The effectiveness of 7E learning cycle model to improve student motivation in work and energy topic

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Abstract. Motivation determines students’ learning creativity through the learning behavior presented in the class. This research was done to indicate the effectiveness of 7E learning cycle model implementation in order to increase student motivation during learning about work and energy. The research was pre-experimental study with one group pretest and posttest design. It used purposive sampling to select the research sample with criteria of previous students’ cognitive score on the last learned topic. The data were collected using motivation questionnaire which has been validated and the result of reliability test was 0.826, which was categorized high. Parametric tests such as N-gain and t-test were used to analyze the data. The results showed that the average score of motivation at the first stage was 59.86 and increased to 89.54 at the final stage with N-gain of 0.72, which represented the improvement of student motivation as high category. The t-test also showed t_{compute} > t_{table} (9.574 > 2.052), thus there was significant difference between initial and final motivation. According to the results, it can be concluded that the implementation of learning cycle 7E model was effective to be used to improve student motivation in learning about work and energy.

1. Introduction

Motivation is a major factor in the learning process [1-5]. Students are able to engage in activities and have initiatives to carry out activities due to the existence of motivation as energy or driving force that arises within themselves [4]. Psychologist researchers revealed that motivation plays an important role in learning skills, learning strategies, and student behavior [6]. Motivation, learning strategies, and emotional components are indicators of assessment of student learning behavior [7, 8]. Motivation can be trusted to guide, encourage, and develop student learning behavior to improve learning outcomes [9, 10]. Interest in learning activities and implementing them is due to motivation of students [11]. The intensity of motivation can be reflected through learning activities [12]. Students who have motivation are characterized by being highly activity, enthusiastic, and having high learning desires [13].

Motivation is needed in understanding teaching materials, including physics materials [14]. The results of several studies revealed the low achievements of physics learning outcomes. Students have an average score of physics learning outcomes in the topic of temperature and heat of 51.75 [15]. The average score of students in the topic of magnet is still below the minimum passed criteria of 40.83
[16]. Furthermore, student learning outcome in harmonic motion material with an average score of 23.56 is also not satisfactory [17]. Physics is seen as a material that is of little interest and most students consider physics as a difficult subject to understand [18]. The evaluation of Acehnese students towards the performance in physic based on the results of national examinations showed the score in 2015 (69.56), 2016 (48.90) and 2017 (36.56). In general, the data showed low learning outcomes, because students have difficulties in understanding the concepts of physics.

The observation in one of the schools in Banda Aceh, Indonesia also shows the same condition based on the national physics test scores from 2015 to 2017, 91.02; 64.67; and 35.91, respectively. These results indicate the score of the students in physics is getting lower over the past three years. Another fact is also revealed in the results of the evaluation of the national examination of students in the topic of work and energy in the 2016/2017 school year, that the student got 29.69. This score is relatively low and is still far from the minimum passed criteria for physics which is 75. Another observation on the learning process was carried out for 3x45 minutes (3 hours of meetings). While in the classroom, the observers found teachers doing learning interactions with students using conventional method, without interactive teaching media and demonstrations or simple experiments to attract students’ attention to motivate them to learn. The delivery of materials was done by lecturing, writing an explanation of the materials on the board, and students recording the materials presented. Furthermore, not all students had textbooks, because the available textbooks were limited. The teacher tested the understanding of students by asking questions. The responses from the questions were not optimal where the students were only silent when the teacher asked, or they just answered with ‘yes’ and ‘understand’ without explaining the answers given. This is due to the lack of students’ understanding of physics materials. Students who do not understand physics can be caused by intrinsic factors that do not appear or develop during the learning process, one of which is motivation.

Motivation can be developed through learning strategies [6]. Student-centered learning with reference to constructivism theory will increase student motivation [19, 20]. The teacher as the facilitator has the responsibility to adjust the learning strategy that encourages students to actively participate in order to foster their motivation [3].

One of strategies is applying the constructivism-based learning model namely learning cycle 7E [21]. The advantages of learning cycle 7E include increasing student motivation to learn because it involves students actively and the learning becomes more meaningful [22]. The learning cycle 7E is an effective learning strategy to increase student motivation to have a high enthusiasm for learning [23]. Students are required to actively participate in conducting investigations and conveying opinions/ideas in purpose to train their communication skills and improve their cognitive skills [24]. Based on the advantages of 7E learning cycle and the problems encountered at the school, a study was conducted to increase student motivation in learning work and energy topic.

2. Methods
The study was pre-experimental study through one group pretest-posttest design, which was a study design that treated the experimental group without being compared to the control group [25]. The sample was determined using purposive sampling which referred to the class with the lowest learning outcomes in the previous physics material. The object of the research was learning motivation of 28 students. The research instruments were motivation questionnaire and observation sheet. Before using the instruments, they were first validated by psychology lecturers, and then tested to students with a reliability score of 0.826 which was classified as highly reliable. The statistical test on the improvement of learning motivation used normalized gain (N-gain) [26]. The hypothesis testing used a paired sample t-test parametric test [27].

3. Results and Discussion
The implementation of a learning strategy to increase motivation on work and energy topic was done by applying the 7E learning cycle model. The 7E learning cycle model has 7 learning stages namely elicit, engage, explore, explain, elaborate, evaluate and extend. The effectiveness of the 7E learning
cycle model in an effort to develop student motivation can be seen from differences in scores before and after the application of the model on each motivational indicator. The results of the student motivation recapitulation are shown in Table 1.

Table 1. Score recapitulation of student motivation

| Indicators of motivation                          | Score (%) |
|-------------------------------------------------|-----------|
| Choice or interest to the task / activity        | Initial   | Final   |
| Efforts made to succeed                         | 62.35     | 88.54   |
| Perseverance and persistence, time used for a task | 61.48     | 89.29   |
| Confidence during involvement                   | 57.37     | 70.09   |
| Confidence during involvement                   | 56.96     | 80.36   |

Based on Table 1, it is known that the initial score of motivation was very low, so it needed to be further developed. After getting the treatment with the application of the 7E learning cycle model the motivation of students increased. The increase of student motivation before being taught with the 7E learning cycle model and after the application is shown in Table 2.

Table 2. Score improvement of student motivation

| Motivation data | Average | N-Gain |
|-----------------|---------|--------|
| Initial         | 59.86   | 0.72   |
| Final           | 89.54   |        |

Referring to Table 2 shows the results of the analysis of differences between the mean score of initial motivation (59.86) and final motivation (89.54). The results of the N-gain analysis obtained in Table 2 shows that an increase in motivation with the application of the 7E learning cycle model was in a high category. The results of the tests are reinforced by the t-test parametric test shown in Table 3.

Table 3. Result of motivation analysis

| t_count | t_table | Conclusion |
|---------|---------|------------|
| 9.574   | 2.052   | H₀ was rejected |

Based on Table 3, the t_count is 9.574 and the t_table is 2.052 at a significant level (5%), thus it can be stated that H₀ is rejected, and Hₐ is accepted. The statement can be concluded that the application of the 7E learning cycle was able to increase student motivation in learning work and energy topic. The assessment of student activity during the learning process with 7E learning cycle model illustrated the increase in student motivation. The results of the observations are expressed as a percentage of the average score shown in Table 4.

Table 4. Score of student activity for the whole stages of 7E Learning Cycle Model

| Stage of 7E Learning Cycle | Score per meeting (%) | Average |
|----------------------------|-----------------------|---------|
|                            | I         | II       | III      |         |
| Elicit                     | 75.00     | 83.33    | 90.28    | 82.87   |
| Engage                     | 79.17     | 83.33    | 95.83    | 86.11   |
| Explore                    | 66.67     | 76.67    | 83.33    | 75.56   |
| Explain                    | 69.44     | 80.56    | 88.89    | 79.63   |
| Elaborate                  | 72.22     | 80.56    | 91.67    | 81.48   |
| Evaluate                   | 79.17     | 79.17    | 91.67    | 83.33   |
| Extend                     | 77.08     | 81.25    | 87.50    | 81.94   |
| Average                    | 74.11     | 80.69    | 89.88    | 81.56   |

Table 4 shows student involvement during the learning cycle learning process. Student score during the learning process showed an improvement for each meeting. Meeting I have the lowest score of 74.11%; meeting II 80.69% and meeting III 89.88%. In every stage of the 7E learning cycle model, the
teacher attempted to involve students actively so that it would increase student motivation. The 7 stages of 7E learning cycle were organized as optimally as possible so students could be active in the learning process.

3.1. Elicit
Elicit stage is the stage that aims to arouse students' initial knowledge. Information about the concept of work and energy has been studied in junior high school and stored in long term memory, then reappeared through basic questions. In this study, researchers asked about the concept of work and energy for students by giving an overview of an event. One of the examples is as below:

T: "Have you ever seen a speeding car suddenly strike? To be able to run again, the car must be pushed first. A father tries to push, but the car does not move. Then, some other people help so that the car can move. What causes the car to move?"
S: "Because of the drive given"
T: "Does the drive for the car include force?"
S: "Yes"
T: "Does the activity that they do to make the car run again include work?"
S: "Yes"

Questions asked to students would give an idea of the concepts to be learned. Students answered each question, and this proved that simple questions would help students recall the concept of work and energy. The response given by students showed an interest in the task/activity. This meant that there was motivation in students and needed to be further developed. Motivation for learning that exists in self will help students in preparing for learning and increasing attention to absorb new information [10].

3.2. Engage
The stage of learning is continued by engaging. The teaching and learning process is that is carried out through the concepts of cartoons, animations, videos or films and demonstrations displayed on material concepts will help to generate motivation [19]. In the process of increasing student motivation, this stage was assisted by a video about work and energy. During the video screening students listened to the contents of the video, and this response showed the interest that arouses the students. At this stage, students discussed the concept of work and energy. One of the examples is presented as follows:

T: "What does it say about kinetic energy and potential energy?"
S: "Kinetic energy is energy that is possessed when objects move and potential energy is possessed by an object when it is stationary."

Positive motivation possessed by students will encourage students to be involved in the learning process [12]. The involvement of students in taking part in engaging and answering questions will develop student motivation. The teacher strives to make students interested in learning so that they are motivated to learn [29].

3.3. Explore
During the experiment students followed the instructions available in the student worksheet, prepared tools and materials, determined the height of the slide, calculated the amount of time needed for the beam to slide, and measured the amount of displacement of the beam. The data retrieval was done repeatedly for three times to get accurate results. Perseverance of students trying to get good results showed the motivation that developed in students. Student interaction directly with objects can develop student motivation, because there is no limitation of information received. The 7E learning cycle model increases student motivation and encourages interaction with the subject through experimental activities [30]. Experimental activities provide opportunities for students to adapt knowledge in the form of new information obtained, increase motivation through expressing ideas/opinions, desire to make observations, provide an overview of concepts learned with those
observed, and develop positive attitudes towards the concept of knowledge in life, communicative, creative and practical knowledge [31,32].

3.4. Explain
The results obtained during exploration, then explained in the explain stage. This process would foster the spirit of learning in students, because during the presentation the teacher facilitated students about the concept of work and energy to be more focused. Students explained the results of the experiment in front of the class. Each student paid attention to the results described. Then they gave an opinion if there was a mistake in the presentation. One example explaining the relationship between kinetic energy and work is as follow:

S1: The relationship between kinetic energy and work is the same, if a moving object has a value.
S2: Work will occur when there is a change in energy caused by an object while moving.
S3: In accordance with the concept of the equation that an object that has a fixed mass will have different speeds when moving, the change will produce a work in joules.

Explanatory activities will train student ability to communicate and express their opinions. Students who are able to give their arguments have an attitude of confidence or confidence in their own answers. Students' self-confidence will be seen when asking questions, expressing ideas, and expressing their opinions or answers [33]. Self-confidence is a driving force for motivation [34].

3.5. Elaborate
The elaborate stage was the stage where students apply work and energy concepts, work terms and symbols, kinetic energy, potential energy and mechanical energy to solve mathematical problems. The students tried to solve problems using concepts that have been studied before. Through this stage, the students showed willingness to solve problems by discussing them or each student from the five groups' representatives asking for guidance from the teacher. This showed that the motivation in students began to develop. Learning motivation refers to the expectations and values shown by students to be able to complete the given assignments and beliefs to succeed in learning [35].

3.6. Evaluate
The evaluate stage was done to find out the extent to which students have been able to understand the concept of work and energy. The assessment was done by giving questions in writing and asking students to work individually. Motivation was shown by students when trying to find answers and this would train students' independence. Motivation is characterized by students who have confidence in the success of the efforts made, so they will face the challenges in solving the problems [36, 37].

3.7. Extend
The final stage of this model is extending stage. At this stage, students could be motivated by introducing more in the concept of work and energy related to everyday life. The students are trained to be able to use the concept of work and energy into new situations as well as in other fields of science.

The application of the 7E learning cycle makes students engage in learning activities faster in a short time [19]. The activeness of students during the learning process will be able to develop interest in learning and self-regulation [38]. The 7E learning cycle is related to how to increase student motivation in the learning process through several exercises as well as to help students learn actively and improve learning achievement [39].

4. Conclusions
The 7E learning cycle model is effective in increasing student motivation in understanding work and energy concepts topic. The students actively followed the learning process by applying the 7E learning cycle model. The activity of the students showed the desire or curiosity in learning. Based on the
research that has been done, the researchers suggested that 7E learning cycle model can be implemented by modifying the approach or learning media to further increase motivation.

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