The Effect of ARICESA on Achievement Motivation and Understanding of Basic Science Concepts for Prospective Teacher Students

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Abstract: The aim of this research to determine effect of the application ARICESA on student teacher achievement motivation and understanding of basic concepts. The subjects in this study were 34 students in the Department of Elementary School Teacher Education, Universitas Bhinneka PGRI Indonesia. One group pretest-posttest design was used in this study. The achievement motivation of prospective teachers is measured by a motivational questionnaire and understanding of basic concepts is measured by a conceptual test of concept understanding as a pre-test and post-test. Data analysis with t-test and prerequisite test and N-gains core. The results showed a significant increase in motivation effect for 5 indicators of achievement motivation with moderate criteria with an N-gain value range of 0.62 to 0.66 and the normalized mean N-gain is 0.65 in the medium criteria. There is a significant effect of increasing understanding of basic science concepts with a range of N-gain coefficients from 0.72 to 0.77 and a normalized average N-gain of 0.75 with high criteria.

1. Introduction

The role of science subjects in elementary schools is very important, because it becomes the scientific foundation to further explore natural phenomena [1]. Therefore, students must get the correct science concepts in learning in elementary schools. The figure who is very influential on the achievement of students’ needs for the scientific basis is the elementary school teacher. This means that prospective teachers must have the correct understanding of concepts and have high motivation to continue to develop their competencies. The fact states that some elementary school teacher candidates still have low motivation to learn science and low concept understanding in learning science [2,3].

Based on the analysis of Trends in International Mathematics and Science Study (TIMMS) data in 2011 from 26 countries as a sample, it is stated student’s learning motivation is in low criteria, specifically in the Southeast Asian region [4]. The data was updated in the 2015 TIMMS survey which specifically involved Indonesia, and it was stated that the level student’s learning motivation in Indonesia was in low criteria [5]. Middle school students have low motivation to learn [6,7] and their
learning motivation tends to decrease in the span of one academic year, especially for classes with conventional teacher-centered learning [8, 9].

Prospective science teachers who become students in science lecture programs are also detected to have a tendency to decrease their motivation to learn in the span of one semester running [10-12]. The survey conducted on primary school teachers in Turkey also showed low teacher motivation to continue learning and self-actualization [13], which was thought to be caused by a lack of knowledge and skills of prospective teachers in terms of performance management and self-motivation strategies. Prospective teachers who are not able to motivate themselves so that they are not motivated themselves will have difficulty motivating students to learn. This will have an impact on the low quality of learning motivation. Prospective teachers must have superior competencies with various 21st century skills. The teaching and assessment [ATC21s] into four categories, one of which is ways of thinking [14]. The categories of ways of thinking consist of critical thinking, innovation, creativity [15], also metacognition [14]. Motivation, confidence, thinking category to succeed are the capital to achieve these skills. Understanding the concept is also the basic capital to reach the category level of ways of thinking. This shows that learning motivation and understanding of concepts are supporting target of 21st century skills.

Learning independence and motivation have a positive relationship which is one of the 21st century skills and graduate competencies that refer to the Indonesian Qualification Framework (IQF). Motivation is the main factor for independent learning [16, 17]. Students with high motivation, they will use a lot of time studying independently [18, 19]. Extrinsic and Intrinsic motivation is adaptive which encourages and maintains independent learning. The higher the student's learning motivation, it is suspected that the higher the level of learning independence will be.

The ARICESA model that has been developed is a learning model related to learning motivation and understanding science concepts for students. The ARICESA model is the development of Keller's ARCS motivation model, with the addition of several aspects, namely Inquiry (I), Enjoyment (E), and Self-Assessment (A). The Inquiry aspect in this model consists of several stages, namely: confronting students with problems, collecting experimental data and hypotheses, observing, interpreting data, presenting results and verifying results. The aspects that make up this model are outlined in the model syntax or learning flow, namely Attention (A), Relevance (R), Inquiry (I), Confidence (C), Enjoyment (E), Satisfaction (S), and Self-Assessment (SA). Each phase has goals that must be achieved in a complete series of learning processes, namely: (a) Attention phase to focus attention and arouse students' enthusiasm when starting the learning process, (b) Relevance phase to show learning objectives and the relevance of the material to the context of life, (c) Inquiry phase to actively involve students to construct conceptual understanding, (d) Confidence phase to generate confidence and confidence to succeed in learning in students, (e) Enjoyment phase to make students feel comfortable and happy in learning. the learning process, (f) the Satisfaction phase to make students feel valued and able to appreciate the effort and results in learning, and (g) the Self-Assessment phase to give students the ability to be able to assess, reflect, and develop further learning plans.

Based on the foregoing, purpose this research to examine the effect of ARICESA in overcoming the learning motivation of prospective teachers and their conceptual understanding of basic science. Because it is very urgent to apply when teaching in elementary schools after graduating from college in Elementary School Teacher Education.

2. Method

One group pretest posttest research design was used on 34 prospective science teacher students in the School Teacher Education at the University of Bhinneka PGRI Indonesia. To see the effect of applying the achievement motivation of prospective science teacher students, it is done in 2 ways, namely by using the Wilcoxon Signed Rank test and N-gain. N-gain used to determine the level of increase in achievement motivation. Wilcoxon Signed Rank Test used to determine the significance effect of the increase [20].
The description of understanding of basic science concepts for prospective teacher students uses N-gain and paired t-test. The use of N-gain is intended to determine the criteria for increasing understanding of the basic science concept of effects from the application of ARICESA. While the use of paired t-test is intended to determine the significance of the increase. The significance of increasing concept understanding between the results of the pre-test and post-test illustrates the significant positive effect of the results of the application of ARICESA. Measurement of understanding of basic science concepts is carried out with pre-test instruments before learning and post-test after learning is carried out. The tests carried out included six learning topics that had been implemented, namely quantities and units, simple machines, temperature, electricity, magnetism, and life processes.

3. Results and Discussion

3.1 ARICESA effect on achievement motivation

The results of the analysis of achievement motivation on 34 prospective students for basic science teachers at the University of Bhinneka PGRI Indonesia are described statistically in Table 1.

| No | Description | Initial Motivation | Final Motivation |
|----|-------------|-------------------|------------------|
|  1 | N           | 34                | 34               |
|  2 | Mean        | 1.9062            | 3.9171           |
|  3 | Median      | 1.8900            | 3.8900           |
|  4 | Mode        | 1.5500            | 3.8100           |
|  5 | Variance    | 0.1150            | 0.0560           |
|  6 | Skewness    | 0.3760            | 0.2020           |
|  7 | Kurtosis    | -0.7830           | -0.6380          |
|  8 | Range       | 1.1900            | 0.9300           |
|  9 | Minimum     | 1.3800            | 3.5000           |
| 10 | Maximum     | 2.5700            | 4.4300           |
| 11 | Sum         | 64.810            | 133.18           |

Based on Table 1, the average initial motivation and final motivation are 1.91 and 3.92, respectively, which indicates an increase in the average student learning motivation. The mean value of learning motivation data shifted from 1.89 as initial motivation to 3.89 and as late motivation. The data mode of learning motivation is 1.55 for initial motivation and 3.81 for final motivation, respectively. The mean, median, and mode data show a measure of central tendency that is close to each other between the three, both initial and final motivation.

The results differences in initial and final achievement motivation for basic science teacher candidates obtained the diversity of data on initial motivation and final motivation, respectively, 0.115 and 0.056. Skewness shows a value of 0.376 as initial motivation and 0.202 as late motivation, both of which indicate the slope of the data distribution to the left or the mode is to the left of the median and mean. Kurtosis data motivation, initial and final motivation are -0.783 and -0.638, both of which fall into mesokurtic criteria or have a homogeneous tendency [11]. Early learning motivation has a value range of 1.19 from a minimum value of 1.38 to a maximum value of 2.57. The final learning motivation has a value range of 0.93 from a minimum value of 3.50 to a maximum value of 4.43.

While the results of N-gain are based on 5 indicators of achievement motivation [4], namely: (1) tasks of choice*, (2) effort*, (3) persistence*, (4) self-confidence*, and (5) achievement*, to 34 student teacher candidates in basic science courses the results are presented in Table 2.
Table 2. N-gain* indicators of achievement motivation

| No | Indicator              | Initial Score | Final Score | N-gain* | Criteria |
|----|------------------------|---------------|-------------|---------|----------|
| 1  | Tasks of choice*       | 1.920         | 3.950       | 0.660   | Medium   |
| 2  | Effort*                | 1.860         | 3.940       | 0.660   | Medium   |
| 3  | Persistence*           | 1.890         | 3.880       | 0.640   | Medium   |
| 4  | Self-Confidence*       | 1.970         | 3.960       | 0.660   | Medium   |
| 5  | Achievement*           | 1.890         | 3.830       | 0.620   | Medium   |
|    | **Average**            | **1.910**     | **3.910**   | **0.650**| Medium   |

Based on Table 2, it shows that the results initial and final motivation measurements showed an increase in learning motivation for the 5 motivation indicators with moderate criteria with an N-gain value range of 0.62 to 0.66. Meanwhile, the normalized N-gain average is 0.65 in the medium criteria. This means that there is an effect of implementing ARICESA on the achievement motivation of the 34 student teacher candidates.

The results of the Wilcoxon signed rank statistic between the initial motivation and the final motivation were 34 which showed that all students experienced an increase in learning motivation. The test results also have a p-value [significance] of 0.0001 [<0.05]. The significance value of the test results is less than 0.05, the conclusion is that there is a significant difference between the initial and final motivation of prospective basic science teacher students.

3.2 Effects of ARICESA on understanding basic science concepts

The results of ARICESA's effect on understanding basic science concepts are measured by test questions for understanding basic science concepts consisting of topics on quantities and units, simple machines, temperature, electricity, magnetism, and life processes. The test questions in the form of essays with a total processing time of 120 minutes as Table 3.

Table 3. Analysis of test values for basic concepts

| Topic            | Criteria Understanding | Pre-test | Post-test |
|------------------|------------------------|----------|-----------|
|                  |                        | ∑Student* | X        | ∑Student* | %          | x         |
| Quantity and Unit| High                   | 0        | 0.000    | 17.53    | 31         | 91.18     | 78.88     |
|                  | Medium                 | 2        | 5.880    | 3        | 8.820      |           |           |
|                  | Low                    | 32       | 94.12    | 0        | 0.000      |           |           |
| Simple plane     | High                   | 0        | 0.000    | 15.65    | 31         | 91.18     | 76.59     |
|                  | Medium                 | 0        | 0.000    | 3        | 8.820      |           |           |
|                  | Low                    | 34       | 100.00   | 0        | 0.000      |           |           |
| Electricity      | High                   | 0        | 0.000    | 16.41    | 32         | 94.12     | 80.53     |
|                  | Medium                 | 1        | 2.940    | 2        | 5.880      |           |           |
|                  | Low                    | 33       | 97.06    | 0        | 0.000      |           |           |
| Magnets          | High                   | 0        | 0.000    | 17.65    | 33         | 97.06     | 79.76     |
|                  | Medium                 | 2        | 5.880    | 1        | 2.940      |           |           |
|                  | Low                    | 32       | 94.13    | 0        | 0.000      |           |           |
| Temperature      | High                   | 0        | 0.000    | 17.94    | 33         | 97.06     | 80.18     |
|                  | Medium                 | 2        | 5.880    | 1        | 2.940      |           |           |
|                  | Low                    | 32       | 94.12    | 0        | 0.000      |           |           |
| Life Process     | High                   | 0        | 0.000    | 19.59    | 33         | 97.06     | 81.06     |
|                  | medium                 | 4        | 11.77    | 1        | 2.940      |           |           |
|                  | low                    | 30       | 88.25    | 0        | 0.000      |           |           |
Based on Table 3, it shows the test scores understanding basic concepts for prospective teacher students based on the criteria high, medium, and low concept understanding on each topic of discussion. In addition, it also shows the average value of understanding basic concepts on each topic of discussion. shows that the application of the ARICESA model can increase the average test scores for understanding basic science concepts on 6 topics of discussion.

Students before joining the learning process with ARICESA more than 30 were still in low comprehension criteria on each topic. There are only a maximum four students who enter criteria moderate understanding, no students enter the criteria high understanding. The effect of implementing ARICESA can increase the number of students meet high criteria. Almost all students after participating in the study have an understanding basic science concepts in high criteria. There are no students have low concept understanding criteria.

Based on the results of the pre-test and post-test, the effect of implementing ARICESA in class can increase a higher level of understanding on each topic [5]. Improved understanding of basic science concepts on 6 subjects can be determined by determining value of N-gain. The value of the N-gain understanding of basic science concepts from prospective teacher can be seen in Table 4.

| No | Topic*       | N-gain* Coefficient* | Information* |
|----|--------------|----------------------|--------------|
| 1  | Quantity and Unit | 0.740                | high         |
| 2  | Simple plane  | 0.720                | high         |
| 3  | Electricity   | 0.770                | high         |
| 4  | Magnets       | 0.750                | high         |
| 5  | Temperature   | 0.760                | high         |
| 6  | Life Process  | 0.760                | high         |

Based on Table 4, the ARICESA effect on increasing understanding of basic science concepts for prospective teacher students has high criteria with an N-gain coefficient range from 0.72 to 0.77. If averaged, the N-gain value is 0.75 and has high criteria.

The results of the t-test prerequisite test by testing the normality of data on understanding basic science concepts which overall topic has a value greater than 5%, meaning that the data on understanding basic science concepts follows the distribution function. normal for all topics. Since the data normality requirements have been met, it is possible to test the mean difference both of them for all topics using paired t-test.

The results of the statistical value of the paired t-test between the pre-test and post-test understanding of basic science concepts in each class have a negative t-count, meaning that the post-test result is greater than the pre-test. The significance or the p-value of paired t-test statistics for all pairs pre-test and post-test on each topic of discussion is less than 5% so it can be stated that there is a significant difference between understanding the concept basic science between pre-test and post-test for all topics. The overall difference in the mean shows a negative value, which means that the mean value of the pre-test is smaller than the post-test or there is an increase in the post-test value of understanding basic science concepts.

4. Conclusion
The effect of ARICESA application on achievement motivation and understanding of basic science concepts is summarized as follows: There is a significant increase in motivation effect for 5 indicators of achievement motivation of prospective teacher students with moderate criteria with an N-gain value range of 0.62 to 0.66, and the normalized mean N-gain is 0.65 in the medium criteria. There is an effect of increasing understanding of basic science concepts for prospective teacher students, which is significant with high criteria with a range of N-gain coefficients from 0.72 to 0.77 and a normalized
average N-gain of 0.75 with high criteria. This research was conducted on first year students. Furthermore, it can be tested on different subjects and different majors.

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