

The Effect of Learning Model Based on Higher Order Thinking Skills (HOTS) with Multimedia and Creative Thinking Abilities on Learning Outcomes of Vocational Learning Design

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Abstract— This study aims to determine the differences in HOTS-based learning models for learning outcomes of vocational learning design, differences in the ability to think creatively towards learning outcomes in vocational learning design; and the interaction between HOTS-based learning models with multimedia and the ability to think creatively towards the learning outcomes of vocational learning design. The research method is quasi-experimental. The statistical test used is descriptive statistics to present data and proceed with inferential statistics using two-way ANOVA followed by further tests. The results showed that there were differences in learning outcomes for vocational learning design taught using HOTS-based learning models with higher multimedia than learning outcomes taught with expository learning models with multimedia, there were differences in learning outcomes for vocational learning design that had higher creative thinking abilities. than those who have low creative thinking ability; and there is an interaction between HOTS-based learning models with multimedia and the ability to think creatively on the learning outcomes of vocational learning design.

Keywords—*component; learning model; higher order thinking skills; multimedia; creative thinking; vocational learning design*

I. INTRODUCTION

Education was in the age of knowledge with an incredible acceleration of knowledge increase. In this 21st century, education is increasingly important to ensure students have the skills to learn and innovate, the skills to use technology and information media, and can work, and survive by using skills for life.

The low learning outcomes of vocational learning design for students in mechanical engineering and automotive engineering education programs, due to: (1) the ability to think at a high level or through 4C and HOTS stages is rarely done in organizing and constructing learning and learning development using suitable models; (2) lack of in-depth understanding of the concepts and implementation of vocational learning designs; and (3) the use of interactive

multimedia-based learning. Information technology can be used to develop learning models.

Change and innovation in the world of education will continue to occur and develop. Innovation in education is an effort to make a good change in education [1]. These changes include: easier to find learning resources, more choices for using and utilizing ICT, increasing the role of media and multimedia in learning activities, more flexible learning time, computer-based instruction (CBI), computer assisted instruction (CAI), the use of television / video media, mobile learning, e-learning, learning management systems, on-line curriculum, e-library, learning models with individual learning systems, competency references.

Some educational researchers state that technology has the potential to improve the quality of learning [2]. Creative use of media can facilitate and improve learning efficiency so that learning objectives can be achieved. Learning media is one of the important aspects in the education process, learning media is a messenger technology that can be utilized for learning purposes. In addition, the media has various benefits, including helping teachers to deliver their teaching material, the media are also seen as a communication tool that bridges abstract ideas with the real world. The use of media also makes the process of interaction, communication and delivery of material between lecturers and students so that it can take place appropriately and efficiently. Several studies have shown that the use of interactive multimedia can improve the mastery of concepts, learning achievement, and critical thinking skills. [3]

A. Multimedia Learning Model

The preparation of the learning model is done by taking into account the components including: Design, development, utilization, management, and evaluation [4]. Sutawidjaja and Jarnawi [5] argue that there is no best learning strategy or model, there is accuracy in choosing a learning strategy or model. This condition directly encourages the teacher to better understand learning strategies so that he will be able to easily

choose the right strategy or learning model to use in accordance with certain conditions and situations. Even a teacher is required to be more professional in carrying out their duties, which is always thinking where their students will be taken, as well as by directing their students to achieve the desired results with various learning innovations.

Vocational learning design learning, some topics that are difficult to convey conventionally or highly require high application, can be implemented with the help of computer / multimedia technology, such as graphics and diagrams can be presented easily and quickly, the appearance of images, colors, visualization, video, animation can optimize the role of the senses in receiving information into the information system [6]. Based on these explanations, it can be concluded that multimedia based learning is learning that uses computer / multimedia assistance using Android.

There are several formats of interactive multimedia based learning models such as: (1) tutorial models are one of the interactive learning models used in the teaching and learning process by using software in the form of computer programs containing course material; (2) Drills model is a form of computer-based interactive learning model; (3) the simulation model is basically one of the learning strategies that aims to provide real experience through the creation of imitation forms of experience that approach the real atmosphere and take place in an atmosphere without risk; and (4) instructional games model is one of the learning models using computer-based interactive multimedia [7].

Based on research that interactive multimedia learning models can improve the mastery of the concepts of physics teachers [8]. In addition, it is also supported by the results of research that utilizes multimedia in learning the blended elearning model also can improve student learning outcomes [9]. Other research also shows that the development of interactive multimedia learning can improve students' mastery of concepts [10]. From some of these studies, it is clear that interactive multimedia learning provides benefits for learning. In interactive multimedia learning, students can learn certain material independently by using computers equipped with multimedia-based programs [11].

B. Higher Order Thinking Skills (HOTS)

The role of education in tertiary institutions contained in the KKNI-based curriculum, focuses on developing students in learning outcomes such as cognitive, affective and psychomotor, or spiritual attitudes, social attitudes, knowledge and skills. HOTS ability is an indication of the success of increasing student competence in the field of education in the 21st century. Two very simple reasons that make why HOTS is important, is that students will be successful and grow into adults who make positive contributions to society [12].

There are several characteristics of HOTS according to Conklin [13], creative thinking is two very basic human abilities because creative thinking can encourage someone to always look at every problem faced creatively, and try to find a solution creatively, so that a new thing is better and beneficial for his life.

Resnick [14] said that, HOTS has characteristics, as expressed, namely non-algorithmic, complex, multiple solutions, involving variations in decision making and interpretation, applying multiple criteria, and being effortful. Called effortful because when solving the HOTS problem, it takes deeper and deeper thinking.

C. Creative Thinking Ability

Creative Thinking is a mental process for analyzing the information obtained. The information is obtained through observation, experience, communication, or reading. In addition, Brookhart [15] mentioned that what included creative thinking included reasoning, questioning and investigating, observing, describing, comparing, connecting, finding complexity, and exploring point of view.

Creative thinking is an organized process that allows students to evaluate the evidence, assumptions, logic, and language that underlies the thinking of others [16]. The ability to think creatively includes creating, discovering, imagining, guessing, designing, proposing alternatives, creating and producing something [17]. Forming a creative idea means coming up with something unusual, new, or come up with a solution to a problem. A person's ability to think creatively can be demonstrated through several indicators, for example being able to propose new ideas, ask questions, dare to experiment and plan strategies.

Creative thinking is used in efforts to solve problems in the design of vocational learning. Problem solving is using existing knowledge and skills to answer unanswered questions or difficult situations [18]. The ability to solve problems is something that is very important because it relates to drawing mechanical engineering. Included in determining, planning, with various provisions that require that it can be done properly, correctly and the products produced in accordance with the plan. The ability to think high level both the ability to think creatively, creatively and problem solving abilities possessed by students can not be owned directly but obtained through practice.

The formulation of the problem of this research are: (1) Whether the learning outcomes of vocational learning design in education in students taught using HOTS-based learning models with multimedia are higher than those taught by using expository learning models with multimedia; (2) Is the learning outcomes of vocational learning design in the education of students who have higher creative thinking abilities higher than students who have low creative thinking abilities; and (3) Is there an interaction between learning models and the ability to think creatively affecting the learning outcomes of student vocational learning designs?

II. METHOD

This research was carried out in the mechanical engineering education and automotive engineering education programs, in the vocational learning design courses in Education. The study population was all students taking vocational learning design courses, which consisted of 4

classes, and each class consisted of 22 students (class A), 24 students (class B), 23 students (class C), and 22 students (class D) which means the study population consisted of 91 students. While the sample of this study was assigned to 2 classes, namely classes A and C with the Cluster Random Sampling technique. This research is a Quasi Experiment with 2x2 factorial design. The learning model is divided into two, namely the HOTS-based learning model with multimedia and the expository learning model with multimedia. The ability to think creatively is also divided into two, namely the ability to think highly creative and low creative thinking abilities.

Data collection techniques using the ability test of mastery of vocational learning design in the learning system design aspects of the Dick & Carey [19] model. The second is an instrument to know students' creative thinking abilities. The validity test is done by using the biserial correlation coefficient. Whereas the validity test was carried out using K.R-20

This analysis was carried out using the Anava factoria 2 x 2 technique with the F test. Before the hypothesis was tested, a requirement test was first performed on the data collected using the normality test using the Liliefors test and homogeneity test using the F test and the Bartlett test. Because the third hypothesis is significant it means that there is an interaction, the research test is continued using the Scheffe test.

III. RESULTS AND DISCUSSION

A. Results

Statistical data description of learning outcomes for vocational learning design based on variations in the learning model is as follows.

TABEL I. CALCULATION RESULTS OF DESCRIPTIVE ANALYSIS

Variables		Learning Model Variables (A)		Total
		HOTS and Multimedia Model (A1)	Exploration and Multimedia Model (A2)	
Creative Thinking Ability (B)	Height (B1)	n ₁ = 11 ΣX ₁ = 284 X̄ ₁ = 23,62	n ₂ = 12 ΣX ₂ = 202 X̄ ₂ = 18,06	n _{B1} = 25 ΣX _{B1} = 484 X̄ _{B1} = 21,00
	Low (B2)	n ₃ = 11 ΣX ₃ = 202 X̄ ₃ = 16,82	n ₄ = 11 ΣX ₄ = 193 X̄ ₄ = 17,46	n _{B2} = 23 ΣX _{B2} = 394 X̄ _{B2} = 18,13
Total		N _{A1} = 22 ΣX _{A1} = 486 X̄ _{A1} = 19,21	N _{A2} = 23 ΣX _{A2} = 395 X̄ _{A2} = 17,74	N _t = 45 ΣX _t = 876 ΣX _t ² = 16718 X̄ _t = 19,62

Description of learning outcomes data based on variations in the learning model. The learning outcomes of student vocational learning designs in the experimental group taught using HOTS-based learning models with multimedia are higher than the learning outcomes of students who are taught

with expository learning models with multimedia. Description of learning outcomes data based on variations in creative thinking abilities. The learning outcomes of vocational learning design of students who have high creative thinking ability are higher than the learning outcomes of students who have low creative thinking ability.

Based on the results of the normality test data show that all groups of subjects were normally distributed, thus it can be concluded that the study sample came from populations that were normally distributed. And thus the group of subjects taught by HOTS-based learning models and those taught by expository learning models based on high and low creative thinking abilities have homogeneous variance. After testing the analysis requirements, the results are required that all subject group data are normally distributed and have a homogeneous variance, thus the requirements relating to the two-way variance analysis technique have been fulfilled.

TABEL II. ANOVA CALCULATION RESULTS

Source Variance	dk	Number of Squares	Average Number of Squares	F _{count}	F _{table} α= 0,05
Learning Model (A)/ column	1	23,69	37,69	7,15	4,07
Creative Thinking Ability (B)/ row	1	85,07	81,07	18,13	4,07
Interaction (A x B)	1	58,11	57,11	15,92	4,07
Error	41	184,45	4,799	-	-
Total	44	379,32	-	-	-

The learning outcomes of vocational learning design for students taught with HOTS-based learning models with multimedia are higher than students taught with expository learning models with multimedia. From the results of calculations with Anava in table 2 obtained that F_{count} = 7.15 and F_{table} = 4.07 at a significant level of 0.05. This means that F_{count} > F_{table}, indicating that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Thus it can be stated that the learning outcomes of vocational learning design of students taught with HOTS-based learning models with multimedia are higher than the learning outcomes of vocational learning design designs of students who are taught with expository learning models with multimedia.

The learning outcomes of vocational learning design for students who have high creative thinking abilities are higher than students who have low creative thinking abilities. Based on the results of calculations with Anava in table 2 obtained data calculation results of learning outcomes of student vocational learning design based on the ability to think creatively namely F_{count} = 18.13 and F_{table} = 4.07 at a significant level of 0.05. This means that F_{count} > F_{table}, indicating that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Thus it can be stated that the learning outcomes of vocational learning design students who have higher creative thinking abilities are higher than those who have low creative thinking abilities.

The interaction between learning models and the ability to think creatively on the learning outcomes of vocational

learning designs. In this case, the ability to think creatively is divided into two categories, namely low and high. From the results of calculations with the ANAVA table in table 2 it was found that $F_{count} = 15.92$ and $F_{table} = 4.07$ at a significant level of 0.05. This means that $F_{count} > F_{table}$, indicating that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. Thus it can be stated that there is an interaction between the learning model and the ability to think creatively on the learning outcomes of student vocational learning design.

Because of the interaction in this study, it was continued by conducting further tests using the Scheffe test. Summary of the results of the Scheffe test calculation

TABEL III. SUMMARY OF SCHEFFE TEST CALCULATION RESULTS

No	Subject Group	Statistical Hypothesis	F_{count}	F_{table}	Criteria
1	A_1B_1 - A_2B_1	$H_0 : \mu_{A_1B_1} = \mu_{A_2B_1}$ $H_a : \mu_{A_1B_1} > \mu_{A_2B_1}$	18,74	2,82	Significantly different
2	A_1B_1 - A_1B_2	$H_0 : \mu_{A_1B_1} = \mu_{A_1B_2}$ $H_a : \mu_{A_1B_1} > \mu_{A_1B_2}$	32,68	2,82	Significantly different
3	A_1B_1 - A_2B_2	$H_0 : \mu_{A_1B_1} = \mu_{A_2B_2}$ $H_a : \mu_{A_1B_1} > \mu_{A_2B_2}$	25,04	2,82	Significantly different
4	A_2B_1 - A_1B_2	$H_0 : \mu_{A_2B_1} = \mu_{A_1B_2}$ $H_a : \mu_{A_2B_1} > \mu_{A_1B_2}$	4,76	2,82	Significantly different
5	A_2B_1 - A_2B_2	$H_0 : \mu_{A_2B_1} = \mu_{A_2B_2}$ $H_a : \mu_{A_2B_1} > \mu_{A_2B_2}$	3,65	2,82	Not significantly different
6	A_2B_2 - A_1B_2	$H_0 : \mu_{A_2B_2} = \mu_{A_1B_2}$ $H_a : \mu_{A_2B_2} > \mu_{A_1B_2}$	1,25	2,82	Not significantly different

B. Discussion

Based on several research findings in vocational learning design learning shows that: (1) HOTS-based learning model with multimedia can improve student learning competence in the cognitive, affective, and psychomotor domains, (2) increase the ability to cooperate in study groups, able to apply various abilities skillfully when doing structured tasks. Furthermore, in the implementation of the learning process to achieve learning objectives in accordance with learning achievements, learning media that can motivate learning, including: (1) through animations that are designed to attract learning, and not boring; (2) designed based on parts and fragments into the smallest units, so it can easily understand the contents of the material delivered; (3) communicative language and containing interesting illustrations will be effective, stimulating for independent learning; (4) improve learning outcomes, can easily check the success of their learning independently; and (5) parts / fragments have reinforcement, can improve learning outcomes in vocational learning design courses. This is supported by research results that the use of computer-based interactive media is more effective in increasing students' knowledge and understanding compared to using conventional media in the eyes of vocational learning design.

Student learning outcomes that follow the learning posing problem oriented HOTS implementation better than the learning outcomes of students who follow conventional mathematics learning [19]. The ability of HOTS is shown to students in learning mathematics, that (1) students with high

mathematical abilities are included in both categories of analyzing questions, evaluating questions and creating problems, (2) students with mathematical abilities are included in both categories of problems in analyzing, as well as including enough categories in questions evaluating and creating questions, (3) students with low mathematical ability, including the category lacking in analyzing questions and evaluating questions, and including the category lacking in creating problems [20].

The advantage of computer-based learning is the application of the principle of complete learning or mastery learning [21]. Thus, students who have positive innovative abilities to the ability of vocational learning design will quickly finish in learning the content / subject matter of vocational learning design programmed in computer-based learning.

Students who are capable of high creative thinking have a tendency to easily adapt to new knowledge, they prefer to learn face to face with challenging knowledge. This direct interaction will facilitate and speed up responses to what they are doing. The results showed that those with high creative thinking skills and being taught with HOTS-based learning models evidently mastered vocational learning design in higher education than those who used the direct learning model without HOTS integration. This condition is appropriate, that those who have high creative thinking ability prefer to obtain information based on feedback and assimilate to previous experiences.

Students' creative thinking skills, are considered important to be developed at every level of education, to create and produce students who have good cognitive abilities in following the learning process and the formation of abilities in HOTS [22].

Learning by using interactive multimedia in the design of vocational learning means practicing the ability to solve problems by using the stages of learning design correctly through accelerating ICT-based learning. The courage of students with high creative thinking ability to try to solve problems in various ways according to the rules of the system is a difficult step to implement if they learn by direct learning strategies and without using interactive multimedia media. Synder and Synder [23] asserted that teachers should instill creative thinking skills for students, students are not only formed as recipients of information but must be processors of information, this is related to information in the design of vocational learning.

The results of other studies indicate that learning programs through creative thinking skills are very effective in improving students' academic abilities [24]. In another research also revealed that with good thinking skills of students at the level of analysis, evaluation, and creation with HOTS achievements will increase the classical completeness of students beyond the minimum completeness criteria [25]. The ability to think creatively high in the HOTS realm is a problem-solving step in the learning process that is formed based on the level of intellectual skills, new concepts they find themselves will add experience to solve the problem of vocational learning design.

According to Lambertus [26], the development of students' creative thinking skills can be done through the application of student-centered learning, because they are given the freedom to build their own knowledge, discuss with friends, freely submit opinions, be able to accept or reject peer opinions, and with the guidance of teachers formulate conclusions.

IV. CONCLUSION

The conclusions in this study are: (1) The average student learning outcomes in the vocational learning design taught using HOTS-based learning models with multimedia are superior to using expository learning models with multimedia; (2) The average student learning outcomes in vocational learning designs that have high creative thinking abilities are superior to those with low creative thinking abilities; (3) there are differences in student learning outcomes in vocational learning design between classes that use HOTS-based learning models and classes that use expository learning models, (4) there are differences in learning outcomes in vocational learning design for students who have high creative thinking abilities and students who have low creative thinking ability. (5) there is an interaction between the use of HOTS-based learning models with the ability to think creatively on the learning outcomes of vocational learning design.

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