The Effectiveness of ARICESA-based Learning Material on Students’ Motivations

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Abstract. This research aims to describe the effectiveness of ARICESA (Attention, Relevance, Inquiry, Confidence, Enjoyment, Satisfaction, and self-Assessment) -based learning material to improve students’ motivation on the basic concept of natural science. This research was conducted in 6 weeks by employing a pre-experimental research, that is one group pre-test and post-test design. The data to seek for the effectiveness was obtained through students’ motivation questionnaire that consists of 5 aspects (choice of tasks, effort, persistence, self-confidence, and achievement). Then, the data that were obtained were analysed descriptive and inferential statistics. The mean scores of students’ motivation before joining learning process with ARICESA-based learning material (initial motivation) is still in “very less” criteria in each aspect of motivation. The mean scores of students’ motivation after following the learning (final motivation) increase in “good” criteria. The increase was shown quantitatively with a normalized gain (N-gain) mean of 0.65 in the medium criteria. The dependent t-test results showed p-value (significance) of 0.000 (<0.05). This means that there is a significant difference from the beginning and the end of students’ motivation in an undergraduate program of primary school teacher education for basic science concept learning.

1. Introduction

The prospective teachers should have good competence with a various of 21st-century skills. “Assessment and Teaching of 21st-Century Skills” (ATC21S) categorizes 21st-century skills into 4 categories, one of them are ways of thinking [1]. The ways of thinking category consist of creativity, innovation, critical thinking, and metacognition [1], [2]. In the ways of thinking category, motivation and succeed confidence become capital to achieve these skills [1]. This shows that the learning motivation to support the achievement of 21st-century skills.

Learning motivation has a positive correlation with the level of student self-sufficiency, which became one of 21st-century skills [1], [3], and the competence of graduates referring to Indonesian National Qualification Framework. Learning motivation becomes the main factor of learning independence [4]. One of the intrapersonal resources as a principal to achieve learning independence is the motivation to learn [5]. When students have high motivation, then the student will spend a lot of time to study independently [6], [7]. Intrinsic and extrinsic motivations are adaptive that encourage and sustain learning independence [8]. The higher level of the learning motivation, the higher level of learning self-sufficiency.

The creativity that is one of the 21st-century skills is also influenced by learning motivation. Learning motivation has a significant causality relationship between creative thinking ability [9]–[11]. Creative
thinking skills emerge from learning motivation [12], [13]. The motivation to learn motivation can improve creativity [9], [12]. Learning motivation is a major factor in creative thinking [14].

Learning motivation is the main principal of students to achieve 21st-century skills such as self-sufficiency and creativity [1], [5], [14]. The challenges of achieving 21st-century skills are not supported by the students' motivation. The preliminary study that has conducted in an undergraduate program of primary school teacher education in STKIP PGRI Tulungagung, showed that the students' motivation is still very low. This fact is supported by PISA findings [15], TIMMS 2015 [16], and UNESCO [17] that indicating low student’ motivation. The low student’ motivation also indicated from those who are not motivated in the educational environment in school [18]–[20]. Based on the description above, the researcher develops a natural sains learning materials that are able to fulfill the criteria of validity, practicality, and effectiveness. Generally, the purpose of this research is to describe the effectiveness of ARICESA-based learning material to improve students’ motivation on the basic concept of natural science.

ARICESA-based learning is carried out based on the ARICESA model syntax. The ARICESA model (Attention, Relevance, Inquiry, Confidence, Enjoyment, Satisfaction, and self-Assessment) is the result of the expansion of the ARCS model by adding an inquiry process (I), creating an enjoyment atmosphere (E), and self-assessment (A) that has fulfilled the content and construct validity [21]. The ARCS model (Attention, Relevance, Confidence, and Satisfaction) is an excellent synthesis of motivational research, but the weakness of ARCS is to only focus the source of motivation on the individual as a unit of analysis. Whereas there are external factors that can also affect learning motivation, such as the presence of collaborative factors on social presence, the structure of experience that causes learning to flow, and environmental conditions [22]. I as an Inquiry phase can encourage learning that provides an active role for students while learning. This inquiry model is also able to bridge the needs of students to the space of social interaction and active involvement to generate motivation and self-determination [23], [24]. E as an enjoyment phase that makes it clear that learning must be in the form of joyful learning. The learning environment (in terms of the physical structure of the classroom environment and equipment and materials to be used in the classroom) must be designed appropriately to increase learning motivation [25]. A as an Assessment phase that encourages self-assessment of students themselves as a continuation of learning that supports inquiry. If it is associated with the forming of learning motivation, then self-assessment is more integrated with the achievement of mastery goals aspects [26].

2. Methods
The research subjects of the implementation of ARICESA-based learning material on basic science concepts (Force and Motion, Temperature, Heat, Energy and Changes, Light, and Sound) are 34 students who are 2nd graders of the undergraduate program of primary school teacher education, STKIP PGRI Tulungagung. The development of learning material are adapted from Plomp design [27]. The developed learning material in this research consists of the lesson plan, student worksheet, and learning book. The stages in research and development method include preliminary research, prototyping stage, and assessment phase. However, this research is limited to the stage of prototyping stage. The learning material that is implemented in this research has passed the validity test stage with “very valid” category.

This research was conducted in 6 weeks by employing a pre-experimental research, that is one group pre-test and post-test design [28]. The experimental design was used to investigate the effectiveness of ARICESA-based learning material. The one-group pretest-posttest has been performed by means of a group of students subject to treatment and the dependent variables observed (measured) to assess the effect of the treatments [28]. The treatment in question is related to learning by applying ARICESA-based learning material which measured the learning motivation on the basic concept of science. The learning process at the time of limited implementation is done by the lecturers of the Basic Concepts of Science.

The data to seek for the effectiveness was obtained through students’ motivation questionnaire that consists of 5 aspects (choice of tasks, effort, persistence, self-confidence, and achievement). Student motivation data was obtained by completing questionnaire before (initial motivation) and after (final motivation) the implementation of ARICESA-based learning material. Analysis of students’ motivation to describe students' self-condition about learning motivation level with implementation of ARICESA-
based learning material, analyzed descriptively qualitative with formula percentage of agreement. Students said to be complete if the score of learning motivation of at least 3.25 and classical completeness is achieved when 85% of students complete. The completeness of the indicators using questionnaires motivation to learn. Students are said to master the indicator when the minimum value of 3.25 and the completeness of the indicator is achieved if 75% of students have been completed. The data that were obtained were analyzed descriptive and inferential statistics. The scores of students’ motivation are categorized based on the following criteria: very less, less, good, and very good. The differences in students’ motivation scores before and after the treatment were analyzed using N-gain.

3. Result and discussion
The descriptions of student learning motivation were done in two ways, using N-gain and paired t-test. The use of N-Gain is intended to find out the criteria of increasing motivation to learn basic concepts of science students. While the use of paired t-test is intended to know the significance of the increase. Table 1 shows descriptive analysis of students’ learning motivation questionnaire of each indicator based on excellent category (EX), good (G), enough (E), and less (L). It also shows the average score of learning motivation in each indicator. In summary, the description of Table 1 is presented in Figure 1 and Figure 2.

### Table 1. The analysis results of learning material questionnaire.

| Indicator of Motivation | Categories | Initial Motivation | Final Motivation |
|-------------------------|------------|--------------------|------------------|
|                         |            | \( \sum \) | % | x | \( \sum \) | % | x |
| Choice of Tasks         | EX         | 0 0.00             | 14 | 41.18 |
|                         | G          | 0 0.00             | 20 | 58.82 |
|                         | E          | 13 38.24           | 0 0.00 |
|                         | L          | 21 61.76           | 0 0.00 |
| Effort                  | EX         | 0 0.00             | 17 | 50.00 |
|                         | G          | 0 0.00             | 17 | 50.00 |
|                         | E          | 11 32.35           | 0 0.00 |
|                         | L          | 23 67.65           | 0 0.00 |
| Persistence             | EX         | 0 0.00             | 15 | 44.12 |
|                         | G          | 0 0.00             | 19 | 55.88 |
|                         | E          | 16 47.06           | 0 0.00 |
|                         | L          | 18 52.94           | 0 0.00 |
| Self-Confidence         | EX         | 0 0.00             | 18 | 52.94 |
|                         | G          | 0 0.00             | 16 | 47.06 |
|                         | E          | 16 47.06           | 0 0.00 |
|                         | L          | 18 52.94           | 0 0.00 |
| Achievement             | EX         | 0 0.00             | 13 | 38.24 |
|                         | G          | 0 0.00             | 21 | 61.76 |
|                         | E          | 12 35.29           | 0 0.00 |
|                         | L          | 22 64.71           | 0 0.00 |

\( \sum \): number of student; x: average score

Figure 1 shows that the implementation of the ARICESA-based learning material can increase the average score of learning motivation in all learning motivation indicators. Based on the results of the initial motivation and final motivation, the implementation of ARICESA-based learning material can increase the number of students to a higher level of motivation on each indicator, which is summarized in Figure 4.2.
Figure 1. The average of learning motivation score.

Figure 2 shows that all students before attending the learning process with ARICESA-based learning material is still in enough category and less good in each indicator of motivation. No student has a good and excellent motivation category. Implementation of the ARICESA-based learning material can increase the number of students in the higher category. All students after learning have a motivation to learn science in good and excellent category. No student still has a category of motivation is good enough or less good.

Table 2 shows that the completeness of the final learning motivation indicator the basic science of students has reached 100% in each indicator. The level of achievement is already above the minimum threshold set that is 75%. It is much improved from the completeness of the student's initial motivation on each indicator. The results of initial and final motivational measurements showed an increase in motivation with a normalized gain average of 0.65 in the medium category.
The testing of difference of initial and final learning motivation was done to see the significance of improvement of learning motivation after applied ARICESA-based learning material. The test of difference of learning motivation was used paired t-test. Assumptions in paired t-test analysis are the normality and homogeneity of variance between groups [29]. Data analysis used to determine data normality was Kolmogorov-Smirnov test, whereas to test the homogeneity of variance between groups was used Levene's test [29]. Both testing techniques are assisted by SPSS 18 software. Test results of normality of learning motivation by using Kolmogorov-Smirnov Test obtained p-value or statistical significance equal to 0.194 for initial motivation measurement and 0.200 for final motivation measurement. Both have values greater than 0.05; that means learning motivation follow normal distribution function. While the results of homogeneity test of data variance of learning motivation by using Levene's test obtained p-value or statistical significance of 0.186. The value is greater than 0.05; that means the variance of initial and final learning motivation are homogeneous.

Based on the normality and homogeneity test results obtained that the data has followed the normal distribution function and the variation of the data is also homogeneous, so testing the difference between learning motivation were done by paired t-test. This test was conducted to determine whether there are differences in initial motivation and final motivation. The result of paired t-test analysis on learning motivation of basic science concepts is presented in Table 3.

Table 3. The result of paired t-test analysis on learning motivation of basic science concepts.

| Indicator of Motivation | Initial Motivation | Final Motivation | N-gain |
|-------------------------|---------------------|------------------|--------|
| Score | Completed Indicator | Score | Completed Indicator | <g> | Criteria |
| Choice of Tasks | 1.92 | 0.00% | Not completed | 3.95 | 100.00% | Completed | 0.66 | Medium |
| Effort | 1.86 | 0.00% | Not completed | 3.94 | 100.00% | Completed | 0.66 | Medium |
| Persistence | 1.89 | 0.00% | Not completed | 3.88 | 100.00% | Completed | 0.64 | Medium |
| Self-Confidence | 1.97 | 0.00% | Not completed | 3.96 | 100.00% | Completed | 0.66 | Medium |
| Achievement | 1.89 | 0.00% | Not completed | 3.83 | 100.00% | Completed | 0.62 | Medium |

| Average | 1.91 | 0.00% | Not completed | 3.91 | 100.00% | Completed | 0.65 | Medium |

Table 3 shows that the paired t-test statistic value for initial motivation and final motivation is -26.722 and has p-value (significance) of 0.000 (<0.05). Because of the significance value of the test result is less than 0.05; then the conclusion is H0 rejected or H1 accepted. This means that there is a significant difference between initial and final learning motivation of students.

Based on the data findings, it can be stated that the developed ARICESA-based learning materials has qualified effectiveness in terms of student's learning motivation. In other words, the ARICESA-based learning materials is an effective tool for improving the learning motivation. This is in accordance with the basic component characteristics of the ARICESA model that is the ARCS motivation model and the Inquiry model. Application of ARCS model in learning can increase learning motivation [30]–[32]. Similarly, the results of the application of inquiry models that have been done by previous researchers have proven to improve learning motivation [32]–[34]. The combination of the two characteristics of the model into the ARICESA model eventually proved to be able to increase the motivation to learn. The joyful learning (enjoyment) component included in the ARICESA model also makes students focus, persistent, and make optimal efforts in understanding learning materials [35]. That is, students are increasingly motivated to learn with a fun learning atmosphere [36].
4. Conclusion
Based on the findings during the research it can be concluded that the ARICESA-based learning material are effective to improve students’ motivation on basic science concepts in undergraduate program of primary school teacher education. That have shown from N-gain for learning motivation the medium category with an average score of 0.65 and paired t-test results for learning motivation indicate a significant difference between before and after the implementation of ARICESA-based learning materials. Based on the conclusion of the research result, it is given some suggestions for further research in order to pay attention to the design of classroom management, especially in group work, related to the number of members, supporting equipment, and the allocation of learning time, and also need to be tested consistency of improvement of learning motivation.

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