

Developing Self-Assessment Research Competency Instruments for Prospective Building Engineering Teachers

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Abstract

This is development research towards the research competency assessment in research learning. The aim of this research was to determine the content validity and reliability of the research competency assessment tool. The instrument was made in the form of a non-test self-evaluation sheet. The V Aiken's coefficient was used to evaluate the content validity of the self-evaluation sheet. This research used the development method in line with the ADDIE approach. The research subjects were 48 preservice teachers of building engineering education in Surakarta. The Aiken's formula was used for the validity study. According to the research results, the research competence instrument was both valid and reliable. The research instrument was appropriate to be used as a guide in assessing the competence of prospective building engineering teachers.

Keywords

instrument development, preservice teachers, research competency, validity

1. Introduction

Professional competence is critical to teacher performance. One indicator of a teacher's professional competence is the ability to conduct research. The impact of research skills on education in the 4.0 industrial revolution is for the development of 21st century competencies, which are made up of three main components: thinking, acting, and living in the world. Thinking components include critical thinking, creative thinking, and problem-solving skills. Critical thinking is significantly linked to research competence (Chen et al., 2020). Research competence is critical because

modern society demands professional people who can work in a variety of settings and successfully solve critical and professional problems (Yarullin et al., 2015), to ensure the integrity and continuity of competitiveness as a process of subject teacher formation, integrating research and professional activities (Ivanenko et al., 2015).

However, research on the research competence of preservice teachers reveals that the level of mastery of research skills is low or requires additional knowledge. This is because there is a lack of motivation to write scientific papers for teacher professional development (Ishartiwi, 2012), knowledge, understanding, experience of teachers about research is still lacking (Annury, 2019), competence in writing research methodology, data analysis, and discussion remains low (Oyedokun et al., 2019), the competence of Indonesian teachers is seriously lacking, particularly in terms of action research (Leonard & Wibawa, 2020), multicultural pre-service teachers have inexperienced research skills and find it difficult to conduct action research, such as related literature and research conceptualization (Toquero, 2020), pre-service teachers find research to be frustrating and stressful, and very few choose to do it (Katwijk et al., 2019), based on the results of research on educators, the writing of the framework is the root of the most difficulties, to limited knowledge of statistics and data analysis acting as an impediment to research activities (Aguilar-de Borja, 2018).

In order to determine the level of research competence of prospective teachers, preservice teachers' mastery and research knowledge must be measured using developing instruments. In research, research competency instruments adapted from various sources and applicable in Indonesia are being developed. The objectives of the research are (1) to understand the quality of the research competency self-assessment instrument; and (2) to test the psychometric validity of the research competency of the self-assessment instrument

2. Methods

2.1. Instrument Development

The first step in developing the instrument is to conduct a literature review. In addition, the researcher presented indicators and generated 36 statement items. Research competency instruments adapted from various sources (Böttcher & Thiel, 2018); (Hauser et al., 2018). Research competencies include five components: (1) the skills to determine the topic and background of research, (2) the ability to formulate theoretical foundations, (3) the skills to apply research methodologies, (4) the skills to discuss and draw the conclusion of the research results, and (5) the skills to compose publication manuscripts. This instrument was created using four Likert scale criteria, namely: (2) Disagree, (1) Strongly Disagree, (4) Agree, (3) Agree, (2) Disagree, (1) Strongly Disagree (Vagias, 2006) .

The research procedure used the ADDIE development model, which stands for Analysis, Design, Development, Implementation, and Evaluation. The analysis stage is the first step for researchers in identifying relevant literature sources with research competencies and interviews or observations necessary for needs analysis. At the designing stage, the researcher created the instrument by reviewing the literature and writing indicators as a standard instrument to be developed. Expert judgment was used to validate the collected indicators. At the development stage, the researcher designed instruments based on the prepared indicators. The items are then expertly validated. At the implementation phase, the researcher tested the instruments that had been compiled for prospective teachers of building engineering education. At the evaluation stage, the researcher used Aiken's and Cronbach's Alpha to assess the validity and reliability.

2.2. Participants

This research enlisted the help of research experts from six universities in Central Java, Indonesia, to validate the research competency self-evaluation instrument. This expertise consist of substance, material, and language. This research would include 11 lecturers, with 18.2 % holding Professor and 81.8 % holding Doctoral degrees. The experts validated the self-evaluation instrument for student teacher research competencies using a Likert scale of 1 to 5, i.e. from very irrelevant to very relevant (Vagias, 2006).

Respondents were selected by purposive sampling technique based on the analysis of sample needs. In this sampling obtained 48 respondents. 43.75% male and 51.25% female. All respondents have taken courses in research methodology and statistics.

2.3. Data Collection and Analysis

The stage of collecting research data using an online questionnaire or Google Form distributed online. Expert validity was analyzed based on the Aiken's validity formula (Lewis. R. Aiken, 1985); (Aiken, 1980). The validity of the data from the questionnaire test results from respondents is calculated using product moment (Headrick, 2016) and reliability is calculated with Cronbach's Alpha (Taber, 2018).

Aiken's Validity Calculation

$$v = \sum s/[n(c-1)] \quad (1)$$

Where =

V = Aiken's Validity Coefficient

s = r – lo

lo = the lowest number of validity assessments = 1

c = highest validity rating score = 5

r = numbers given by experts

The validity of the questions/statements are declared valid if the value of v > v aiken table

5. Results and Discussion

5.1. Analysis Stage

The researcher conducted a preliminary analysis by interviewing predetermined sources. Based on the interview results, prospective teachers conducted research in learning and required a research competency self-assessment instrument for prospective teachers of building engineering education. We would therefore develop a research competency instrument that would specifically assess preservice teachers' self-knowledge.

5.2. Design Stage

The researcher creates indicators at the designing stage. The data was then validated by experts, and five indicators were established for assessing the research competence of prospective teachers of building engineering education. Based on the design results, 5 indicators are valid in both content and language. According to Aiken (1980), the lower the number V (close to 0 or equal to 0), the lower the value of an item's validity will be. The value of v in a table with 11 experts is 0.77. Table 1 shows the results of the design phase validation.

Table 1. The Results of the Design Stage Validation.

Items No	V	Items qualifications
1	0.818	Valid
2	0.773	Valid
3	0.909	Valid
4	0.909	Valid
5	0.909	Valid
6	0.886	Valid
7	0.909	Valid
8	0.841	Valid
9	0.955	Valid
10	0.818	Valid
11	0.818	Valid
12	0.818	Valid
13	0.818	Valid
14	0.818	Valid
15	0.818	Valid
16	0.818	Valid
17	0.818	Valid
18	0.818	Valid
19	0.773	Valid

20	0.773	Valid
21	0.773	Valid
22	0.818	Valid
23	0.818	Valid
24	0.818	Valid

5.3. Development Stage

At the development stage, the researcher listed 24 items based on indicators validated by experts, which are then peer reviewed before being validated by experts. This is done to determine the item's compatibility with the indicator. The instrument was then validated by eleven experts with professor and doctoral backgrounds, including Educational Research Experts, Linguists, and Substance Experts. According to the expert validation results, 24 items were declared valid in terms of content and language, as seen in Table 2.

Table 2. The Results of the Development Stage Validation.

Items No	V	Items qualifications
1	0.833	Valid
2	0.803	Valid
3	0.924	Valid
4	0.917	Valid
5	0.924	Valid
6	0.932	Valid
7	0.917	Valid
8	0.917	Valid
9	0.886	Valid
10	0.902	Valid
11	0.924	Valid
12	0.932	Valid
13	0.902	Valid
14	0.917	Valid
15	0.932	Valid
16	0.909	Valid
17	0.894	Valid
18	0.932	Valid
19	0.879	Valid
20	0.879	Valid
21	0.909	Valid
22	0.947	Valid
23	0.871	Valid
24	0.841	Valid

5.4. Implementation Stage

The implementation stage involves the application of research competency instruments to prospective Building Engineering Education teachers in the form of instrument trials. The trial was carried out with the help of a Google form, which was distributed to prospective Building Engineering Education teachers. The results of filling out the Google form questionnaire obtained the number of respondents as many as 48 prospective teachers of Building Engineering Education.

5.5. Evaluation Stage

The evaluation stage consists of calculating and interpreting the instrument's validity and reliability using the Aiken and Cronbach's Alpha formulas. The research competency self-assessment instrument's output is to assess preservice teachers' research ability. At the development process, the researcher thoroughly reviewed the literature on research competence and consulted with experts. The researcher then appointed 48 prospective Building Engineering Education teachers to test the instrument's validity and reliability. The results of the instrument's development and validity are presented in Table 3 to Table 7.

Table 3. The Validation of Skill Instruments Used to Determine the Research Topic and Background.

Statements	Product Moment	Cronbach's Alpha
I am able to find the important phenomena to research.	0.767	0.966
I am able to choose important issues.	0.756	0.966
I am able to write background research problems in my bachelor thesis.	0.722	0.967
I am able to write down research problems identification in my bachelor thesis.	0.615	0.968
I am able to write the research problem formulation in my bachelor thesis.	0.710	0.967
I am able to write down the research objectives in my bachelor thesis.	0.775	0.966
I am able to relate the background of the problem, problem identification, problem formulation and research objectives.	0.701	0.967

Table 4. The Skill Instruments Validation To Develop A Theoretical Foundation.

Statements	Product Moment	Cronbach's Alpha
I am able to find the theory that that serves as the research foundation in my bachelor thesis.	0.729	0.967
I am able to find research results relevant to the topic of the bachelor thesis.	0.772	0.966
I am able to develop a framework for my research/ bachelor thesis.	0.743	0.966
I am able to formulate hypotheses in my research/bachelor thesis.	0.677	0.967

Table 5. Skills Instrument Validity in Applying Research Methodology.

Statements	Product Moment	Cronbach's Alpha
I am able to develop research designs according to the planned data analysis.	0.780	0.966
I am able to determine the research sample/bachelor thesis.	0.773	0.966
I am able to determine research data according to the planned data analysis.	0.856	0.965
I am able to collect research data according to the planned data analysis.	0.759	0.966
I was able to test the validity of the research instrument according to the planned data analysis.	0.800	0.966
I am able to test the reliability of research instruments according to the planned data analysis.	0.839	0.966

I am able to analyze research data to answer the planned problem formulation.	0.828	0.966
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Table 6. Skill Instruments Validation in Discussing and Concluding Research Results.

Statements	Product Moment	Cronbach's Alpha
I am able to interpret research results in line with the theories that underpin the research topic.	0.848	0.965
I am able to interpret research results in line with other relevant research results.	0.799	0.966
I am able to write down the implications of research results.	0.817	0.966
I am able to draw conclusions from research results.	0.780	0.966

Table 7. Instrument Validation of the Skills in Writing Publication Manuscripts

Statements	Product Moment	Cronbach's Alpha
I am able to write publication manuscripts in accordance with national level scientific writing standards.	0.666	0.967
I am able to write publication manuscripts in accordance with international level scientific writing standards.	0.671	0.967

Research activities essentially provide opportunities for innovation that develop higher cognitive abilities and foster creativity. Research ability is the ability of students to transfer their learning process into new situations, so that they can develop as experts rather than as competent practitioners (Roach et al., 2000).

Indicators of research competence of prospective teachers are developed to measure the ability of teachers in researching. Indicators developed include: (1) the skills to determine the topic and background of research, (2) the ability to formulate theoretical foundations, (3) the skills to apply research methodologies, (4) the skills to discuss and draw the conclusion of the research results, and (5) the skills to compose publication manuscripts.

Based on the results of the analysis of data instrument indicators of teacher research competence developed in obtained product moment value (table r) from 48 number of respondents to prospective teachers, namely 0.284 for the number of retting 5. While the results of all statements obtained from the calculation give a product moment value greater than 0.284, so that everything is declared valid. While Cronbach's alpha value of all research competency indicators obtained is greater than 0.6, it shows that all statements obtained from calculations are reliable.

Supported also various indicators of researching skills from various sources including: (1) students are able to make problem formulations; (2) students are able to make observations to find the information and methodology needed (relevant); (3) students are able to make research plans; (4) students are able to sort and describe the research data that has been collected; (5) students are able to analyze research data to answer problem formulations and then interpret, and make conclusions; and (6) students are able to communicate the results of their research, both in the form of dissemination in scientific forums and scientific publications in the form of journals or proceedings (Prahmana, 2015). Background, problem formulation, research objectives, benefits of research results, theoretical studies/ libraries, frame of mind, action hypotheses, research methods, research schedules, and bibliography (Fadli, 2017). 1) ask important questions that can be investigated empirically; 2) link research with relevant theories; 3) use methods that allow direct investigation of questions; 4) provide a coherent and explicit chain of reasoning; 5) replicate and generalize across studies and 6) disclose research to encourage safety and professional criticism (Roulston et al., 2005). knowledge, skills in reviewing research circumstances, methodological skills, skills in reflecting research findings and communication skills (Böttcher & Thiel, 2018), So the instrument developed in this study deserves to be used to measure the ability to research prospective teachers.

6. Conclusion

The instruments written in this study were created specifically to assess prospective teachers' research competence. The expert validation test results for questionnaire items were used as a method to measure research competence. Field validation was then conducted to 48 respondents. The research results of the field test analysis generated valid and reliable criteria.

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Biography

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