JURNAL VOKASI KETEKNIKAN
Vol.1, No. 1, Maret 2023
e-ISSN: xxxxxx | p-ISSN: xxxxxx
https://ojs.unm.ac.id/vokasiketeknikan

HIGHER ORDER THINKING SKILLS BASED ASSESMENT FOR LEARNING MODEL IN PROBLEM BASED LEARNING USING SIAVO FOR VOCATIONAL SCHOOL STUDENTS

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Abstract. This study aims to find out: (1) an AFL model based on HOTS SIAVO; and (2) a valid and practical model. The model can be applied applied to learning in the field of computer networks for vocational high school students. This research is a development research using the modified HC-ADDIE model, namely collaboration and modification of the Hopkins and Clark research, development, and diffusion (RDD) model with the ISD ADDIE model and classroom action research (CAR). The development stages involve activities of prototype model design, model validation, readability testing, training teachers/observers, and conducting limited and expanded trials as implementation, analysis, and evaluation activities through CAR diffusion including dissemination of research results through seminars and journals. The results showed that the HOTS based AFL model for learning in the field of computer networks for students developed through the modified HC-ADDIE model is valid and practical.

A. INTRODUCTION

Vocational High School (SMK) is a formal education that aims to prepare students to enter the world of work, prepare students to master the knowledge, skills, attitudes and values needed by the world of work (Achmad, 2019). SMK graduates are required to be able to work independently, have a professional attitude in the field of expertise they are interested in and have competencies in accordance with the chosen expertise program. The fact is that SMK graduates have not been able to answer the labor problems needed by the world of work (Alimudin et al., 2018). Moreover, if we look at BPS data per 2018, South Sulawesi Province ranks 6th highest in the SMK Open Unemployment Rate, which is 12.48% even above the national average of 11.24%. For example, the number of alumni, especially the Computer and Network Engineering Department produced by a number of favorite

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e-ISSN: xxxxxx | p-ISSN: xxxxxx
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SMK in South Sulawesi, also shows a sad phenomenon, namely those who work according to the background of expertise taken at SMK are no more than 5.% of the average graduate. Even though this expertise course is the most preferred department in SMK. We can predict the conditions of other schools. Nationally, the computer engineering and informatics department is in the third position of contributors to unemployment for alumni in 2018, amounting to 228,554 people. One of the obstacles in the acceptance of SMK graduates in the world of work is the ability to think highly. This is in accordance with the opinion of Delise (Delisle, 1997), Rose and Nichole that the ability to think and work at a high level is one of the competency requirements that must be possessed in the world of work(Nicholl & Rose, 2000). The ability to think at a high level is now known as Higher Order Thinking Skills (HOTS).

Higher Order Thinking Skills

Currently, the learning design at SMK has been directed at HOTS. One of the reasons is that the development of the National Examination questions continues to be improved so that it can measure students' abilities in the higher cognitive domains… ”(Akuntono, 2013). On the other hand, many vocational teachers still use the Low Level Thinking Skills (LOTS) assessment, which only facilitates students in short-term memory (Nugroho, 2018). This phenomenon is not only a local problem, but also a global problem. There is international concern about the dominant practice of LOTS assessment which only encourages students to focus on learning that emphasizes rote (Osborne & Dillon, 2008). As a result, graduates are less skilled and lack high-order thinking skills to solve problems in life.

Vocational schools must also be able to prepare their graduates to enter the world of work according to the specified requirements. Cotton and Robinson (Robinson, 2000) stated that to enter the world of work, prospective workers must have the readiness, abilities, and skills needed by the workforce (job skills), one of which is HOTS. According to Robinson (2000: 3), with HOTS a person will be able to learn, provide reasoning, think creatively, make decisions, and solve problems.

Some of the abilities mentioned above can be achieved if someone is able to apply knowledge, analyze problems, evaluate problems, and compile alternative problem-solving designs based on their knowledge and understanding. Several indicators of this ability are summarized in HOTS, so HOTS is a must-have for all students including computer and network engineering students. Therefore, the development of HOTS is very important in the educational curriculum for computer and network engineering students.

Assessment For Learning

Araceli (Araceli, 2016) explained that AFL is often referred to as formative assessment which involves teachers and students in using assessments to improve learning, namely assessing and analyzing progress and providing positive and constructive feedback on assessment results for both teachers and students to help improve student learning. and adapting teaching methods to identify student

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learning needs. Currently, the learning design in SMK has been directed at HOTS, so the development of HOTS assessments is a priority. Assessment is a process carried out as a step to evaluate the performance of the entire system, analyze the effectiveness of teaching, and obtain information in the framework of student decision making which aims to improve the quality of learning.

Laveault D., and L. Allal suggested that AFL consists of four basic elements (components), namely: sharing learning goals and success criteria, using effective questioning technique, self-assessment, and effective feedback (Laveault & Allal, 2016), (Heritage, 2010). The assessment process in Vocational High Schools must be carried out in all aspects of student abilities so that the assessment results have meaning for students, both for entering the world of work and for continuing education to a higher level. This is in accordance with the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 66 of 2013 concerning Education Assessment Standards, which states that the scope of assessment of student learning outcomes includes competency attitudes, knowledge and skills which are implemented in a balanced manner so that they are balanced. can be used to determine the position of each student relative to the standards that have been set. It was agreed by Brookhart that by conducting HOTS assessments regularly, there will be positive developments in students, namely the ability to think and performance will increase as a whole (Brookhart, 2010).

Learning Computer and Network Engineering In general, the thinking ability of SMK students is still low. When doing the exercises, students can do their job well based on teacher demonstrations and worksheets. However, when they find an error, they have not been able to analyse the cause of the error (analysis level C4), evaluate the error steps (evaluation level C5) and come up with a solution to manage the error (manufacture level C6). The biggest problem faced by students is the difficulty in generating ideas (Heong et al., 2011). This pattern is the same as research which states that the highest learning styles for vocational high school students are actors and the lowest is thinkers (Chappuis, 2002). Therefore, it is necessary to think about the HOTS development strategy of computer and network engineering students.

Assessment with these characteristics has advantages, including being able to detect the weaknesses and strengths of students, being able to detect the position of students' abilities in learning based on criteria not compared to other students, involving teachers and students in the implementation process, and being able to help teachers and students achieve the expected learning goals. In addition, assessment can foster motivation, responsibility, self-confidence, independence, honesty, and student achievement in learning . Yusuf agreed that the function of the assessment is to provide information and control the quality of education which includes all components of education from the implementation process to educational products (Miarso & Yusuf, 2009).

The development of students in Computer and Network Engineering HOTS is a demand that must be done immediately, considering that the characteristics of work

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https://ojs.unm.ac.id/vokasiketeknikan

in the field of computer and network engineering are to produce or produce products related to the network world that require critical and creative thinking skills. This is because in general the installation and configuration process requires a long problem-solving process, namely: (1) developing a network concept; (2) designing a network which includes making topologies and making network designs; (3) raw material selection; (4) determining the technology used; (5) the installation and configuration process; and (6) testing; Therefore, students as computer and network engineering must be ready and able to master well in accordance with the demands of the global world. Based on the description above, it can be said that an increase in the assessment of student learning outcomes can be done by developing a HOTS-based assessment model. Therefore, this research was conducted to develop a HOTS-based For Learning (AFL) assessment model for learning Computer Engineering in Vocational High Schools (SMK). The media for assessment for learning (AFL) is an application developed based on the management of student learning assessments.

B. METHOD

This type of research is Research and Development. This study develops the HOTS-SIAVO-based AFL Model for learning computer and network engineering for students through Educational development research. The educational development research model used in this study refers to the: (1) Research, Development, and Diffusion (RDD) model from Hopkins & Clark (Havelock, 1976); and (2) Instructional System Design model (ISD) from ADDIE product development paradigm (Branch, 2009), (Richey & Klein, 2009). In the trial phase, the development phase is carried out through the approach of Classroom Action Research (CAR) (Hopkins, 2011); (Mertler, 2009). The selection of the development model with these three approaches is based on considerations of completeness, coherence, convenience, simplicity, practicality, and the suitability of the model with the research focus.

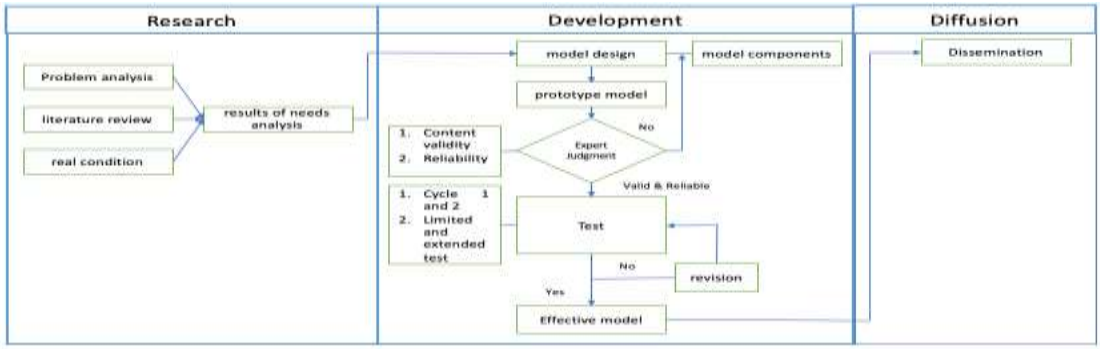

FIGURE 1. Model Development Stages

JURNAL VOKASI KETEKNIKAN
Vol.1, No. 1, Maret 2023
e-ISSN: xxxxxx | p-ISSN: xxxxxx
https://ojs.unm.ac.id/vokasiketeknikan

C.RESULTS AND DISCUSSION

Step 1 : Research

Results of the Preliminary Study Review

HOTS Vocational School students in the field of computer networks which include the ability to apply, analyze, evaluate, and create are generally still low enough that they need to be improved and developed. This is indicated by the low ability of students in applying theory to solve problems, think critically, provide logical reasons and arguments, solve problems, make decisions, and compose concepts and designs/designs in the process of creating new products when students are finished. assignments given by the teacher. Most students also have difficulty writing or compiling scientific papers. This seems to be due to the lack of time to read and the unfamiliarity of using HOTS skills during the learning process and in the process of completing assignments /questions.

Results of Theoretical and Empirical Studies

HOTS development, learning motivation, positive attitude and student motivation in the field of computer networks are very important. Therefore, learning strategies and learning models in the field of computer networks in SMK must be able to develop HOTS, learning motivation, positive attitudes and student motivation, in order to produce pious, intelligent, and independent learning outcomes and be able to present increasingly complex learning outcomes. global challenges. The development of HOTS, learning motivation, positive attitudes and student motivation can be done by implementing HOTS-based AFL in the learning process of computer networks in the classroom as an effort to prepare the workforce needed in the 21st century.

Results of Problem Analysis and Needs Analysis

The results of the problem analysis show that: (1) SMK students in the field of computer networks still have quite low HOTS, even though students should already have high enough HOTS to be able to face the challenges of an increasingly complex global world. ; (2) students also still have low learning motivation, positive attitudes and behavior, even though this aspect is very important to support student learning success; (3) the learning strategies and assessment systems applied so far have not been able to develop HOTS, learning motivation, positive attitudes and positive student behavior even though they should have been developed either through learning strategies or assessment systems; (4) In the learning process in the field of computer networks, the assessment model has not been integrated, namely the assessment for learning (AFL) for the purpose of HOTS development, learning motivation, student attitudes and positive behavior even though they are actually being developed. through the application of AFL in classroom learning; (5) most of the questions/assignments given by the teacher still measure students 'cognitive abilities at a low level (low order thinking skills, LOTS), while at the student level

JURNAL VOKASI KETEKNIKAN
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e-ISSN: xxxxxx | p-ISSN: xxxxxx
https://ojs.unm.ac.id/vokasiketeknikan

questions / assignments must measure and develop students' cognitive abilities. at a higher level (higher order thinking skills, HOTS); and (6) HOTS-based AFL model for learning computer networks of SMKini students does not yet exist, so it is necessary to develop a HOTS-based AFL model for computer learning so that it can be immediately applied in classroom learning as an effort to develop HOTS, learning motivation, positive student attitudes and behavior and improve and improve the quality of learning in the field of computers at SMK.

Step 2 : Development
Results of HOTS-Based AFL Model Development

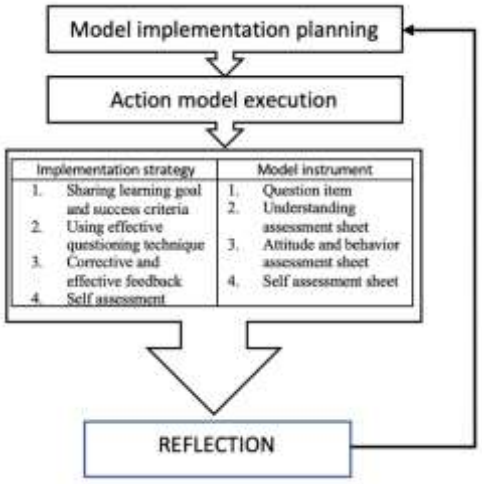

FIGURE 2. HOTS-based AFL models in learning computer networks

Result

a. Prototype Model Validation Results

Validation of the prototype model is carried out through an expert assessment of the suitability and feasibility of the model in terms of model objectives, model characteristics, model components, model instruments, model implementation procedures (syntax), and model implementation guidelines. Aspects of the assessment include the suitability and feasibility of the model: (1) as AFL for learning in the field of computer network engineering in SMK; (2) to improve and develop students' understanding and HOTS; (3) to provide information about students' motivation, attitude, and positive behavior; and (4) to improve and improve the quality of assessment and learning process.

The prototype model that has been validated by the expert is then revised by the researcher, followed by the readability test, and validated again by the expert until an appropriate and appropriate model is obtained so that it is ready to be tested in classroom learning.

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e-ISSN: xxxxxx | p-ISSN: xxxxxx
https://ojs.unm.ac.id/vokasiketeknikan

the results of the validation of the prototype model stage 1 in terms of model objectives, model characteristics, model components, model instruments, model syntax, and model guides, overall already have good quality and are declared appropriate and suitable for use with some input and suggestions for improvement (revision), namely between: (1) it is still necessary to observe the consistency of the definition and concept of HOTS used: (2) it is necessary to improve the instrument in terms of material, construction, and language, (3) the flow of syntax needs to be clarified, and (4) guidelines need to be compiled in detail, clear, coherent, and systematic. After the revision, it appears that the results of the validation of the prototype model at stage II have shown an improvement in the quality of the model, namely being very good and has been declared appropriate and suitable for use without any further revisions. However, it is recommended to conduct both limited and broad trials to find out its effectiveness empirically.

b. Content Validity Results

TABLE 1. Instrument Validation Results by Experts

No	Instrument	Average Score of Assessment Results		Total Score Average	Category	Result
		Expert 1	Expert 2			
1	HOTS-SIAVO based AFL model instrument grille	1	1	1	Very Relevant	valid
2	Observation sheet on the implementation and implementation of the model	1	1	1	Very Relevant	valid
3	Questionnaire on the implementation and implementation of the model	1	1	1	Very Relevant	valid
4	Student-teacher activity observation sheet	1	1	1	Very Relevant	valid
5	Student and teacher activity questionnaire	1	1	1	Very Relevant	valid
6	Observation sheet and assessment of student attitudes and behavior	1	1	1	Very Relevant	valid
7	Student attitude questionnaire	1	1	1	Very Relevant	valid
8	Model effectiveness questionnaire	1	1	1	Very Relevant	valid
9	HOTS-based questions/tasks	1	1	1	Very Relevant	valid

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e-ISSN: xxxxxx | p-ISSN: xxxxxx
https://ojs.unm.ac.id/vokasiketeknikan

10	Student understanding and HOTS assessment sheets	1	1	1	Very Relevant	valid
11	*Self-assessment & self-reflection* Sheet	1	1	1	Very Relevant	valid
12	Assessment rubric	1	1	1	Very Relevant	valid
13	Model prototype assessment sheet	1	1	1	Very Relevant	valid

c. Reliability Test Results

TABLE 2. Instrument Reliability Calculation Results

No	Instrument	Alfa Cronbach	Result
1	Observation of Student-Teacher Activities in the development of Student HOTS	0,783	Reliable
2	Observation of the Implementation and Implementation of the Model	0,744	Reliable
3	Model Functionality Questionnaire	0,731	Reliable
4	Observation of Student Attitudes and Behavior Perilaku	0,757	Reliable
5	Student Attitude Questionnaire	0,710	Reliable
6	Questionnaire Implementation and Implementation of the Model	0,782	Reliable
7	Student Activity Questionnaire in Developing HOTS	0,822	Reliable
8	Student Self-Assessment and Reflection Sheet	0,713	Reliable
9	Integrated Student Understanding and HOTS Assessment in HOTS-Based Questions/Assignments	0,714	Reliable

d. Item Validity Test Results

TABLE 3. Item Validity Test Results

No. question	Validity		Result
	r_{count}	r_{table}	
1	0,849	0,632	Valid
2	0,788	0,632	Valid
3	0,758	0,632	Valid
4	0,774	0,632	Valid
5	0,141	0,632	Drop
6	0,661	0,632	Valid

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Vol.1, No. 1, Maret 2023
e-ISSN: xxxxxx | p-ISSN: xxxxxx
https://ojs.unm.ac.id/vokasiketeknikan

e. Practicality

TABLE 4. Results of Student Assessment Questionnaires on the Application and Implementation of the HOTS-SIAVO AFL Model Based

No	Test	Average	Category
1	Limited	3,315	Very Good
2	Expanded	3,57	

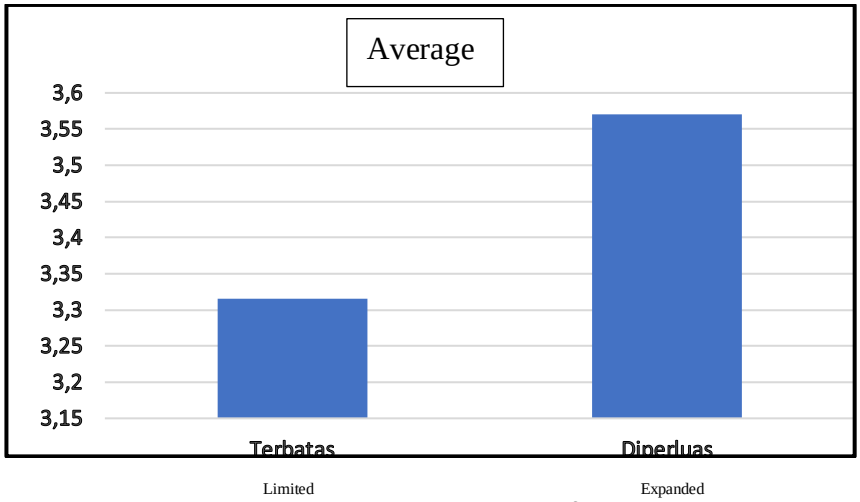

FIGURE 3. Diagram of the Average Score of Student Assessment of the Application and Implementation of the HOTS-based AFL Model in Learning

D. CONCLUSION

Referring to the research objectives, research and development results, it can be concluded as follows:

1. The results of the content validity analysis show that overall, the instrument developed in the HOTS-based AFL model for learning in the field of Computer Network Engineering has met the validity requirements. This is indicated by the resulting value is 1, where the minimum value of content validity for Gregory is V> 0.75. Therefore, this model is declared valid. Furthermore, in the reliability test, it appears that all instruments have Cronbach's Alpha above 0.7 (> 0.7). This means that all instruments are reliable. In the analysis results of the calculation of the validity of the items it can be said to be valid because r-count > r-table.
2. The results of student assessments of the application and practicality of the HOTS-based AFL model in learning both in limited and expanded trials as a whole are very good. The limited test resulted in 3,315 in the very good category and in the expanded test it resulted in 3.57 in the very good category. This shows that the HOTS-based AFL model can be applied and implemented well or practically in the field of Computer Network

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Vol.1, No. 1, Maret 2023
e-ISSN: xxxxxx | p-ISSN: xxxxxx
https://ojs.unm.ac.id/vokasiketeknikan

Engineering learning with a trial sample of Network Infrastructure Administration learning. While the results of the observations of the two observers showed that overall both in the limited and expanded trials, the HOTS-based AFL model could be implemented well in learning, and experienced an increase in each cycle, namely in cycle 1, the average implementation of the model in limited trials and expanded to 25 to 27 in cycle 2.

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