criteria in the assessment questionnaire with three aspects of assessment, namely interest, material and language. The results of the overall assessment of students obtained an average percentage of 75.4 in the good category. Based on interviews with students, there are several revised Students’ Worksheets sections, namely the material and language in the Students’ Worksheets are made shorter, and the images are clearer. In phase II, it would revise the material and language so that it is complete and clearer so that students easily understand it. Then, the revised results would produce draft IV.

The final stage is a large-scale trial. Trials are conducted on three classes, namely: DP III Nautical I D class as many as 20 students, Nautical I E as many as 21 students and Nautical I F as many as 20 students and involve five teachers. This trial was conducted to see the effectiveness, teacher response, and students' responses toward Students' Worksheets based on a Scientific Approach. The results obtained were the average score of students' pretest was lower than the posttest score, which was 3.97 for pretest and 6.77 for posttest. In other cases, the response of teachers and students as a whole the average percentage of teacher responses was 79.9 in the good category and responses of students was 80.3 in the very good category as well. Thus, it can be said that Students' Worksheets based on Scientific Approach is effectively used in Physics learning, especially in heat transfer material. Besides, teachers and students give a positive response to Students’ Worksheets based on this Scientific Approach.

Based on the steps that have been carried out in the development of the Students’ Worksheets based on a Scientific Approach, it can be concluded that the Students’ Worksheets has been properly used optimally without revision. This is in line with [19,20], which states that product revisions are made if there are errors in the trial. Referring to the results of the feasibility trials, teacher responses, and student responses, the Students’ Worksheets does not need to be revised again. Therefore, the Students’ Worksheets based on the Scientific Approach is declared feasible and effective. It can be seen from the results of the expert validator’s assessment while the effectiveness can be seen from the results of the Students’ Worksheets trial assessment of the students.
All in all, it can be concluded that the Students’ Worksheets based on this Scientific Approach is in the good category. According to students’ responses, Students’ Worksheets is quite complete, illustrated, and presented in colorful image. Argues that an image can clarify the content of the material so that it is very necessary because it is not only to clarify the description of the material, images or symbols, but also to add attraction, and reduce the boredom of students towards the Students’ Worksheets [21].

Referring to the students learning outcomes who have increased after using the Students’ Worksheets based on the Scientific Approach with an average score of N-Gain which is 0.21 included in the low category. This is happened because students are not used to using Students’ Worksheets based on a Scientific Approach. Although in the low category but the average value of students has increased, where the average score of the pretest is only 3.97 to 6.77 in the posttest, it means that scientific-based Students’ Worksheets is effectively used in Physics learning, especially in heat transfer material. This is in accordance with the statement [22] which states that the application of learning using Student Worksheets with a Scientific Approach can improve student learning outcomes. [23] states learning by using a Scientific Approach is influential in improving student learning outcomes. Furthermore [24] added, the learning pass criteria of students in each cycle can be improved by using a Scientific Approach

The teacher’s and the students’ response to the Students’ Worksheets can be concluded that the Students’ Worksheets based on the Scientific Approach can increase the motivation of students in learning physics. Motivation in the learning process is a very important component that must be possessed by students. Learning that is accompanied by strong motivation will form a good learning environment that produces optimal learning outcomes [25]. If students do not have the motivation to learn, it will lead to passive learning, and the learning becomes meaningless. According to [26,27] motivation is an effort for someone to behave, [20,28,29] states that learning that invites students to be more active can build up knowledge, develop reasoning abilities and can improve students’ learning motivation.

Development of scientific-based Student Worksheets is very feasible to use in learning. The number of capabilities that can be improved through Students’ Worksheets, so it makes it an important thing to develop a scientific-based Student Worksheets product in learning science, especially Physics [7]. The development of science-based Student Worksheets on heat transfer material is an effort made so that students have the attraction and increase the motivation of students in learning Physics, increasing motivation of students is expected to provide an effective atmosphere in the teaching and learning process.

4. Conclusion

The development of Students’ Worksheet based on Scientific Approach in heat transfer material is very fair and effective to be applied in Physics learning and Students’ worksheet based on Scientific Approach get the good responses from teachers and students. In conclusion, using Students’ Worksheet based on Scientific Approach in heat transfer material is very effective used in Physics learning process.

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