

## Developing instrument of academic potential test analogy verbal ability for undergraduate students

Efi Septianingsih<sup>1</sup>, Mohammad Adam Jerusalem<sup>2</sup>

<sup>1</sup>Postgraduate of Educational Research and Evaluation, Yogyakarta State University, Indonesia

<sup>2</sup>Culinary and Fashion Education, Yogyakarta State University, Indonesia

### Article Info

#### Article history:

Received Sep 27, 2019

Revised Dec 11, 2020

Accepted May 7, 2021

#### Keywords:

Academic potential test

Analogy

Instrument

Reliable

Valid

### ABSTRACT

The paper aims to develop the instrument about analogy test to measure the level of intelligence of undergraduate students. Determination of the number of samples is done by purposive sampling technique. This instrument is analyzed by factor analysis. Of the 15 items that will be used to develop the academic potential test instrument for verbal analogies, 4 analysis factors. The formation of these 4 factors is from Eigenvalues greater than 1 so that there are only 4 factors that fulfill the requirements. Furthermore, 15 items of the tested instrument to 91 undergraduate student respondents obtained 2 items of invalid instrument with correlation coefficient  $\leq 0.3$ , Kaiser-Meyer-Olkin (KMO) and Bartlett's test amounted to 0.785 with  $p < 0.05$ . Trial results from the results of the trial results obtained that the average validity of the questions is 96.8%. Test reliability was analyzed using the Alpha ( $\alpha$ ) formula of Cronbach. The calculation is done using the help of the IBM SPSS version 22.0 Windows program and the coefficient of 0.806 is obtained. Based on the results of the research, it can be concluded that the quality of the developed instrument items has been valid and reliable.

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### Corresponding Author:

Efi Septianingsih

Postgraduate of Educational Research and Evaluation

Yogyakarta State University

Colombo Street Num. 1, Depok, Sleman, 55281, Yogyakarta, Indonesia

Email: efi270992@gmail.com

## 1. INTRODUCTION

Tests are an important instrument in the education field, especially to improve the quality of education. One way to improve the quality of National Education in a better direction requires courage to take the policy of fixing the system used as a system of assessment tools [1]. Education is regarded as a key that unlocks the development of potential personal and national values and all other kinds of rights and powers in the world [2] Education in Indonesia as stated in the 1945 Republic of Indonesia's Constitution that every citizen has the same right to obtain education, this indicates that all people have equal opportunity to get education without exception [3] Schools are part of the government which seeks to implement regulations as a form of active role in building better human resources through education [4].

In learning, an assessment of the level of student success needs to be held in order to achieve the goals that have been set in a program [5]. In general, a test is carried out in the final stages of a learning process. Yet occasionally, tests are conducted before the learning process begins (pretest). Some research indicates that the test of potential has a relation with the intelligence [6]. The Academic Potential Test is a test held to measure the possibility of student success. For students who will continue to the world of work or study and to measure the probability of success of the student if accepted. Test has to learn more in university

[7] academic potential test is a psychological test that can reveal what someone has achieved intellectually [8]. Potential tests are one form of measurement of general potential cognitive ability (measurement of maximal performance) specifically designed to predict the chances of successful learning in college, which is why such tests are usually called Academic Potential Test. Although cognitive neuroscience has progressed remarkably towards understanding human intelligence, relative contributions supporting high level cognition and predicting performance remain poorly characterized [9].

The basic idea in the construction of the Academic Potential Test is to gradually follow the development concept of the graduate record examinations (GRE) which consists of the Verbal Reasoning (V) section. In general, the Academic Potential Test in Indonesia consists of three subtests, namely Verbal subtest, Quantitative subtest, and Reasoning subtests. Generally, academic potential tests are not arranged based on the course syllabus, [10] The material contained in the Academic Potential Test consists of three subtests, namely verbal (equality test, opposite word test, and verbal analogy), quantitative (numerical test, series test, arithmetic test, and arithmetic logic) and reasoning (logic formal, analytical, spatial/spatial, and logical reasoning). To answer the question, students should have talent. Talent is an interaction between the three basic groups of human nature, namely general abilities above average, level of task commitment and level [11].

In Academic Potential Tests there is one intelligence test that is closely related to mastery in the field of verbal ability, namely analogical intelligence. Critical thinking is active and organized in mental processes. This skill is able to solve problems using logic [12] because retention is one indicator of success in learning [13]. According to the Big Indonesian Dictionary, the analogy is one, the similarity or compatibility between two different things or things; second, equivalence between the forms of language that form the basis of other forms; third, something that is the same in form, composition or function but is different in origin so that there is no kinship; four, the similarity of some characteristics between two objects or things that can be used for the basis of comparison. Analogy means equation or comparison. Analogy problems are often used as measures of aptitude and achievement [14]. Analogy speaks of a different matter and two different things which are then compared. Analogy in linguistics is the equation between forms as the basis for the occurrence of other forms. Analogy is one of the morphological processes in which in the analogy, the formation of new words from existing words. In addition, in the analogy, only the equations are considered, regardless of the differences between the two things.

An analogy test is a test to find answers in the form of new words that have a similar or similar relationship to the words in the problem presented then make thereby generating prediction errors and motivating both suppressive actions and new predictions [15] Analogy tests aim to measure a person's ability to know the similarity of relations between two words. Sets of explicit analogy problems provide useful tools for investigating the mechanisms underlying analogical reasoning [16]. By testing this analogy, a person's ability will be assessed primarily in interpreting the meaning of a word, word functions, relationships between words, and usage and equivalent functions in other words. Then the control-value theory specifies that the determinants of emotions experienced in the academic context involve the student's appreciation of the control and the value/valence attributed to learning activities and their outcomes [17].

With high analogical abilities students can understand concepts and solve questions about Academic Potential Test more easily. In general according to [18] classifying there are two analogies, namely: 1) Analogy Declarative is an analogy used to explain or affirm something that is not yet known or still vague, with something that is already known; and 2) Inductive Analogy is an analogy compiled based on principal equations that exist in two phenomena, then concluded that what is in the first phenomenon also occurs in the second phenomenon.

Technically, in the Analogy Test the test takers will be asked to identify or look for equivalents or the equivalence of words that are interconnected. People who have adequate verbal abilities, indicate that they have uptake of information, insight, and adequate knowledge about education. Following the development of the 21st century, students are required to be able to have high-order thinking skills [19].

Education in the 21st century faces the challenge to teach and train key skills which will be helpful for students in real-life competition [20]. The success of education in building human character requires accurate education because education will make a major contribution to the achievement of the overall national development goals [21]. This means that the better the level of one's verbal abilities, the better the level of intelligence. The key to success in the academic potential test of this verbal analogy is the mastery of adequate treasury functions, and how participants can use the logic of good thinking.

In general, the Academic Potential Test materials are materials that are not routinely taught on campus. Students who often get high grades in their school, not necessarily able to pass this Academic Potential Test. However, the students who have or often see and practice Academic Potential Test questions have a higher probability of getting a high score. Therefore we need an exercise or habituation for students to

work on the Academic Potential Test questions. These studies found that high self-efficacy in the context of research made students' academic performance even higher [22].

Many sources explain these Academic Potential Test questions. Some students practice the Academic Potential Test questions from question books, or try outs held by educational institutions or from tutoring. However, this was considered ineffective in seeing that only certain students had the opportunity to get used to working on the Academic Potential Test questions. Therefore, we need a set of Academic Potential Test questions with the help of media that can be used by students. As well as the classic, modest relationship between overall brain size and intellectual ability [23].

The differences between this journal and another author are first based on journals from [24]. The research is a study of the development of computer software with data inputs in the form of value of the academic potential test, national exam score, and levels of learning motivation, and generate output in the form of student achievement results prediction (GPA) [25]. The purpose of research was to conduct the standard norm of academic potential test for university students. Academic potential test used Graduate Management Admission Test (GMAT) components: verbal, quantitative and abstract components. Academic potential test was supported with content validity, construct validity, criterion related validity and high reliability and Subjects of research were 586 university students from four departments at Faculty of Medicine and Health Sciences-The University of Jambi. Norm used empirical norm based on normal distribution: stamina, percentile, z score, Wechsler and GMAT. Standard nine showed nine intervals of normal distribution score. Percentile norm showed five degrees of percentile: P5, P10, P15, P20, ..., P85, P90, and P95.

This study aims to add insight and knowledge regarding the development of an academic potential test on good Analogy tests. The development of educational institutions has been studied to inform about the growth and development [26]. In addition, the results of this research product are expected to be a practical training material for studying the Academic Potential Tests of verbal abilities. Exploring cognitive emotions thus could be considered an opportunity for real-time evaluation of the emotional responses to the learning process [27]. Therefore, the Academic Potential Test tools must be valid, testing the validity of a test needs to be carried out continuously from various approaches [28] reliable, flexible, and can be done anytime and anywhere. Simultaneously, advances have been made in the intelligence literature in terms of identifying and developing accounts of the most consistent neural correlates of overall cognitive ability [29], [30].

## 2. RESEARCH METHOD

The method used in this research is development research commonly called research and development (R and D) model Borg and Gall develops the question of Academic Potential Test in the field of Verbal Ability, Analogy Test. The development will be carried out in the form of developing a question instrument for Academic Potential Tests of verbal ability Analogy. The development model used in this study is a procedural model that is a descriptive model, showing the steps that must be followed to produce a product in the form of analogy test questions.

The research on the development of this instrument was conducted from February to May 2018. The research location was on the 1st floor of room 102 of the old post graduate building in Yogyakarta State University, Sleman district, Yogyakarta, Indonesia. The research subjects in this study were 91 undergraduate students. The sampling technique is a purposive sampling technique, because the sample taken by the researcher has been determined by the terms and criteria in advance according to the needs of the researcher. The object of the research is the product development questions about the Academic Potential Test of Verbal Ability Analogy. Researchers obtain measuring instruments that can be used in measuring self-efficacy, which is entirely focused on general self-efficacy [31]. Retrieval of trial data is done by spreading the instrument in the form of subtest products of verbal analogy. The questions used are multiple choice questions with five answer choices. These questions are also used to determine the level of cognitive understanding of students towards the material in the Verbal Ability Field of Academic Test, Analogy Test. Determinants and consequences of retest effects are not comprehended in detail, false decisions based on test results can be easily made.

This research is a trial place for product development results. The weakness of the research is that the trial only uses 15 items. All items should be validated in the content validity ratio (CVR) as many as 30 items. Validation is done on the instrument to determine the level of feasibility of the instrument to measure the desired aspects. The validity used is content validity and extraction. Content validation is by 9 students who are experts in education research and evaluation and have experienced revisions and reinforcement as well as conformity between statements with Analogy problem indicators. To determine the validity of the construct in this study using ITEMAN software to abort items that are not feasible and the second uses SPSS software to perform factor analysis.

According to Badrun [32] the use of CVR can reflect the validity of the contents of the items. These items are rated by experts called subject matter experts (SME). The equation of the CVR can be stated as follows:

$$\text{CVR} = (2n_e/n) - 1 \quad (1)$$

$n_e$  = the number of SMEs who value an item is 'essential'

$n$  = the number of SMEs who conducted the assessment

The range of CVR numbers is between -1.00 and 1.00 so that it can be said when the number  $\text{CVR} > 0.00$  means that items are declared essential by 50% more by SME. The construct validity of the instrument will be analyzed using the theory of exploratory factor analysis (EFA). The use of EFA aims to recognize and identify the factors that form a construct through score variance.

Analysis of each variable was carried out in several indicators, the first of which was taken into account the value of Kaiser-Meyer-Olkin (KMO). KMO values are calculated using partial correlation to test whether the variables in the sample are sufficient to correlate, so researchers can distinguish the variables. The general rules of the KMO state that the KMO value must be greater than 0.5 for further analysis. Next is to look at the Bartlett test, and the anti-image correlation with the MSA requirements which is greater than 0.5 so that further tests can be carried out. The tested variables must meet the communal requirements greater than 0.5. If there are variables with a communal value smaller than 0.5, then re-testing is done by not involving variables that do not meet the requirements of communal values. Furthermore, further analysis was carried out on the reliability of the instrument with the Cronbach Alpha technique. According to Sugiono [33] the reliability value of the Cronbach Alpha theory ranging from 0-1.

### 3. RESULTS AND DISCUSSION

Development of academic potential test questions instruments verbal analogy skills for undergraduate students respondents using the steps of research and development (R and D) according to Borg and Gall models [34], grids that have been produced and developed into 30 items that are ready for validation testing by 9 experts judgment. Validity refers to the accuracy and precision of a measuring instrument [35].

After the assessment has been validated by the expert judgment the results of the instrument are revised based on the critics and suggestions that have been given in making the item questions. Then the items are calculated by the researcher using  $\text{CVR} = (2n_e/n) - 1$  [36] and the result is that all items are valid because  $\text{CVR} > 0$ . Data analysis is carried out using the IBM SPSS 22.0 program. Instrument testing is done through validity and reliability. The requirement for a good instrument is one that has high validity and reliability or meets psychometric requirements [37]. So that an intelligence level assessment instrument is obtained. A total of 15 valid statements were tested on 91 randomly selected undergraduate students respondents consisting of various students from various universities in Yogyakarta, Indonesia. Respondents were given 9 minutes for 15 questions about the test of academic potential verbal analogies and required to work independently.

Based on the result on Table 1, the trial results researcher using ITEMAN software for 91 undergraduate students' respondents who have validity obtained 13 items of valid statements from 15 items of statement. Trial results from the results of the trial results obtained that the average validity of the questions is 96.8%. Test reliability was analyzed using the Alpha ( $\alpha$ ) formula of Cronbach with the calculation is done using the help of the IBM SPSS version 22.0 Windows program and the coefficient of 0.806 is obtained. The coefficient of 0.806 is categorized as good. Referred to in the category of very high reliability.

Table 1. Reliability coefficient with ITEMAN

Score	Alpha
Scored items	0.806

Based on the outputs of items one until 15 with an ITEMAN software analysis, the results of validity are obtained as shown in Table 2.

Table 2. Validity of verbal analogy test items

No item	Total rpbis	No item	Total rpbis
1	0.306	11	0.472
2	0.485	12	0.358
3	0.345	13	0.567
4	0.473	14	0.528
5	0.381	15	0.536
6	0.128		
7	-0.123		
8	0.561		
9	0.629		
10	0.535		

There are 13 valid items statements namely numbers 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15 and 2 invalid items statements namely numbers 6 and 7, this is because the correlation coefficient is below 0.3 in accordance with "if the correlation coefficient is equal to 0.3 or more (at least 0.3) then the instrument item is stated "Valid". The data above shows two items must be aborted based on Total Rpbis are 0.128 and -0.123. Thus, it can be stated that the assessment instrument for measuring intelligence developed in this study has very good reliability. Reliability figures in the range of 0.70 are declared acceptable, whereas if the reliability value above 0.80 is stated as good.

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The valid instrument was then implemented from 91 respondents to measure the intelligence of the undergraduate students. The answer data from 91 respondents were tabulated. Furthermore, the data is entered into the IBM SPSS 22.0 program which has been reduced by items 6 and 7 as follows:

The construct validity of the instrument was then analyzed using the Exploratory Factor Analysis (EFA) is a statistical method that increases the reliability of the scale by identifying inappropriate items that can then be removed [38] method with the help of the SPSS 22.0 program. Based on the results of the instrument analysis, it was found that the Kaiser-Meyer-Olkin (KMO) used to verify the sampling adequacy for the analysis [38] score was equal to 0.785 with a significant level of 0.000. These results indicate data can be further analyzed because the Kaiser-Meyer-Olkin (KMO) value is greater than 0.50. In addition, a positive thing is also shown in the Bartlett test with a significant level of 0.000 which is smaller than 0.05 (5%). These results prove that there is correlation between multivariate variables. As a result of the value of Kaiser-Meyer-Olkin (KMO) and Bartlett's test, the data can be analyzed further.

The results obtained based on total variance explained at 33,847% show that the aspects of the test items for academic potential verbal analogies are still very small and if viewed based on the Measures of Sampling Adequacy (MSA) in the anti-image matrices table shows good value because all Measures of Sampling Adequacy (MSA) analyzed items > 0.5. The cumulative percentage of the four factors is quite good, which is 63,215%. This percentage shows that the instrument explains the test about the analogy of 63.215%. The results of multivariate correlations show that the coefficient of measures of sampling adequacy (MSA) on the overall anti-image correlation is greater than 0.5. In addition, the overall value of items shows greater than 0.5. These results interpret that the overall variable can explain a factor of more than 50%. Because all assumptions have been fulfilled, factor analysis can be continued. And if viewed based on Figure 1 of the characteristics of the academic potential test instrument the verbal analogy meets the dimensional assumptions because it can be seen in the Eigen value that is more dominant in component number 1.

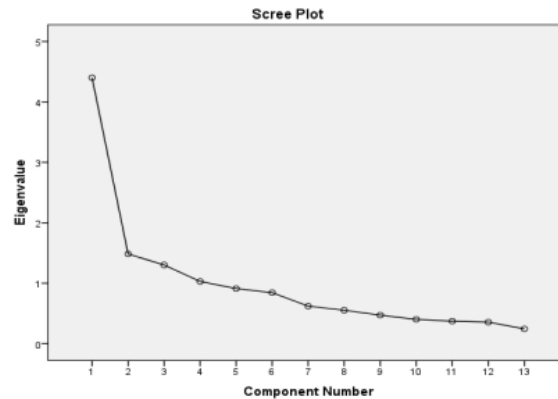


Figure 1. Screen plot

Of the 15 items that will be used to develop the academic potential test instrument for verbal analogies, 4 analysis factors are formed using the IBM SPSS 22.0 program. The formation of these 4 factors is from Eigenvalues greater than 1 so that there are only 4 factors that fulfill the requirements. Based on scree plot development the academic potential test instrument for verbal analogies is unidimensi, because each item test only measures one ability. In the interpretation based on Table 3, the component formed in component 1 of the component results shows that the instrument measures 1 trait which is the test of academic potential verbal analogy. If observed on each matrix component all items have met the requirements, namely  $<0.3$ .

Table 3. Rotated component matrix

	Rotated component matrix <sup>a</sup>			
	Component			
	1	2	3	4
Item1	-.220	.324	.347	.595
Item2	.079	.077	.835	.069
Item3	-.147	.512	.478	-.008
Item4	.364	.039	.577	.154
Item5	.055	.747	-.021	.233
Item8	.601	.188	.139	.426
Item9	.767	.201	.334	-.118
Item10	.518	.682	-.022	.006
Item11	.817	.035	.078	.045
Item12	.295	-.055	.035	.741
Item13	.480	.026	.607	.137
Item14	.670	.223	.083	.326
Item15	.320	.691	.194	-.070

Extraction Method: Principal Component Analysis.  
 Rotation Method: Varimax with Kaiser Normalization.  
 a. Rotation converged in 8 iterations.

The results analysis that meets the requirements using the IBM SPSS 22.0 program shows that factor 1 consists of items number 8 (.601), 9 (.767), 10 (.518), 11 (.817) and 14 (.670), factor 2 consists of items number 3 (.512), 5 (.747), 10 (.682) and 15 (.691), factor 3 consists of items number 2 (.835), 4 (.577), and 13 (.607), and factor 4 consists of items number 1 (.595) and 12 (.741). The reliability of instruments from Confirmatory Factor Analysis (CFA) shows fairly good values and the results of Cronbach alpha reliability analysis of 0.806 are almost close to 1. Based on these results prove that items have a good level of trust so that the instrument is valid and reliable in measuring verbal analogies for undergraduate students. The disadvantage of this instrument is that it only uses 15 items about the test of academic potential verbal analogy so that if there are items that fall cannot be replaced, therefore more and more variety is needed in making items about the test instruments for academic potential verbal analogies to replace items that fall can be recovered with other items.

#### 4. CONCLUSION

Based on the results of research and discussion, conclusions can be taken as follows: First, research instruments using research and development (R&D) models of Borg and Gall in developing the question of Academic Potential Test in the field of Verbal Ability, Analogy Test. Second, the formulation of the questions is analyzed qualitatively in terms of quantitative through content validation, namely by 9 students who are experts in education research and evaluation. Validation criteria include material aspects, construction of questions and use of language and culture. The results of expert validation show that 95.9% of the package questions are feasible to be tested. Third, the items that have been properly tested are evaluated for the quality of each item, namely question validity and question reliability. From the results of the trial results obtained that the average validity of the question is 96.8%, the average reliability of 0.806 is classified as very good. Four, the formation of these 4 factors is from Eigenvalues greater than 1 so that there are only 4 factors that fulfill the requirements. Based on screen plot, development the academic potential test instrument for verbal analogies is unidimensi, because that each item tests only measures one ability. Five, the developed question is valid and reliable so that it can meet the criteria as a good attitude evaluation tool. The instruments produced have been able to measure the level of intelligence. The last is based form the results analysis Rotated Component Matrix that meets the requirements using the IBM SPSS 22.0 program shows that factor 1 consists of 5 items, factor 2 consists of 4 items, factor 3 consists of 3 items, and factor 4 consists of 2 items. From the results of the distribution, it is expected that further research will be done to improve the verbal analogy test instrument by preparing more test questions and varying degrees of difficulty.

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