

PAPER • OPEN ACCESS

Implementation of Computer Bases Assessment on Students' Aptitude Using Online and Multimedia Test for Talent Mapping

To cite this article: M. Khairudin *et al* 2020 *J. Phys.: Conf. Ser.* **1456** 012059

View the [article online](#) for updates and enhancements.

You may also like

- [The Development of Students' Aptitude Test in Online and Multimedia Based Interests Group Selection](#)
F Wulandari, D Mardapi and Haryanto
- [The influence of interaction aptitude-treatment \(ATI\) learning models in improving the geography learning achievement of class XI students in Senior High School PGRI Lumajang](#)
B Apriyanto, F A Ikhsan, E A Nurdin et al.
- [The development of online vocational aptitude test](#)
I W P Yudha, I M Candiasa and G Indrawan



244th Electrochemical Society Meeting

October 8 – 12, 2023 • Gothenburg, Sweden

50 symposia in electrochemistry & solid state science

▶ **Deadline Extended!**
Last chance to submit!

New deadline:
April 21
submit your abstract!

Implementation of Computer Bases Assessment on Students' Aptitude Using Online and Multimedia Test for Talent Mapping

M. Khairudin^{1,2}, F. Wulandari², D Mardapi^{1,2}

¹Electrical Engineering Education Dept., Universitas Negeri Yogyakarta, Indonesia

²School of Graduated Studies, Universitas Negeri Yogyakarta, Indonesia

E-mail: moh_khairudin@uny.ac.id

Abstract. Each individual has different aptitudes and personalities. As a very important role, schools can map students' interests according to students' talents and interests. This is very important because proper placement of interest can support students' academic ability. This study aims to create a standard measurement that can be used for mapping and tracking students' talent in high school becomes easier and measurable. There are 5 aspects related to aptitudes in this research such as visual reasoning test, numerical reasoning test, verbal analysis test, spatial recognition test and vocabulary test. The Rasch model was used to analyze the difficulty level of the item, and from the results of the study showed that the difficulty level of the item was in the normal distribution at the interval - 4.5735 to 6.4989. By using the Google Form tool, students' aptitudes tests are developed and presented in varied form and can provide test result information automatically. The use of Google Form has several advantages, such as (1) the test does not have to be done simultaneously at the same time and place, (2) the item can be made more interesting because it can use images and audio visual facilities and (3) there is no need to duplicate the test paper since it is computer-based tests to minimize test administration.

Keywords: Aptitude Test Instrument,

1. Introduction

Every human being was born as a unique person; he or she has different aptitudes and personalities. Initially, aptitude refers to intelligence. Aptitude is considered as characteristic of individual ability to



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

obtain training, in the form of knowledge and skills such as language skills, the ability to play musical instruments etc. [1]. A talented person is said to be a qualified and highly capable individual [2]. Individual differences in subsequent learning can occur in both cognitive and non-cognitive domains [3], so talent or aptitude can refer to the quality of a person's characteristics that shows how well he or she can learn to solve a particular problem. One must have certain preconditions in order to master a skill, and this is what is called as talent.

In education of a school, talent differences of each student must be considered because it can determine both poor and good the achievement of students. The school aims to develop all the talents and abilities of students during the education process to reach the highest level. Choosing the right field of specialization can support the academic ability, but otherwise if the student is not right in choosing the specialization field then the students will tend to be lazy to learn and can have difficulty in the teaching and learning process.

The 2013 curriculum provides opportunities for learners to develop their abilities, talents and interests more broadly and openly according to the principle of individual differences. Students can develop in an over achievement, i.e. students who have mastered over the standards that have been determined both in knowledge, attitude, and skills. To support that at the Curriculum of 2013 are provided (1) subjects, which must be followed by all students in one educational unit in each unit and level of education, and (2) selected subjects followed by students according to their choice. Compulsory subject groups and electives contained in the structure of the secondary education curriculum (SMA / MA and SMK / MAK). Specialization offered at the equivalent high school level education is conducted in an effort to direct students according to their academic aptitudes or talents and interests. The students who have the ability in the field of science and exact sciences can choose IPA, while those who have an interest in the socio-economic and linguistic sciences can choose IPS specialization.

The group process of specialization is done at the time of admission of newly registered students. It is expected that prospective students can have a high interest and talent in the program of expertise of their choice. Talent as a person's potential or special ability can be developed through intensive training and education processes. With this process, talent or aptitude will become a real ability and skill. Aptitude tests can map students according to their competencies and skills. Furthermore, talent or aptitude assessment can be used to predict success or determine the appropriate level of education. In line with the interest, talent can also be seen from some of the characteristics possessed by students. Here is one example of the level of contribution of skills in engineering aptitude mapping test.

The test or test can be used after going through the development process. The item response theory approach can be used in the design, assembly and item analysis [4]. The item response theory model results independent item parameters of testee and independent testee's parameters of a set of items tested [5]. Problem level of the item as one of the parameters in determining the feasibility of the test, also can measure the competence of the testee. The Rasch model can produce a characteristic curve that can see the distribution of the difficulty distribution of the item. The other advantages of the rasch model are (1) the ability to provide a linear scale at the same interval, (2) the ability to predict lost data, (3) accuracy in estimating, (4) the ability to detect inaccuracy model and (5) generates replicable measurement [6].

The test as one of the instruments to know the ability of the students has evolved the way and the process of its implementation. A test is said to be good if it can make it easier for tthe testee to

complete the test execution process with satisfactory results [7]. Prior to the existence of computer-based tests, usually the test is done in writing using paper (paper based test), but along with the development of information technology, written tests began to be replaced with computer-based tests (CBT). CBT overcomes the limitations of written tests. With CBT the problem distribution process can be done safer because it no longer requires printing. Computer and internet devices can distribute the problem with the desired format, so that the test can be done anywhere and anytime which is unlimited. Distribution of questions can also be adjusted to the participants' ability, so that the measurement error is smaller than the measurement error when using the written test. In other words the utilization of computer technology for test and evaluation purposes can improve the effectiveness and efficiency in the implementation of the tests [8].

In the implementation of the test, students also need a comfortable condition and free from anxiety. Computers as a communication medium can create conditions like these, where computer-based tests can avoid face-to-face between testers and students, so students feel unattended, students can think straightly without thinking the supervisor is always lurking. In addition, computer-based tests can help students because students can have revised answers, got corrections quickly, can rework the tests and can find out the remaining time [8] and many students also prefer for web-based tests rather than written tests [7] and [9]. One easily accessible software, free usage, simple operation, and good enough to be developed as a talent or aptitude test tool for knowing student's talent is Google Form. This app is one component of Google Docs service that is perfect for students, teachers, lecturers and other professionals who enjoy online forms and surveys.

The importance of knowing students' talent and the need for effective and efficient test execution becomes the background of this research. So in this study developed an online student-based talent instrument to be able to map student's interest in high school level. With the ease of being offered by Google Form and its familiar usage among high school students, it is possible for each student to take this test unlimited by space and time.

Knowing one's talent is important to increase the potential of oneself, so there needs to be a talent test prepared to achieve the goal of developing individual potential [10-11]. According to [12], the test is a systematic procedure to observe and describe one or more characteristics of a person with a numerical scale or categorical system. The test can be grouped according to its purpose [13]. One form of test is a learning achievement test used to obtain data and information on how much knowledge one possesses or controls as a result of education and training [13]. Based on this information, in the selection process, students can be grouped according to their ability.

The talent or aptitude test not only focuses on measuring more specific capabilities but also provide other information of different abilities. A description of talent differences, abilities and achievements, where individual talent refers to how quickly or easily individuals can learn in the future [14]. Talent tests measure behavior that can diagnosis predict future behavior comprehensively. Talent test functions can be used to predict a person's performance in the future. This specific ability is derived from the experience and individual learning process measured through the test.

According to Guilford, aptitude or talent has three dimensions. The first dimension is the perceptual dimension, which is the ability to perform perception or sensory sensitivity associated with visual sensitivity, hearing, and kinesthesia [15]. The second dimension is psychomotor dimension includes 6 factors, namely strength, impulse, velocity, accuracy (dynamic or static), coordination and flexibility or flexibility. The third dimension is Intellectual dimension includes memory factor and thinking or cognition factor, production (divergent and convergent), and evaluation. Thrustone divides

the ability of the individual into six dimensions, namely (1) the verbal ability of understanding the relationship of words, vocabulary and communication oral communication, (2) the ability of numbers that is accuracy and speed in the use of basic arithmetic functions, (3) spatial ability (4) the ability of the fluency of the ability to observe with certain words, (5) the ability of memory is the ability to remember images, messages, numbers, words and patterns and (6) the ability of reasoning is the ability to take conclusion [10].

The aptitude test is different from the achievement test. The aptitude tests are intended to predict individual success in a particular activity or occupation [12]. The talent tests focus on behavior in the future, i.e. what individuals can learn with appropriate learning [16]. While achievement tests emphasize the ability of individuals based on what they had learned in the past.

The item response theory approach is one of the alternatives in analyzing a test. In the item response theory, the probability that students answer the item correctly depends on the student's ability and the item's characteristics. In this study, the instrument of talent test items using logistic model 1 parameter (rasch model), which analyzes with only emphasize on the parameter of difficulty level. The item characteristic curve for a single parameter model [6] is expressed in the equation (1) :

$$P_i(\theta) = \frac{e^{(\theta - b_i)}}{1 + e^{(\theta - b_i)}} \quad (1)$$

where $P_i(\theta)$ and θ are the chance that the testee with the ability to answer the item correctly and Parameter ability of the testee respectively. Otherwise b_i is the difficulty level parameter, i.e. one point on the ability scale where the ability to answered correctly is 0.5.

The b_i parameter is a point on the scale of the ability to correctly answer the probability of 50%, it means the greater the b_i parameter value the greater the ability required to answer correctly with the 50% chance. Opportunity relationships responded correctly to the participant's ability level (θ) can be illustrated by the item characteristics curve [6]. A person with a high ability will have a greater chance of answering the item question correctly [17].

In developing the talent test instrument, a tool is needed to test the instruments that have been made. With advances in information and communication technology (ICT), then the implementation of tests that are usually done manually can now be done with the help of computers. And to make it easier for testee to follow this series of talent tests, this test is done online using Google Form. With the online system is expected to overcome the limitations of respondents in space and time. Database capability of the computer can be used to store the tests so that it can overcome the difficulties of variation item.

Some of the benefits of making aptitude tests using google form are (1) display can be made interesting because this application provides facility of inserting and using photo in the test. This online test will be more interesting because it has a template; (2) google form provides a wide selection of test types as needed, such as multiple choice, checklist, short answer, scal liner, and so on. Even images and videos from youtube can be used in google form; (3) the application can be used by everyone to have a test online for free using a laptop or smartphone which is connected to internet. By distributing the link form to the intended respondent or website page, respondents can give their responses anywhere and anytime just by clicking on the link or web address; (4) test results can be collected in a form and arranged neatly automatically, along with real time response info and response graphs.

2. Method

The development of online aptitude test instruments using research and development (R & D) method, which refers to the method developed by Borg and Gall so that the general process in the research can be tested systematically, evaluated and perfected to reach certain quality criteria. The data of the test respondents consisted of 105 respondents of senior high school students from selected new schools selected by random sampling. The types of tests used in this study are multiple choice and short answers are presented in the form of writing, drawing and video. The instrument talent selection model is justified by expert judgment, and uni-dimensionality testing is tested by using factor analysis. The SPSS 20 application was used to look at the Eigen value of the intercellular covariance matrix (KMO) and EFA, whereas to analyze the difficulty level of the item was used the item response theory with the model of analysis of one logistic parameter (Rasch model) using the R program.

3. Results and Discussion

The online talent test using the google form media is actually similar to most tests. The thing that sets it apart is the facilities that can be accessed online so that it is not limited by space and time. Data collection is also easier to analyze. To create an online talent test using Google Form then first must have a Google account. How to sign in to your Google account is by visiting the <http://accounts/Google.com/sign> page. But if you do not have a Google account then first register by visiting the page <http://accounts/Google.com/signup>, and then fill out the registration form. For the account verification process can be done by sending active mobile phone number and then Google will send the verification code to the number via SMS. With this account, existing apps on Google can be visited like Google Drive, Youtube, Google Map, create an online questionnaire, test online using Google Form, etc.

The steps to create an online talent test using Google Form are: (1) Go to Google Drive page, (2) On the left side of Google Drive view, choose New> More> Google Forms. The google form can be seen at Figure 1.

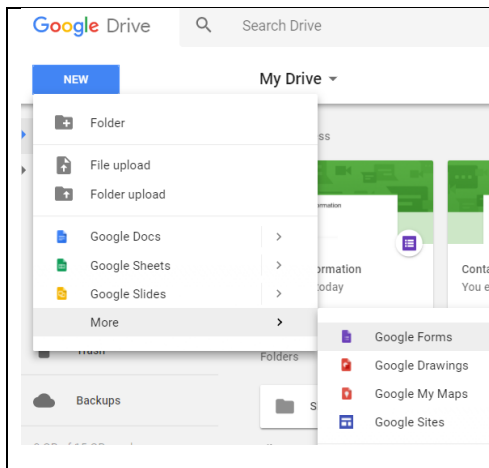


Figure 1. Google Drive View

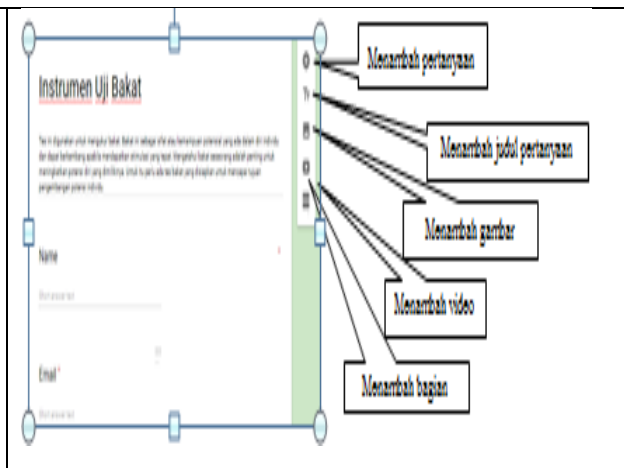


Figure 2. Google Form Display

(3) The Google Forms display page will display some columns like the title column "untitled" and should be replaced with the title of the form as shown at Figure 2.

In the aptitude test tool, Google Form is made into two parts, namely the respondent's information section and the item point. Respondent information using short answer fields such as name, gender, class, school name and email. The symbol located on the right side of the question can be used to add a question item.

One of the advantages of google form is to create a problem with various types. In this study, the problem item was developed using multiple choice type and short answer, question presented in the form of pictures, story and video that can be seen at Figure 3 and Figure 4.

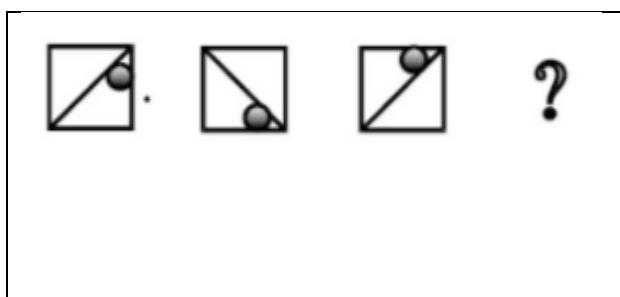


Figure 3. Example of item type of image

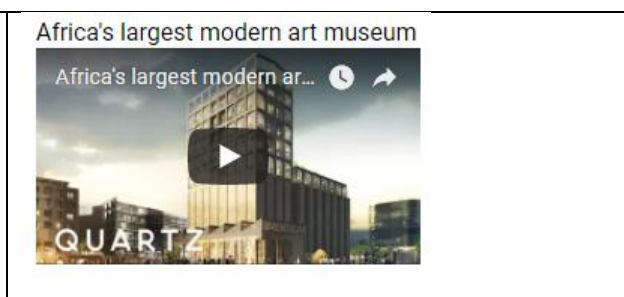


Figure 4. Example of the video type

In the museum video above, it is known that the sculpture exhibit can be found on the floor of the section under the watercolor painting exhibition. The ceramic exhibit is on the floor above the oil painting exhibition. On the top floor consists of a collection of ancient objects. The watercolor

exhibition is on the same floor with contemporary painting exhibitions. While the oil painting exhibition is under the exhibition floor of the statue.

Development of Talent Instruments

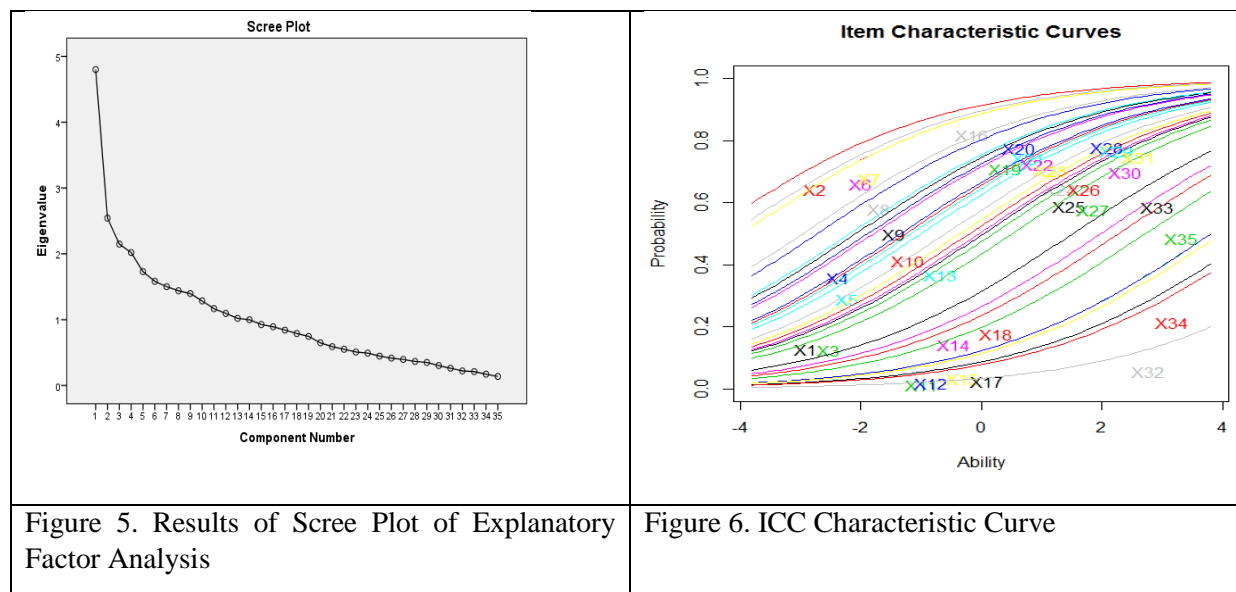
The development of this talent test instrument consists of 35 items that are divided into 5 sub subjects namely visual reasoning test is 5 items, numerical reasoning tests consisting of 10 items, verbal analysis test consists of 5 items, spatial recognition test consists of 10 item and vocabulary test consisting of 5 items. Talent test instruments consist of several subtests presented in some form of problem. Some subtests represent the variables to be measured, namely (1) Visual reasoning test is one of the closest tests in measuring natural intelligence or innate intelligence that can be when we were born, (2) Numerical reasoning test measures the potential of mathematics by understanding the relationship (3) The Verbal Analysis Test measures the skills of word analysis by investigating, weighing instructions and making sensible conclusions from the given facts, (4) Spatial recognition tests measure the ability to detect, the potential of self-understanding of abstract problems as well as those often associated with art and design. (5) Vocabulary Test. This test measures intelligence in choosing and expressing themselves through the use of words, remembering words, concepts and expressions of information and ideas.

The method of collecting student data about visual reasoning tests is to use multiple choice. The type of item is presented in a series of shapes or drawings. The task of the student is to choose one of the forms or drawings on the choice of answers given, where one of them will be the next form or picture that is marked with a symbol "question mark" on the problem. For numerical reasoning tests, the type of item is presented in the form of numbers arranged in several ways. The numbers are arranged along the lines, there is a relationship with the numbers above or below the row of numbers with each other. A number can be lost and replaced by a space or line (-) placed on the spot. One number has been replaced with a question mark (?) And the student must be able to find the number that will replace the question mark. The form of numerical reasoning test is a short answer.

Furthermore for the verbal tests presented in multiple-choice form, students are asked to describe the reasonable conclusions of the information already given. Students will be given a series of stories that contain enough facts and information. In addition to a series of stories, on this verbal test there are items given in the form of video views. The fourth type of test is a spatial recognition test presented in the form of a True (B) or False (S) option. This test will find out how students can view and rotate a spatial object form. Students will be confronted in a form of reference image to answer each item. The choice of image form will not be similar if any part or proportion is changed. Student will give answer "B" for correct answer choice and "S" for wrong answer choice. The last test is the vocabulary test presented in the form of multiple choices. Students will be given a word and are asked to look for one of the available options whose meanings are closest to a word on each question number.

Rasch Analysis Result, based on the analysis of sample adequacy shows the value of Khi-squared on Bartlet test of 1028.308 with degrees of freedom 595 and p-value less than 0.01. Furthermore, from the result of factor analysis by using SAS / IML, it can be obtained that student response data on talent test contains 13 Eigen values greater than 1, so it can be said that the talent test contains 13 factors. Of these 13 factors, there are 67.805% variances that can be explained. Furthermore, the significance of these factors was tested using the chi square test

The next Eigen value is presented with the scree plot in Figure 5. Looking at the results of the Scree plot, it appears that the Eigen value starts to ramp up on the 6th factor. This suggests that there is a dominant factor in the talent test device, the other 5 factors also contributed substantially to the component variance. Figure 5 presents that is only 1 threshold on 1 component, so it can be concluded that the talent test instrument measure 1 dimension test.



The analysis using a Rasch model approach aims to scale measurements at equal intervals. Since the unprocessed score does not have an intrinsic nature, it can not be used to directly interpret the student's ability. Rasch modeling uses score data based on each student and scores data per item simultaneously. By using program R hence can be seen difficulty level hardest item exist on item 32 point with value 6,499 and 2nd point as the easiest item with value -4.573

In the one logistic parameter model (1PL) or known as the Rasch model, all items have the same distinguishing power (same Discrimination value). The item parameters on the Rasch model only have item difficulty levels. An item is said to be good if the level of difficulty (b) is between -2 to 2 (Hambleton & Swaminathan, 1985). The closer to 2 the item difficulty index is very high, and vice versa. From the data above can be concluded every item has a normal difficulty level because it ranges between -4,574 up to 6,499. Because analyzed with 1PL then each item has discriminant index or the same difference that is 1.515. A good item has a power value difference of between 0 up to 2.

Figure 6 presents the curve of ICC characteristic that item 2 is the easiest item and the most difficult item is on item 32. The curve above is a description of item characteristics for 1PL analysis, where there are no different power factor and guessing.

4. Conclusion

Based on the study of mix method of development of online talent test instrument, it can be concluded that online test tool using Google Form can facilitate the testee in taking aptitude test. Results generally show significant advantages over when tests are done conventionally using paper and pencil. Google Form that can be accessed via laptop and cellphone make this test tool has ease in its usage and execution of test can be done anytime with customized time. In addition, by using the Google Form can be made a variety of test items such as text, images or video. Test scores can be directly generated and analyzed so that it can be said the use of these talent test tools to be more effective and efficient. From the results of the measurement can be concluded that the student's aptitude test instrument has a difficulty level of the problem item with a good enough interval that is generated ranging from -4.57352370 to 6.49879143. Item difficulty levels still have weaknesses in some items that are too difficult and too easy. The items that have a level of difficulty above +4, is an item that is too difficult they are in items 17, 32 and 34. While the item that is too easy is under -4 is number 2 and 16.

References

- [1] Bingham, W. V. 1948. What is an aptitude? *Test Bulletin Service*, 36, 1-3.
- [2] Martinson, R. A. 1974. *The Identification of The Gifted and Tallent*. California: Office of The Ventura County Superintended of Schools.
- [3] Salkind, N. J. 2008. Aptitude *Encyclopedia of educational psychology*. New York: Sage Publisher.
- [4] Herawati. 2009. Mengestimasi parameter butir perangkat tes dengan pendekatan regresi logistik multivariat.
- [5] Xitao Fan. 1998. Item response theory and classical test theory : an empirical comparison of their item/person statistics. *Educational and Psychological Measurement*, 58, 357-381.
- [6] Hambleton, R.Kswaminathan,H. 1985. Item Respon Theory. Boston, MA: Kluwer Inc.
- [7] Williams, Brett. 2007. Students' perceptions of prehospital web-based examinations. *Education Journal of Education and Development Using ICT* Vol 3, Number 1.
- [8] Muwanga-Zake, J.W.F. 2006. Applications of computer-aided assessment in the diagnosis of science learning and teaching, *Education Journal of Education and Development Using ICT*, Vol 2, Number 4
- [9] Triatmaja, A. K. & Khairudin, M. (2018). Study on Skill Improve/ment of -Digital Electronics Using Virtual Laboratorium With Mobile Virtual Reality. *Journal of Physics: Conference Series*. Vol. 1140, DOI: 10.1088/1742-6596/1140/1/012021
- [10] Kementrian Pendidikan dan Kebudayaan. 2016. Pengembangan Bakat dan Minat Siswa SMK

- [11] Khairudin M., Triatmaja A.K., Istanto W.J., Azman M.N.A., (2018). Mobile Virtual Reality to Develop a Virtual Laboratorium for the Subject of Digital Engineering. *International Journal of Interactive Mobile Technologies. Vol 13, No 04 (2019)*
- [12] Cronbach, Lee J.1984. Essentials of Psychological Testing, New York: Harper & Row Publishers.
- [13] Anastasi, A., & Urbina, S. 1997. Psychological testing (7th ed.). Upper Saddle River, NJ: Prentice Hall.
- [14] Carter, Philip. 2007. IQ and Aptitude Tests, London: Kogan Page
- [15] Guilford, j.p. 1982. Psychometric methods (2nd.ed). New york: mcgraw-hill publishing co.ltd.
- [16] Aiken, Lewis R. 1988. Psychological Testing and Assessment, Boston: Allyn and Bacon Inc
- [17] Croker, L & Algina, J. 1986, Introduction to classical and modern test theory, Nes York ; Holt, Rinehard and Winston Inc.