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Assessment Instruments for Critical Thinking Ability in Basic Work Lessons of Industrial Engineering Class

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ABSTRAK

Peningkatan mutu pendidikan tidak terlepas dari penerapan penilaian yang tepat untuk mengukur hasil akhir dan diperlukan suatu alat ukur yang berkualitas sehingga instrumen penilaian yang digunakan oleh satuan pendidikan harus memenuhi persyaratan yang salah satunya memiliki bukti validasi empiris. Penelitian ini dilakukan untuk menghasilkan instrumen penilaian keterampilan berpikir kritis yang valid dan reliabel. Metode penelitian yang digunakan adalah Research and Development, dengan menggunakan metode pengembangan 4D yaitu 1) observasi dan studi pustaka, 2) uji validasi ahli, 3) uji coba untuk siswa, 4) produk siap pakai. Hasil penelitian ini didapatkan. hasil dari tipe tersebut. instrumen penelitian. yang dikembangkan layak. digunakan dengan indikator analisis, interpretasi, inferensi, evaluasi, penjelasan, Induksi, deduksi. Instrumen penilaian yang dikembangkan adalah PG (Multiple Choice). Uji kesukaran menunjukkan bahwa dari 40 soal yang dibuat memiliki tingkat kesukaran 0.27 sampai dengan 0.44, yang berada pada kriteria sukar dan sedang, pada hasil pengujian 5 soal dinyatakan baik, 17 soal dinyatakan cukup, dan 18 soal dinyatakan cukup. dikatakan buruk. Instrumen penilaian kemampuan berpikir kritis mata pelajaran dasar teknik mesin dinyatakan valid sebanyak 30 soal dari 40 soal yang dibuat dan nilai reliabilitasnya 0,82, kemudian dinyatakan realistis. Kesimpulannya, instrumen penilaian kemampuan berpikir kritis pada mata kuliah kerja teknik dasar layak untuk digunakan.

ABSTRACT

The quality of education for the improvement is inseparable from the application of appropriate assessments to measure the final result and a quality measuring instrument is needed so that the assessment instruments used by educational units must meet the requirements, one of which has evidence of empirical validation. This research was conducted to produce a valid and reliable assessment instrument for critical thinking skill. The research method used is Research and Development, using methods.4D development, namely 1) observation and study of literature, 2) expert validation test, 3) testing for students, 4) ready-to-use product. The results of this study obtained. the result of that type. research instrument. which is developed feasible. used with analysis indicators, interpretation, inference, evaluation, explanation, Induction, deduction. The assessment instrument developed was PG (Multiple Choice). The difficulty test shows that of the 40 questions made have a difficulty level of 0.27 to 0.44, which is in the difficult and moderate criteria, on the test results 5 questions are stated as good, 17 questions are stated as sufficient, and 18 questions are said to be bad. The instrument for assessing critical thinking skills in basic mechanical engineering subjects was declared valid for 30 out of the 40 questions made and the reliability value was 0.82, then it was declared as realistic. Conclusion, the instrument for assessing critical thinking skills in the basic engineering work course is feasible.

1. INTRODUCTION

Government policies with Presidential Instruction of the Republic of Indonesia Number 9 of 2016 concerning Vocational High School Revitalization to improve the quality and competitiveness of human resources in Indonesia, one of which is by increasing the number of Vocational High Schools (SMK) (Risqiyain & Purwanta, 2019; Setiadi, 2019). So that many students continue to vocational schools to support and follow the development of various industrial sectors (Al Anshari, 2019). The assessment process carried out to determine the achievement of learning outcomes is stated in the 2016 minister of education and culture regulation number 23 concerning educational assessment standards that the assessment aims to see the development of student learning outcomes so that they can evaluate the learning (Amri & Tharihk, 2018; Erfianti et al., 2019; Mukti & Istiyono, 2018). In the world of curriculum education has a specific goal so that students are competent in accordance with what is needed by society, the industrial world for the present and even the future and currently in the 21st century with such rapid

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development, the competencies that students must have such as the ability to think critically, communication, initiative (Antara et al., 2020; Putri et al., 2019).

The quality of education for the improvement is inseparable from the application of appropriate assessments to measure the final result and a quality measuring instrument is needed so that the assessment instruments used by educational units must meet the requirements, one of which has evidence of empirical validation (Amri & Tharihk, 2018; Badriyah et al., 2019; Widiana, 2016). Whereas Developing an assessment instrument depends on the ability of the teacher and can affect student learning outcomes measuring instruments that state good if it is 1) Validation 2) Reliability 3) Has practical value (Aji & Winarno, 2016; Fityana et al., 2017). Every vocational high school (SMK) should carry out periodic evaluations on assessment instruments for productive student subjects such as basic work in mechanical engineering so that they can see and improve the measurement of student learning outcomes and Vocational High Schools (SMK) in their learning prioritizing skills or The skills that students will have are different from Senior High Schools (SMA), so vocational students are required to have skills in accordance with the chosen major (Badriyah et al., 2019; Churri & Agung, 2013). In the development of the 21st century, it can be seen that it is not enough for us to have skills in the fields we are good at, but we must have critical thinking skills, to solve problems. or we know it as HOT and one of the components of 21st century skills (the issue of 21 century literacy) and vocational high school graduates are still not competent in communicating, thinking critically in overcoming problems, professional work ethics, not working in teams and lacking working together, using technology, management in working on projects and leadership (Bhattacharjee & Deb, 2016; Bialik & Fadel, 2015).

At SMKN 26 Jakarta, there are industrial order classes, one of which is the Metal Fabrication and Manufacturing Engineering (TFLM) department. Industrial order class or what is often referred to as industrial class is a program prepared by the Government through SMKN 26 Jakarta. The program was created to prepare graduates with competitiveness ready to jump directly into the world of work, so in this program schools form partnerships with the business world and the industrial world. Assessment of critical thinking skills is used to obtain information about someone's critical thinking skills in learning. The results showed that of the five indicators of critical thinking skills of students who got a greater percentage, namely the indicators to consider whether the source was trustworthy or not as much as 83.4%, while the indicator of observing and considering the results of the observation was 87.7%, and the aspect of the number of the percentage was smaller, which was the indicator of asking and answering questions. This happens because students do not understand the material relationship between an event or event, it can be seen that students who enjoy learning solutions and non-electrolytes with practicum make students more active and students. acquire knowledge and experience directly so that students can be trained in critical thinking skills through experiments. Based on previous research, this study aims to develop instruments for assessing critical thinking skills in assessing basic work learning in industrial class mechanical engineering SMKN 26 Jakarta.

2. METHODS

This research to develop critical thinking skills assessment instruments uses research and development (R & D) research. With the 4D development model (Sugiyono, 2014), namely: 1) Define is a part of collecting information about the product to be made, information in the form of a needs analysis and a description of the product specifications needed, 2) Design is a part of designing a product based on the specifications previously described, 3) Develop is part of validating experts related to products that have been designed. The study also conducted limited trials to determine the usability of user products, 4) Disseminate is a part of distributing products that have been tested to the general public. The instrument for assessing critical thinking skills in the subject of basic mechanical engineering work is in the form of multiple choice questions. The research instruments used were needs analysis instruments, expert validation instruments, and question instruments to be tested on students. Taking needs analysis techniques using interviews. Validity and reliability were tested using excel. The instrument development flow is shown in Figure 1.

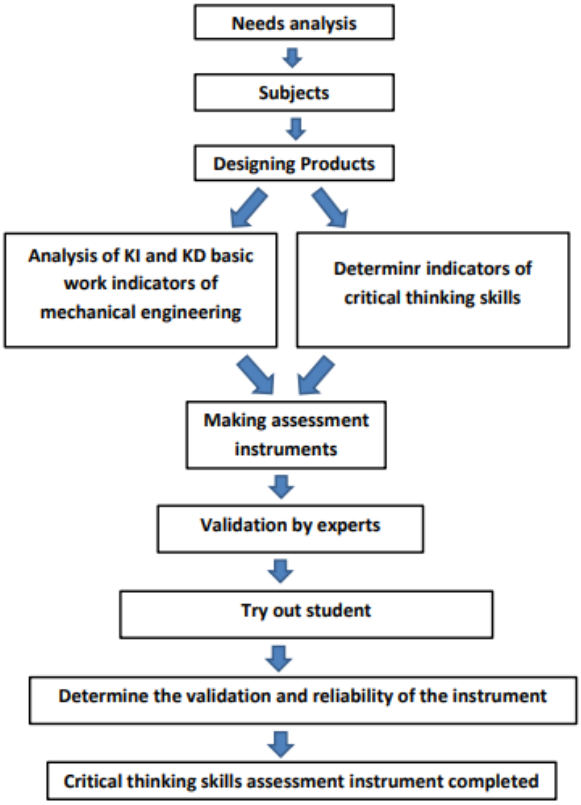

Figure 1. The Flow of Making Instruments

This research was conducted at SMKN 26 Jakarta, Metal Fabrication and Manufacturing Engineering Department with a sample of 60 students. Validation of the instrument for assessing critical thinking skills was carried out by 2 material experts, namely 1 material expert from the university and 1 material expert from the basic work mechanical engineering subject teacher. The data processing stages are carried out as follows starting with the validity test, Reliability, Distinguishing Power and the problem difficulty. In research, a test is called valid if the test is able to measure what you want to measure The instrument tested is said to be valid if r counts with r table with a significance value of 0.05. If r count <r table, then the instrument is declared invalid and vice versa if r count> r table then the instrument is declared valid. A test validity is determined by looking for the product moment correlation for each question from the instrument based on the item score with the total score (Erwinta et al., 2018).

An instrument in research is said to be reliable if the results are consistent, because the more reliable an instrument is, if it is re-tested the results will be the same with previous study that stated an instrument in the study is said to be reliable if the measurements are consistent, so that the measured results can be trusted (Imron, 2019). Stating that the reliability test is in accordance with the degree of consistency and stability of the data found, the reliability test is used to determine whether the respondent's answer is consistent or not, the variable is said to be reliable if the results of the calculation use KR 20 (Kuder Richardson) reliability value> 0.6 (Erwinta et al., 2018). The distinguishing power of questions on the research instrument is used to see the difference between students' abilities between students who have high abilities and students who have low abilities. When testing the difference in power, there is a discrimination index, which is a number that shows the amount of distinguishing power that ranges from 0.00 to 1.00 (Erwinta et al., 2018). In research, the question assessment instrument must be analyzed to determine or determine the difficulty level of the questions (Zubaidah, 2019), a) Determine the value of the multiple choice answer that will be tested, b) Analyze the test results with item validity, reliability, discriminatory power test, and level of difficulty. The difficulty level has the following criteria, according to Arikunto (Arikunto, 2013).

3. RESULT AND DISCUSSION

Results

The theoretical validity test of the instrument was carried out by 2 experts and 60 panelists to test the suitability of variables, dimensions, indicators and descriptors. Results of expert analysis Based on the results of expert validation, two material expert validators obtained a score of 3, meaning that the instrument for assessing critical thinking skills in basic mechanical engineering subjects can be used provided that you have to make minor revisions first, as for some suggestions given by expert validators, namely 1) please use Indonesian grammar better, 2) The spelling of a word needs to be improved. The results of the instrument trial were carried out on 60 students of the Metal and Manufacturing Engineering Department (TFLM) with 40 multiple choice questions.

The instrument for assessing critical thinking skills in basic mechanical engineering subjects must be tested first, therefore the researcher tested this instrument on 60 students majoring in Metal and Manufacturing Engineering (TFLM) with the number of questions given 40 optional questions. double. Then after testing the results were analyzed using the validity and reliability test to determine whether the questions were valid or not, the validity test used Microsoft Excel with the product moment method, it can be seen that the results of the validity trial obtained 30 valid questions and 10 invalid questions. The specific results od question validity is presented in Table 1.

Table 1. Results of Question Validity

Item Questions	Information
3,5,6,7,8,10,11,12,13,14,15,18,19,20,21,22,24,25,26,27,28,29,31,33,34, 35,37,38,39,40	Valid
1,2,4,9,16,17,23,30,32,36	Invalid

The assessment instrument was tested for reliability using the method KR 20 (Kuder-Richardson). It can be seen R_{table} was 0.60, that the assessment instruments made get reliable results because the reliability of the instruments made is greater than the R table. Based on the calculation of the results of the distinguishing power can be seen in Table 2.

Table 2. Distinguishing Power Test Results

Item Questions	Criteria
Poor	1, 2, 4, 5, 8, 9, 16, 17, 19, 21, 23, 27, 29, 30, 32, 33, 36, 38
Enough	3, 7, 11, 12, 14, 20, 22, 24, 25, 26, 28, 31, 34, 35, 37, 39, 40
Good	6, 10, 13, 15, 18

In Table 2, there are 5 questions in the good category, 17 questions in the enough category, and 18 questions in the bad category. The items that have a discrimination index of 0.41 to 0.70, but some of the questions are categorized as moderate and bad. In this case the questions can still be used because the questions still have distinguishing power. It should be remembered that the questions made do not need to have high distinguishing power so that the questions with sufficient categories can be used. In this assessment instrument it is defined as the percentage of students who are able to answer the questions and state that this question is easy, medium, or difficult, it can be seen in the Figure 2 the results of the test results of the assessment instrument made by the researcher.

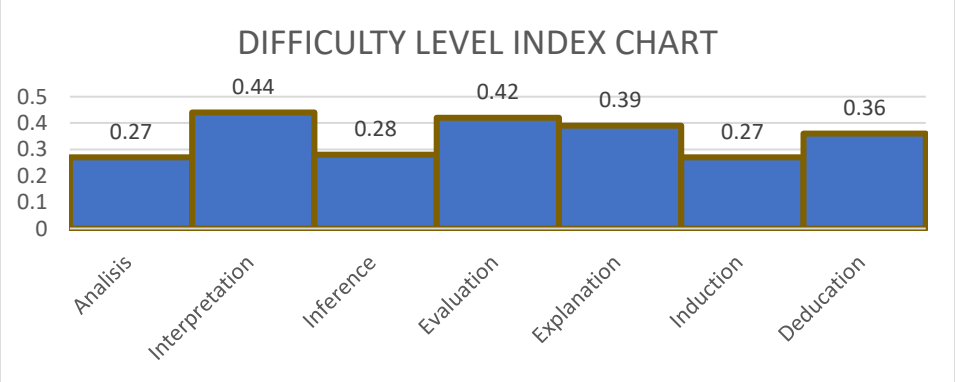

Figure 2. Difficulty Level Graph

It can be seen in Figure 2 that the results of the test results of the assessment instrument made by the researcher have the results of the analysis between 0.27 to 0.44. The item is said to be difficult if the difficulty index is 0.00 to <0.30 then the difficulty index of 0.31 to <0.7 is said to be moderate and it is said to be easy if it is 0.71 to <1.00. The difficulty index of the distribution questions is close to normal. This can be seen from the high to low level of difficulty of the items, namely analysis, induction, inference, deduction, explanation, evaluation, and interpretation.

Discussion

The results of the validation test of the questions stated as valid from 40 questions made 30 and 10 questions were declared invalid, this means that the instrument is valid and can be used only 30 questions because the score is said to be valid if r count> r table (Erwinta et al., 2018). Results Reliability questions get 0.79 results and are reliable according to (Erwinta et al., 2018). an instrument in research in research is said to be reliable if the measurement is consistent so that the results can be trusted. The Distinguishing Power Test results in 15 good questions, 17 sufficient questions, and 18 bad questions seen from the clarification of the distinguishing power 0.00 - 0.20 said to be bad, 0.21 - 0.40 said enough, 0.41 - 0.70 it is said to be good, and 0.71 - 1.00 is said to be very good, the results of the discriminating power do not really affect the research because it is used only to see the difference between students' abilities between students who have high abilities and students who have low abilities. (Fatimah & Alfath, 2554). The results of the difficulty test obtained were 0.27 to 0.44 and the results obtained were based on the difficulty index criteria if 0.00 to <0.31 were difficult, 0.31 to <0.70 moderate, 0.71 to <1, 00 is easy, then the results obtained are that the difficulty test results are varied (Yuslita et al., 2016). A total of 30 multiple choice questions have been tested worthy of being used as an instrument for assessing critical thinking skills measure critical thinking skills in basic work subjects, according to research Du Bois variety (Yuslita et al., 2016).

The quality of education for the improvement is inseparable from the application of appropriate assessments to measure the final result and a quality measuring instrument is needed so that the assessment instruments used by educational units must meet the requirements, one of which has evidence of empirical validation (Amri & Tharihk, 2018; Badriyah et al., 2019; Widiana, 2016). Whereas Developing an assessment instrument depends on the ability of the teacher and can affect student learning outcomes measuring instruments that state good if it is 1) Validation 2) Reliability 3) Has practical value (Aji & Winarno, 2016; Fityana et al., 2017). Every vocational high school (SMK) should carry out periodic evaluations on assessment instruments for productive student subjects such as basic work in mechanical engineering so that they can see and improve the measurement of student learning outcomes and Vocational High Schools (SMK) in their learning prioritizing skills or The skills that students will have are different from Senior High Schools (SMA), so vocational students are required to have skills in accordance with the chosen major (Badriyah et al., 2019; Churri & Agung, 2013). In the development of the 21st century, it can be seen that it is not enough for us to have skills in the fields we are good at, but we must have critical thinking skills, to solve problems. or we know it as HOT and one of the components of 21st century skills (the issue of 21 century literacy) and vocational high school graduates are still not competent in communicating, thinking critically in overcoming problems, professional work ethics, not working in teams and lacking working together, using technology, management in working on projects and leadership (Bhattacharjee & Deb, 2016; Bialik & Fadel, 2015).

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4. CONCLUSION

This study only produces an instrument to assess the critical thinking ability of basic mechanical engineering work for vocational high school students with the 4D development method. The critical thinking ability assessment instrument is in the form of 30 multiple choice questions. This assessment instrument is valid and reliable, so it is declared feasible to measure critical thinking skills in basic mechanical engineering work subjects. so that students will be more focused in learning.

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