

# Development Scaffolding for Construction of Evaluation Instrument Training Program on The Cognitive Domain For Senior High School Physics Teachers and The Same Level

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**Abstract.** The development of scaffolding for evaluation instrument construction training program on the cognitive domain for senior high school physics teacher and the same level that is specified in the test instrument has been done. This development was motivated by the low ability of the majority of physics teachers in constructing the physics learning achievement test. This situation not in accordance with the demands of Permendiknas RI no. 16 tahun 2007 concerning the standard of academic qualifications and competence of teachers, stating that teachers should have a good ability to develop instruments for assessment and evaluation of process and learning outcomes. Based on the preliminary study results, it can be seen that the main cause of the inability of teachers in developing physics achievement test is because they do not good understand of the indicators for each aspect of cognitive domains. Scaffolding development is done by using the research and development methods formulated by Thiagarajan which includes define, design and develop steps. Develop step includes build the scaffolding, validation of scaffolding by experts and the limited pilot implementations on the training activities. From the build scaffolding step, resulted the scaffolding for the construction of test instruments training program which include the process steps; description of indicators, operationalization of indicators, construction the itemsframework (items scenarios), construction the items stem, construction the items and checking the items. The results of the validation by three validator indicates that the built scaffolding are suitable for use in the construction of physics achievement test training program, especially for novice. The limited pilot implementation of the built scaffolding conducted in training activities attended by 10 senior high school physics teachers in Garut district. The results of the limited pilot implementation shows that the built scaffolding have a medium effectiveness in improving the ability of senior high school physics teachers in constructing the physic achievement test instrument that is characterized by more than 70% of trainees achieve scores of test instruments construction of about 80 or more.

## 1. Introduction

In a ministerial regulation of national education of the Republic of Indonesia number 16 of 2007 on standard academic qualifications and competence of teachers stated that one of the pedagogical competence that must be held by teachers is competence in conducting the assessment and evaluation



of learning process and product, which described in the competence of senior high school teacher as follows: 1) Understanding the principles of assessment and evaluation of the learning process and learning outcomes in accordance with the characteristics of the subjects of teaching, 2) determine aspects of the learning process and the learning outcomes that are important to be assessed and evaluated in accordance with the characteristics of the subjects of teaching, 3) Determine the assessment and evaluation procedure of the learning process and learning outcomes, 4) Develop assessment and evaluation instruments of learning processes and learning outcomes, 5) Administer the assessment of the learning process and the learning outcomes on an ongoing basis using a variety of instruments, 6) Analyze the results of the assessment of the learning process and the learning outcomes for a variety of purposes, and 7) Perform evaluation learning process and learning outcomes. From these rules it appears that one of the competencies required of teachers is developing assessment and evaluation instruments of learning processes and learning outcomes [1].

One domain physics learning outcomes should be evaluated at any time after the implementation of learning is the cognitive domain. Cognitive domain is a domain that is important is to be achieved learners after participating in learning. There are six categories of the dimensions of the cognitive processes that should be owned by the students as the acquisition of the learning process, namely remember, understand, apply, analyze, evaluate), and create [2,3,4]. In connection with the evaluation of this cognitive learning outcomes, teachers are required to have a high ability in constructing an item of cognitive test instruments. Unfortunately, the level of ability of teachers in constructing the instrument items of cognitive test is still not in line with expectations. Results of research conducted by researcher showed that the ability of the majority of teachers in constructing the instrument items of cognitive test is relatively low. The results of further research showed that some of the things that cause the low ability of teachers in construct an evaluation instrument learning outcomes include: (1) the majority of teachers stated only know some of the aspects of cognitive domain of learning outcomes according to Bloom's revised by Anderson, (2) most of teachers expressed only know several of all indicators of every aspect Bloom's cognitive domain revised by Anderson, and (3) the majority of teachers expressed do not understand the indicators of every aspect Bloom's cognitive domain revised by Anderson [5]. Ignorance and lack of understanding that have an impact on mistakes in the operationalization process in every aspect indicators. Another thing which is also the cause of the failure of teachers in constructing item test instrument is a result they do not take steps that systematically, they do not start with the construction of a frame or scenario of item test and they did not check the suitability of constructed item test with indicators of cognitive aspects.

This situation can not be allowed to continue to drag on, because it will have an effect on the poor quality of the learning process and results of Physics held. Need to quickly find the right solution so teachers can have pedagogic competence especially those associated with the ability to construct cognitive domain instrument test items, as expected. One effort that can be done to improve the ability of teachers to construct cognitive instruments test item is through in-service training activities. Actually they have completed the training activities on evaluation of learning held by government agencies that have the duties and functions as an institution guarantor of the quality of teachers, yet they feel that the training they follow not specifically oriented towards development instrument test item for measuring the competence of learning outcomes in cognitive domain, but the evaluation of learning in general. On the basis of the factors that cause the failure of teachers in constructing cognitive domain instrument test item as proposed in above, it is necessary to develop a scaffolding that contains stage process of preparing an instrument test item that can provide guidance and directives systematically to teachers in constructing a valid instrument test item. At least on the scaffolding there should be activity of cognitive indicators review, construction frame test item and checking items are constructed. Scaffolds are the supporting structures provided by those people or tools to promote learning [6]. Stone argues that scaffolds allow students to achieve a higher level of understanding within their Zone of Proximal Development. Sinaga et al was designed the scaffolding to improve the pre-service physics teachers' ability in writing teaching materials [7].

This article describes the results of the development of scaffolding for construction cognitive instrument test item, the results of expert judgement and results of limited test about using the scaffolding which was developed on in-service training activities.

## 2. Experiment

The method used in the development of scaffolding for construction cognitive domain instrument test item is a method of research and development (R & D) consist of a three stage process that are define, design, and develop. Define stage is done to obtain an overview of urgent needs related to improvement of professional competence of Physics teachers. At this stage, the activities are policy studies, field studies and literature studies. The design stage is done to design a training program for construction cognitive instrument test item based on the results from need assessment. One of the things that are designed at this stage is the scaffolding for construction cognitive instruments test item that will be used in the in-service training about construction of cognitive domain instruments test item for senior high school physics teachers. Develop stage conducted to produce scaffolding for in-service training activities based on the draft which has been made at the design stage. This includes creating a stage develop scaffolding, scaffolding validation, and limited testing about use of scaffolding in construction activities on in-service training construction cognitive domain instruments test item. Validation scaffolding conducted by three experts in the field of education evaluation, while the use of scaffolding in a limited test on in-service training activities conducted on 10 teachers of Physics in one district in West Java as research subjects. Limited test conducted by using experimental research design as shown in Figure 1.

Pretest	Treatment	Posttest
O	X	O

**Figure 1.** Chart design of experiments to limited test use of the scaffolding in- service training

In the chart above, O is the ability test to construct cognitive instrument test item. To measure the ability of teachers to construct cognitive instrument test item at before and after treatment used construction skills test cognitive ability test instrument that covers 19 indicators of aspects of cognitive domain. To determine the level of teacher's ability to construct a cognitive instrument test item was used levelling guide as shown in Table 1.

**Table 1.** Levelling guide for teacher's ability to construct cognitive instrument test item

Levels of ability	Range of average scores (AS)
High	$AS \geq 80$
Moderate	$60 \leq AS < 80$
Low	$AS < 60$

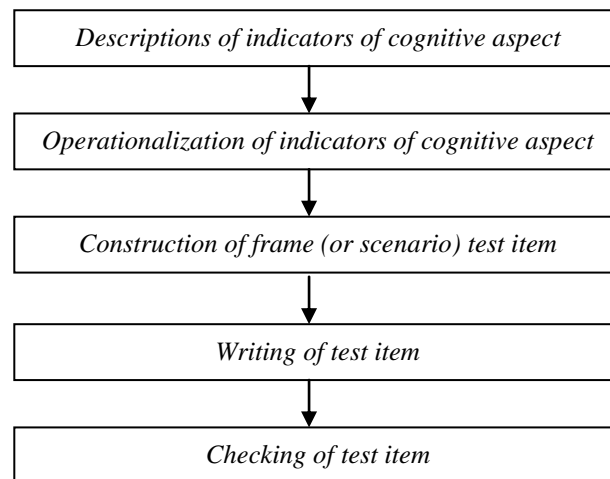
While to determine the effectiveness of the use of scaffolding in promoting teachers ability on constructing cognitive instrument test item used criteria as in Table 2. [8]

**Table 2.** Criteria for the effectiveness of the use of scaffolding in enhancing the teachers ability in constructing cognitive instrument test item

Criteria of effectiveness	The number of teachers (N) who achieve a score $\geq 80$ on a scale of 100
High	$N \geq 75\%$
Moderate	$50\% \leq N < 75\%$
Low	$N < 50\%$

### 3. Result and Discussion

Figure 2 shows the schematic of the scaffolding for construction an instruments test item resulted from the development stage. Scaffolding was built includes five phases of construction activity of instruments test item of cognitive domain.



**Figure 2.** Scaffolding for construction of instrument test item of cognitive domain.

In practice, the use of scaffolding in the construction process of instruments test items of cognitive domain on the in-service training activities assisted by using a matrix as shown in Table 3.

**Table 3.** Matrix for the use of scaffolding in the construction process of the cognitive domain instrument test item

The test form	Cognitive aspects and indicators of aspects	Description of indicators	Evaluated Physics Content	Operationalization of indicators	Construction of frame (or scenario) items test	Writing test item	Checking of constructed test item
.....	.....	.....	.....	.....	.....	.....	.....

To fill the matrix using scaffolding during the construction process of the cognitive domain instrument test item, used the following provisions:

1. Column form of test filled in the forms/types of problems that will be created, for example, an objective test questions multiple choice or essay form about a subjective test.
2. Column cognitive aspect/indicator of aspects is filled with the cognitive aspects and indicators of cognitive aspects to be measured, for example aspects of understanding (C2) and the indicator explain (exemplifying).
3. Column description of the indicator filled in as indicators of cognitive aspects that will be measured in accordance described in the revised Bloom's taxonomy Anderson.
4. Column content filled with physics content and concepts were evaluated, for example, a static fluid material concept of hydrostatic pressure.
5. Column operationalization of aspect indicator is filled with the elaboration of indicators in a more specific aspects which include the concept being evaluated.

6. Making the construction of frame is filled with the exposure of each part consisting of questions about the stimulus, stem question and answer option (for about the multiple choice test form) according to the indicators and content /concepts were evaluated.
7. Column writing of items stocked with complete editorial matter within the framework of questions that have been created, along with an answer key.
8. Column checking items stocked by affixing yes and no on any part of matter is checked, the stimulus created accuracy, conformity with indicators stem matter aspect, homogeneity option answers (to questions on multiple choice form )

The results of the expert judgements on scaffolding developed indicate that: 1) Scaffolding for construction of cognitive domain instruments test item suitable for use in activities in- service training for physics teachers who do not have expertise in constructing the cognitive instruments test items, 2) activities stage in scaffolding construction of the cognitive instrument item ability test developed, assessed will be able to guide teachers in stages in constructing the test items cognitive ability towards problem valid, 3) scaffolding for construction of cognitive instrument test item suitable for learning adults, and 4) Scaffolding for construction cognitive instruments test item suitable for independent practice in which they work.

**Table 4.** Changes in the quantity of teachers at every level of ability to construct instrument test item before and after implementation of the scaffolding in the activities of in-service training.

Pretest	Posttest		
	Low Level	Moderate Level	High Level
Low Level (8)	-	3	5
ModerateLevel (2)	-	-	2
High Level (0)	-	-	-

The results of limited test about using the scaffolding suggest that the use of scaffolding which was developed on in-service training activities of construction cognitive instrument test item indicates that the change of the level of ability to construct cognitive instruments test item before and after implementation of the scaffolding on in-service training activities, as shown in Table 4. At the pre-test most of teachers are at the low level of the ability to construct instrument test item, a small fraction of teachers are at moderate levels, and none of the teachers are at a high level. At the post-test, teachers who initially had low level ability change to the moderate level of being 3 persons and change to the high level of being 5 persons. While the teachers who initially had a moderate level changed to a high level of being 2 persons.

In Table 4 it appears that at the post-test there are seven teachers (70%) who are at high-level capabilities (its means achieving test scores about constructing the instrument test items equal to 80 or more). Based on the criteria for the effectiveness of the use of scaffolding as described above, it means that the use of scaffolding on in-service training activities have the moderate effectiveness in enhancing the physics teachers ability to construct cognitive domain instrument test. These results indicate that the built scaffolding quite powerful in the enhancing ability to construct cognitive instrument test items among high school physics teacher. Systematic stages, slowly and have been able to trace give the guidance to novice to be able to construct instruments test item according to the measured aspects indicators, so that it meets the criteria valid test item.

#### 4. Conclusion

Scaffolding for the construction cognitive domain instrument test item has been developed consisting of stages of the process: description of the cognitive domain indicators, operationalization of the cognitive indicator, construction of frame (or scenario) test items, writing test items, and checking the constructed test items. The result of the limited test suggest that the use of scaffolding which was developed in the activities of in-service training about construction of cognitive instrument test item

which followed by 10 subjects Physics teacher, showed that the use of scaffolding which was developed have the moderate effectiveness in enhancing ability to construct cognitive instrument tests item among teachers Physics became the subject of this experiment. The use of built scaffolding can change the level of ability to construct cognitive instruments test items towards higher ability, previously the majority of teachers are at a low level turn out to be at the moderate and high levels.

## 5. References

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