Developing Scientific Attitudes Instrument of Students in Chemistry

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Abstract. This research aims to evaluate the attitude instrument which will be used to assess the scientific attitudes in chemistry classes in High School in Parepare. The research will provide information to identify student scientific attitudes. Scientific attitudes in this paper consist of scientific attitude indicators. They are curiosity, honesty, objectivity, perseverance, conscientious, openness, being critical, and being responsible. The instrument evaluation is done by testing it to high school students to get its validity and reliability. The instrument has 8 aspects with 32 statements. The analysis result shows that Kaiser-Mayer-Olkin (KMO) indicator is 0.922. The Measure of Sampling Adequacy (MSA) in anti image correlation indicates that all of variables is greater than 0.5 which allows the data to be analysed further. The amount of variance and variable that can be explained by the factors forms 6 factors and cumulative variance 61.884%. The 32 items in the instrument, 26 items are fulfill the 6 factors. The Realibility of all items using Cronbach Alpha coefficient is 0.948. The analysis denotes that the instrument can be used to measure the student scientific attitudes in chemistry class with 26 items and 6 factors. The results of the analysis show that the instrument can be used to measure students’ scientific attitudes on chemistry learning with the number 26 and 6 factors formed.

Keywords: Scientific attitudes; High school; Chemistry.

1. Introduction

The Indonesian curriculum applied nowadays contains the effort of forming the student character to master variative skills. The skills can be used by the students to solve today’s and future problems. It makes the student need of critical thinking in solve the problem will be the first aim of the education system. Another important thing to be formed in education is mental and attitude of the students that can not be separated with the value transfer process. The action choosed is depend on the student attitudes toward the profit-loss, good-bad, or satisfying-unsatisfying value of the student act [1].

Today, Indonesian teachers are demanded to performing test and non test evaluation. A kind of non test evaluation is measuring non cognitive ability of the students. Some examples of non cognitive ability are problem solving, collaboration, and critical thinking ability. Those 3 abilities can be seen in student scientific attitude. This scientific attitude consists of: 1) curiosity, 2) critical attitudes, 3) Openness, 4) Objectivity, 5) appreciating another person works, 6) courage to defend the truth, and 7) having a good vision for the future [2,3].

Students with good scientific attitude have skills to face problems in their environment. One of the skill is the process of finding out and analysing the problems [4]. From the process, students will
overcome the problems with scientific steps. The scientific attitudes of students will help students to understand the concepts given in the class which will take student achievement to the more positive trend [5]. The fact in the class shows that teachers have some troubles in making non cognitive instrument. The problem is produced by the great number of demanded instrument to be used in the class. It cause another problem. Teacher is evaluating non cognitive ability of the students directly, not using a measured instrument [6]. This kind of evaluation is a subjective evaluation, so that the need of validated instrument for non cognitive ability is bigger day by day [7].

The main purpose of this research is to provide information to teachers regarding analysis and instruments that can be used in assessing students’ scientific attitudes. After the teacher can assess students’ scientific attitudes, the teacher can give some treatment from the assessment results.

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Research Method

This section presents the research method

2.1. Data

The data in this research is gained by testing the scientific attitude instruments toward 141 high school students. The scientific attitude instrument is developed using 8 aspects of scientific attitude which consist of 32 statements.

2.2. Method

This research is descriptive research with quantitative approach to get the solutions of the problems. The quantitative research gives openness to the research result to be objectively tested. The instrument validation is done to know the level of feasibility of the instrument. The validity test in this paper consist of two, content validity and construct validity. Using Content Validity Ratio (CVR) can reflect the content validity of the instrument items [5,6]. The items is rated by experts called Subject Matter Experts (SME). The formula of CVR can be stated as:

$$CVR = \left( \frac{2n_e}{n} \right) - 1$$

where

- $n_e = \text{the number of SME who rate an item as "essential"}$
- $n = \text{the number of SME}$

The CVR value from -1.00 to 1.00. So when CVR > 0, it can be concluded that the items are essential more than 50% by SME [7]. Construct validity of the instrument will be analysed using Exploratory Factor Analysis (EFA) theory. The EFA aims to know and identify the factors forming a construct using score variance [8].

The analysis of the aspects is using some indicators. The first one is by using KMO (Kaiser-Meyer-Olkin) value. KMO value is obtained by using partial correlation to test whether the variable in sample is sufficient to be correlated, so that the variable can be differentiated. The general rules of KMO states that KMO value must be greater than 0.5 to be analysed further [9]. The next indicator is by using Bertlett test and the anti image correlation. The MSA should be greater than 0.5. Another indicators is by using variable communality value. The variable tested should be fulfilling the communality requirements greater than 0.5. If the variable has a communality value less than 0.5, the instrument will be retested by not including the aspect that has not fulfill the communality requirements.
The further analysis of the instrument reliability will be done by Cronbach Alpha. The reliability of Cronbach Alpha theory ranges from 0 to 1. The reliability valued 0.70 is acceptable, whereas the one that greater than 0.8 is stated as good [10].

3. Result and Discussion
This section presents the results obtained and following by discussion.

3.1 Result
The research is including designing the instrument of scientific attitudes. The first procedure to build the instrument is identifying the problems and then formulating them. The next procedure is designing the instrument corresponding to the attitudes that will be measured. This instrument design is formed from conceptual and operational definition. Indicators used to measure student scientific attitudes will be derived from those conceptual and operational definition. The description of the operational and conceptual definition of the scientific attitudes is given in the Table 1 below:

| No | Aspects | Sub Aspects | Indicators |
|----|---------|-------------|------------|
| 1  | Curiosity | Curiosity   | Asking questions.  |
|    |         |             | Observing     |
|    |         |             | Enthusiasm    |
| 2  | Honesty | Honesty | Writing observation result as it is.|
|    |         | Not cheating | Do not seeing others observation result |
|    |         |             | Do not mixing the facts with opinions |
|    |         |             | Accepting the result of observation.|
| 3  | Objectify | Objectify | Paying attention and evaluating others perspectives.|
|    |         |             | Paying attention to all processes and conclusions|
| 4  | Perseverance | Having no despair | Having no despair in doing the experiments|
|    |         |             | Having a habit of repeating the experiment|
|    |         |             | Conducting practicum activities to completion|
| 5  | Conscientious | Being careful | Paying attention to the empirical facts|
|    |         | Following the activity based on instructions | Working carefully in the practicum|
|    |         |             | Postponing decisions until enough data is collected|
|    |         |             | Working according the instructions|
| 6  | Openness | Openness | Willing to listen others argument|
|    |         | Working with Team | Working with team in practicum|
|    |         | Appreciating others | Willing to change opinions based on strong evidence|
|    |         |             | Appreciate others works|
| 7  | Being critical | Being critical | Finding as much information as possible|
|    |         |             | Paying attention to data even though it's small.|
|    |         |             | Do not immediately accept conclusions without strong evidence|
| 8  | Being responsible | Being responsible | Dare to maintain opinions on the results of the practicum|
|    |         |             | Collecting the report and task in time|
|    |         |             | Cleaning the tools, materials, and laboratory after the practice class|
After dividing the scientific attitude aspects into some indicators, the instrument will be assessed by experts in focus group discussion (FGD). The discussion will analyse suitability of those indicators, sub aspects, and aspects of the scientific attitude. From the expert consideration, the analysis will be continued by forming the instrument according the FGD results.

Instrument validity is based on its content and construct. The content validity is decided by the expert panel. The experts will decide whether the instrument item is essential or not. The items is essential if they can represent the aim of the measurement [8]. This instrument development is involving 8 experts. The results of the FGD indicate that all of the items is a valid item proven by the CVR value of the items is greater than 0.00. The construct validity is then analysed using Exploratory Factor Analysis (EFA) with SPSS 25 helping. According to the analysis, the KMO score of the instrument is 0.922 with 0.00 significance. The result indicates that the data can be analysed further. Beside that KMO score, another positive result is showed by Bartlett test with 0.00 significance (< 0.05). This Bartlett test shows that the multivariate variables is correlated each other.

The determination of the factor category of the variable is determined by the factor formed. The determination of the factor category of the variable is based on the correlation value which has to be greater than 0.5. The analysis result shows that the first factor is consist of 7 items, the second is those of 5 items, the third and fourth is of 4 items, the five and the last is 3 items each. Another 6 items are not included in those factors, so they will be eliminated. The items eliminated are the 13th, 18th, 19th, 21st, 28th, and 30th. After testing the validity, the realibility of the instrument will be checked. The analysis gives 0.948 Cronbach Alpha score. The score proves that the items has a good realibility to measure the student scientific attitudes.

The next step of the development of the instrument is determining the variable according to the factor formed. The determination of the factor category of the variable is based on the correlation value which has to be greater than 0.5. The analysis result shows that the first factor is consist of 7 items, the second is those of 5 items, the third and fourth is of 4 items, the five and the last is 3 items each. Another 6 items are not included in those factors, so they will be eliminated. The items eliminated are the 13th, 18th, 19th, 21st, 28th, and 30th. After testing the validity, the realibility of the instrument will be checked. The analysis gives 0.948 Cronbach Alpha score. The score proves that the items has a good realibility to measure the student scientific attitudes.

4. Conclusion

This paper has presented an evaluation on the attitude instrument which will be used to assess the scientific attitudes in chemistry classes. The scientific attitudes instrument provide in this paper is eligible to be used in the class. After the EFA, the instrument with 26 items are all fulfilling the requirements of the validity and realibility (0.948 Cronbach Alpha Score). The development of instrument gives benefits to education institution, especially teachers who will use this instrument to measure non cognitive ability of students in Indonesia.

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