Developing Computer-Based Professional Competency Test Items For Automotive Engineering Teachers Professional Education

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Abstract. The objective of the study is to develop Computer-Based Professional Competency Test Items. This type of test items is very important for the successful performance of Teachers Professional Education, recalling the fact that the quality of Teachers Professional Education is determined by the Computer-Based National Test which dominant materials are related to Professional Competency. Then, the study was conducted by referring to the research and development model by Borg & Gall with simplification on several stages. After the study has been conducted, there are several findings that might be elaborated. First, the development of Computer-Based Professional Competency Test Items for the participants of Automotive Engineering Teachers Professional Education is conducted through several stages as follows: (a) planning (content, form and number of test items); (b) test items drafting; (c) computer program developing; (d) testing; and (e) evaluating. Second, based on the rational analysis the quality of the research and development results might be categorized as follows: (a) from the aspects of material there are 2 test items that have been incompatible for the Multiple Choice mode; (b) from the aspects of construction there are 5 test items that have been different formulation for the answers; and (c) from the aspects of language there is 1 test item that has incompatible standard for the appropriate Bahasa Indonesia. Third, the value of Difficulty Level might be described as follows: (a) 23 test items belong to “Easy” category; (b) 32 test items belong to “Moderate” category; and (c) 5 test items belong to “Difficult” category. It means that the ratio among the “Easy,” “Moderate,” and “Difficult” will be 38.30% : 53.30% : 8.40%. Fourth, the value of Discriminant Capacity might be described as follows: (a) 2 test items belong to “Very Good” category; (b) 17 test items belong to “Good” category; (c) 13 test items belong to “Moderate” category; (d) 21 test items belong to “Poor” category; and (e) 7 test items belong to “Very Poor” category. It means that 28 test items (46.70%) have not meet the requirement of a good test item. Fifth, the value of Distractor Effectiveness Distribution might be described as follows: (a) 3 test items have 1 ineffective distractor; (b) 15 items have 2 ineffective distractors; (c) 28 test items have 3 ineffective distractors; and (d) 14 test items have 4 ineffective distractors.

1. Introduction

The Minister of Research, Technology and Higher Education (Menristekdikti, 2017) suggests all Institutions of Teachers Training and Education to conduct reformation in accordance to the Teachers Professional Education Program and to pursue improvement on the learning and education process in accordance to the National Standards of Higher Education and Educational Standards of Teachers. The reformation and the improvement are expected to generate teacher graduates who will be ready to deal with the increasingly complex challenges and opportunities in the 21st Century and who will also be ready to compete in both ASEAN Economic Society and Global Society.
In order to respond the suggestion, through the conduct of the Research Group the researcher would like to pursue the Reformation of Teachers Professional Education Program and the improvement on the quality of both the learning and education process. Looking at the term, the researcher would like to pursue both the reformation and the improvement through developing professional competence test item for Automotive Engineering. The design of such competency test is important recalling the fact that up to date the model of National Test Conduct is always Computer-Based and thus the graduation of Teachers Professional Education participants will be highly based on the competence of the participants in the given domain especially in relation to the curriculum which shows that the proportion of professional domain has been very dominant. By developing the computer-based professional competence test items, it is expected that the participants might be trained to respond the problems in the professional domain effectively so that the maximum rate of graduation will be achieved.

In relation to the above elaboration, the present study is conducted in order to: (1) attain documentation on the Computer-Based Professional Competence Test Item for the participants of Automotive-Engineering Teachers Professional Education; and (2) identify the quality of the Computer-Based Professional Competence Test Item for the participants of Automotive-Engineering Teachers Professional Education. Then, by conducting the present study the benefits that might be attained are as follows: (1) the results of the present study might be an assessment guideline for all lecturers/instructors of Automotive-Engineering Teachers Professional Education especially the ones who teach the professional domains; and (2) the results of the present study might facilitate the provision of training programs for the participants of Teachers Professional Education since the National Test is always conducted by means of Computer-Based.

### 2. Theoretical Review

Teachers Professional Education Program is an educational program that has been implemented in order to prepare the graduates of both Strata I/Diploma IV from Teachers Training and Education Study Programs and also from Non-Teacher Training Study Programs who have talents and interests toward being a teacher to master the competencies of a teacher in accordance to the standards of national education. The objective is to certify the participants of the program as a professional educator for the early childhood education, elementary education and high school education degree. The Teachers Professional Education Program is expected to be able to respond to numerous educational problems such as: (1) teacher shortages especially in the front, outer and remote areas of Indonesia; (2) imbalance teacher distribution; (3) under-qualification teacher; (4) low-competence teacher; and (5) mismatch between teaching qualification and teaching domain.

Teacher professionalism refers to the capacities of a teacher in performing his or her main duties as an educator and in this case the capacities include planning, performing and executing learning evaluation. Principally, each teacher should be supervised periodically in performing their duties. If the number of teachers is to abundant then the principal is allowed to ask for the assistance from the deputy or the senior teachers in his environment. The success of the principal as supervisor might be displayed by, for example, increasing teacher performing, which might be marked by the skills and the awareness in performing the duties responsibly.

Profession is an occupation or an activity that an individual performs in order to meet his or her daily needs. Profession demands the use of skills, expertise or proficiencies that meets certain standards of quality or norms and that also demands professional education. Departing from the two statements, it might be implied that a professional teacher should meet four competencies that have been defined in Law of Republic Indonesia Number 14 Year 2005 on Teachers and Lecturers namely: (1) pedagogic competencies; (2) personality competencies; (3) professional competencies; and (4) social competencies.
Assessment on knowledge competency is conducted not only for identifying whether the students have completed their mastery learning process but also for diagnosing the learning process. Therefore, the provision of feedback to both students and teachers is ultimately necessary so that the results of the assessment might be immediately followed up in order to improve the learning quality. The results of assessment on the knowledge competency during and after the learning process is stated in the form of number ranges from 1 until 100 and also form of description (Dit. PSMK, 2017).

Multiple assessment techniques for knowledge competencies might be applied in accordance to the characteristics of each basic competencies. Then, the techniques that have been normally implemented are oral test, written test and assignment. However, other techniques might also be implemented in accordance to the learning objectives. In addition, portfolio might be benefitted as feedback in planning remedial, in planning enrichment (assessment for learning), and in designing the descriptions of knowledge competence and description in the rapport (assessment of learning).

The scheme of knowledge assessment might be consulted in Figure 1 as follows.

![Figure 1. Scheme of Knowledge Assessment](image)

The development of written test is conducted through the following steps: (1) designing outlines; (2) drafting test items based on the outline and the convention of test item composition; and (3) defining scoring guideline in accordance to the type of test items that will be applied. For multiple choice, blanks, matches and short essays, the key answers should have been provided since the beginning of the drafting process because the answers are already clear and might be scored objectively. On the other hand, for the essays the scoring guideline is provided in the form of rubric with score ranges.

In relation to the written test, there are two types of written test that have been frequently administered for assessing the aspects of knowledge namely: (1) multiple choice; and (2) essay. The test items of multiple choice consist of stem (the test item itself) and option (alternatives of answer). In drafting the multiple-choice type of test items, there are several principles that should be met namely: (1) aspects of Substance/Materials; (2) aspects of Construction; and (3) aspects of Language.

Still in relation to the type of test item, Computer-Based Test (CBT) is an examination method that a trainer or an educator might perform by using a computer unit. Nowadays, the use of computer-based test has been very popular due to the fact that the conduct of computer-based test offers several advantages. For example, the results of a computer-based test might be displayed immediately after the test participants have completed the test. In addition, the use of computer-based test might suppress the operational cost due to the paperless characteristic that the test has. However, the
computer-based test still has a weakness: each participant might have different capacity in operating the computer unit.

Last but not the least, within the test item composition there are two types of test item analysis methods that have been normally implemented namely: (1) rational analysis: a test-item analysis that is based only on ratio comparison without any experiment; and (2) empirical analysis: a test-item analysis that is based on the statistical measurements of experiment results toward the given test item.

3. Method

The study was conducted by referring to the research and development by Borg & Gall. The scheme of the research and development model might be consulted in Figure 2. Then, in analysing the data the techniques that had been implemented were both the quantitative and the qualitative descriptive analysis in order to provide general description on the research data. Both techniques of analysis had been implemented in order to answer the problem formulations or the questions within the study. Then, the quantitative descriptive analysis aimed at analysing the interval-type numeric data while the qualitative descriptive analysis aimed at analysing the qualitative data. Both data analysis techniques had also been implemented in order to identify the quality of competence test item and these techniques were as follows: (1) rational analysis, which identified the test item quality from the aspects of material, construction and language; and (2) empirical analysis, which identified the test item quality from aspects of statistical measure such as: difficulty level, discriminant capacity and distractor effectiveness. The values of the statistical measures were calculated through appropriate formula based on the given reference.

![Figure 2. Scheme of Research and Development Model by Borg & Gall (1989)](image)

4. Result and Discussion

4.1 Method of Computer-Based Professional Competence Test Item Development

In general, the developmental procedures in the study consist of the following steps: (1) preparation; (2) implementation; (3) experiment; and (4) revision. Each step will be elaborated in the following sections:

4.1.1 Preparation
The Preparation Step consists of the following activities: (1) holding discussions with the caretakers of Automotive Engineering Teachers Professional Education Program in order to attain information on the targets of competence achievement in the Professional Competence Test for the Program; (2) reviewing other documents and information that might be relevant; and (3) pursuing collaboration with the instructors who have been frequently assigned for teaching the professional competencies.

4.1.2 Implementation

The Implementation Step consists of the following activities: (1) defining the type of test item that will be developed, namely Multiple Choice; (2) designing the outline of professional competence test items; (3) holding FGD or workshop on designing Multiple-Choice type written test; (4) evaluating the preliminary product that has been resulted from the workshop; and (5) establishing links to the computer-based or e-learning program in order that the computer-based competence test might be administered to the relevant subjects.

4.1.3 Experiment

The Experiment Step deals with pursuing in-depth understanding toward the professional competencies by means of Try Out for National Test. The intention of the try out is that each test participant is expected to work seriously on the test so that the results of the test might be analysed and might provide valid and reliable results.

4.1.4 Revision

The Revision Step deals with revising or improving the test item designs based on the experiment. However, the results of the revision will not be reported yet. The revision itself covers the aspects of material, construction and language in relation to the weakness that has been found.

4.2 Quality of Computer-Based Professional Competence Test Item Development

4.2.1 Based on Rational Analysis

Based on the results of rational analysis, it might be concluded that the quality of professional competence test item that has been developed is still unable to meet the quality of a good test item. The weakness the professional competence test item has might be elaborated as follows. Based on the aspects of materials, there are 2 items that have been incompatible to the Multiple-Choice type namely test item number 2 and test item number 16. Then, based on the aspects of construction, there are 5 test items that have different formulation of alternatives namely test item number 21, 30, 33, 39 and 49. In addition, there are also 2 test items that use the non-operating figure namely test item number 41 and test item number 47. Last but not the least, based on the aspects of language there is 1 test item that has incompatibility to the standards of Bahasa Indonesia namely test item number 40. In the same time, there are also 2 test items that use less communicative language namely test item number 32 and test item number 34.

4.2.2 Based on Empirical Analysis

Based on the results of empirical analysis, the computer-based professional competence test item might be described as follows.
4.2.3 Difficulty Level

The ratio of the test item in reference to Difficulty Level Easy : Moderate : Difficult is 38.30% : 53.30% : 8.40%. Such comparison has not been ideal or has not been in accordance to the requirements of a good test item because theoretically, and also according to the regulations that have been issued by the Ministry of Research, Technology and Higher Education, the ratio of Difficulty Level among Easy : Moderate : Difficult should be 25.00% : 50.00% : 25.00%. As a result, the Difficulty Level in the professional competence test should be changed. The number of test items with Easy Level (13.00% or 8 items) should be conversed into the test items with Difficult Level (21.00% or 13 items).

4.2.4 Discriminant Power

Based on the results of analysis on the Discriminant Power, it might be concluded that not all items have already had Moderate, Good or even Very Good category. There are still 21 test items with Poor category and 7 test items with Very Poor category.

4.2.5 Distractor Effectiveness

Based on the results of analysis on the Distractor Effectiveness, it might be concluded that none of the items has already had good distractor effectiveness. 3 test items have 1 ineffective distractor, 15 test items have 2 ineffective distractors, 28 items have 3 ineffective distractors and the remaining 14 test items have 4 ineffective distractors. As a result, revisions should be pursued on all aspects of material, construction and language depending on the distractor.

5. Conclusion and Suggestion

Departing from the discussions in the previous section, several conclusions that might be gathered are as follows:

5.1 The development of Computer-Based Professional Competence Test Item for the participants of Automotive-Engineering Teachers Professional Education has undergone several steps as follows: (a) planning the content, type and number of test items; (b) drafting the test item; (c) developing the computer program; (d) performing experiment; and (e) evaluating the quality of developmental results.

5.2 The analysis on the quality of Computer-Based Professional Competence Test Item for the participants of Automotive-Engineering Teachers Professional Education shows various implications. The results of the rational analysis are associated to three aspects namely the aspects of material, the aspects of construction and the aspects of language. From the aspects of material, 2 test items are incompatible to the Multiple-Choice type. Then, from the aspects of construction 5 test items have different formulation of alternatives. Last but not the least, from the aspect of language 1 test item is less appropriate in accordance to the standards of good and appropriate Bahasa Indonesia.

5.3 In terms of Difficulty Level, the Computer-Based Professional Competence Test Item for the participants of Automotive-Engineering Teachers Professional Education 23 test items belong to Easy category 32 test items belong to Moderate category and 5 test items belong to Difficult category. It means that the ratio among Easy : Moderate : Category is 38.30% : 53.30% : 8.40%. Theoretically, the ratio has not been ideal yet since the requirement that has been issued by the
Ministry of Research, Technology and Higher Education is Easy : Moderate : Category = 25.00% : 50.00% : 25.00%.

5.4 In terms of Discriminant Power, the Computer-Based Professional Competence Test Item for the participants of Automotive-Engineering Teachers Professional Education might be described as follows: (a) 2 test items belong to Very Good category; (b) 17 test items belong to Good category; (c) 13 test items belong to Moderate category; (d) 21 test items belong to Poor category; and (e) 7 test items belong to Very Poor category. It means that there are 28 items (46.70%) that have not met the requirements of a good test item.

5.5 In terms of Distractor Effectiveness Distribution, the Computer-Based Professional Competence Test Item for the participants of Automotive-Engineering Teachers Professional Education has 3 test items with 1 ineffective distractor, 15 test items with 2 ineffective distractors, 28 test items with 3 ineffective distractors and 14 test items with 4 ineffective distractors.

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