Learning Model Higher Order Thinking Skills at Vocational High School: Achievement and Thinking Behavior

Yusuf[1], Slamet. P. H.[1], Thomas Sukardi[1] , Mohd. Khairudin[2]

[1]*Department of Technical and Vocational Education, School Graduate of Yogyakarta State University, Indonesia*
[2]*Department of Electrical Engineering, Faculty of Technology, Yogyakarta State University, Indonesia*

Abstract

The purpose of this study is to promote learning model of Higher Order Thinking Skills that can improve students' achievement, easy to implement and to adapt the supporting of existing tools and materials. The evaluation effect of the application Higher Order Thinking Skills learning model produced the aspect of critical thinking skills, creative thinking and students' problem solving. The approach used in this study was Research and Development. Preliminary research data was collected through interviews, class observations and documents analysis. The trial data were obtained by quasi experiments. The research data were analyzed by qualitative analysis techniques for interview data and quasi-experimental data were analyzed quantitatively. The results of study indicate that the Higher Order Thinking Skills learning model was proven to be effective improving the achievement students with an effectiveness level of 73%, and the ability to think critically, creative thinking and problem solving students with an effectiveness level of 80%. The learning model developed as an alternative in teaching and learning activities has quite high effectiveness.

Keywords: learning model, critical thinking, thinking skills, problem solving

1. Introduction

The industrial revolution 4.0 make an impact to many aspects. One of these aspect is work force. The world of work requires high competency and the quality of human resources. Vocational education is one of the institution to train and educate human resource. Nowadays, the skilled labor, critical and creative work force is needed. The challenges of the world of work and the entrepreneurship in the global era which is followed by rapid technological development demands learning and innovation skills which include: (1) critical thinking and problem solving, (2) communication skill and collaboration (3) creativity and innovation [1]. Vocational High School (VHS) as one of educational institution is demanded able to train student have sufficient knowledge, good competence, innovative, creative and adaptable to respond changing. Vocational high school as a middle level vocational human resource must be quickly respond rapidly to the economic based information development with the 21st century skills education concept.

The problem of VHS is fail to match between human resource and the industrial demand. This condition cause increasing jobless by VHS graduate. In [2] said there was still a mismatch between the workforce produced by vocational education and the labor that was needed by industries. VHS is demanded able to train student not only skilled but also have higher thinking skill such as critical thinking, creative thinking, innovative and problem solving. The Organization for Economic Co-operation and Development (OECD) stated that one of the skill needed in the 21st century is ICT (Information and Communication Technology) which requires mastering on several skills such as critical thinking, creativity and problem solving [3]. The skills that was mentioned is part of Higher Order Thinking Skills as known by name of HOTS. Then, learning model of HOTS is needed to obtain these skills. The other side of complex problem solving requires critical thinking and creative thinking skills. The skills must be owned in order to be able to compete in the world of work that are able to adapt the changing of the global

environment and excel in the international area [4]. HOTS as part of soft skills is needed in order to complete human resource skills. By increasing soft skills and hard skills is useful to reduce the gap between industrial and educational institution.

The gap between competencies of vocational high school graduates and demands of the workforce is still wide. This condition needs concrete action by vocational education practices to minimize the gap. Therefore, the development of learning models that are able to foster and enhance students' high level thinking skills are needed. The learning model can adopt existing models and add aspects of learning activities to increase students' critical and creative thinking abilities. The HOTS learning model is expected can be used students to obtain a high level thinking skills such as critical thinking, creativity and problem solving. The investigation result of several schools showed that some teachers did not have readiness to carry out HOTS learning, including in conducting assessments [5]. Many teachers still do not understand as well how to conduct the HOTS learning process. The another survey also showed that there were obstacles to teachers in designing and implementing evaluations based on HOTS, difficulties in delivering learning materials, difficulties in designing medias and learning tools, and difficulties in preparing teaching materials [6].

The obstacles and unpreparedness of teachers in carrying out HOTS learning encourage researchers to develop learning models that are able to foster high level thinking skills of vocational students' who are feasible in improving student achievement, practically applied and easily adapted to the support of existing tools and materials. The development of the learning model was carried out by referring to the steps of development research by [20]. As a first step, this study is limited to vocational high school students by taking 3 schools as research sample units. The proposed HOTS learning model is expected to be able to provide solutions that many teachers face in implementing HOTS based on learning processes.

Learning model is a conceptual framework that describes the systematic procedure in organize learning experiences to achieve specific learning objectives that serve as guidelines for the designers of learning and teaching in designing and implementing learning activities. According to [7], learning model is a description of the learning environment that describes the planning curriculum, the courses, the design of the learning unit, learning equipment, books, lessons, multimedia programs and support learning through a computer program. The learning model is also a wrap or frame of the application of a method, strategy and learning approach.

There are several learning models that were used by teachers or trainers. One of the learning model develop to increase students' higher order thinking skills. The HOTS is a concept of educational reform based on Bloom's Taxonomy that are some skills involve analysis, evaluation and synthesis to build creation of new knowledge. These conditions are considered of a higher order, which requires learning and teaching method is different than learning from facts and concepts. High level thinking is also involving learning complex determining skills, such as creative thinking, critical thinking, and problem solving [8]. This high level thinking skill is used to manipulate, and transform knowledge and experience that important to think critically and creatively in order to determine decisions and solve the problems in new situations [9]. Brookhart explain HOTS definitions that are divided into three categories, namely HOTS in terms of: transfer, critical thinking and problem solving. HOTS's position in Bloom's taxonomy at the top is three things: analyzing, evaluating and creating [9].

The HOTS learning model as far as the researchers know explicitly there is not published yet. According to [10], nowadays modern industry requires workers who can be good problem solvers, competent communicators, and effective team players. The HOTS learning model requires student strategies, techniques, and activities that show that thinking skills can be taught together with subject matter and an integrated approach applied to the school system [11]. On the other side critical thinking is the art of analyzing and evaluate thinking with a view to improve it. The results of well-trained critical thinking include: (1) being able to raise important questions and problems; (2) collecting and assessing relevant information; (3) making reasonable

conclusions and solutions and testing them; (4) think openly in alternative thought systems; and (5) communicate effectively in finding solutions to complex problems [12]. The Problem solving is a mental and intellectual process to find problems and solving them based on accurate data and information, so that accurate conclusions can be obtained [13].

The thinking skills include creative thinking, critical thinking and problem solving is required by work force in 21st century. In [14] stated that in the 21st century creativity is very important. Students can be said to be creative if they are able to do the following things: (1) recognize the importance things in deep knowledge base; (2) usually open to new ideas and actively looking for the other ideas; (3) finding sources of material and ideas; (4) looking for ways to rearrange ideas into different categories and combination and evaluate them; (5) using trial and error when they are not sure how to proceed them [9]. In [15] research on the application of Problem based learning as a strategy to improve higher order thinking skills in vocational students in Kupang showed that application of problem based learning strategies was superior in conventional learning and was able to improve students' HOTS abilities in problem solving, team work and their self-confidence are better. High level thinking skills are very important to win the competition for work competition, find solutions and career enhancements.

Thinking skills is part of softskill that influence individual attitude or behavioral. The study of the achievement of HOTS in Colorado, US by Janet Casagrand and Katharine Semsar from Department of Integrative Psychology, the University of Colorado Boulder published in 2017 stated that the active learning environment significantly improves HOTS abilities and improves cognitive skills below (lower cognitive skills). This leads to change in teaching from lower order cognitive skills to higher order cognitive skills [16]. Research at Monash University, Australia by Pretorius and friends, about the application of a new assessment model that is flexible according to student desires. The results show that learning with assessment selection is proven to provide stages in learning, reduce students' stress levels and encourage the development of HOTS abilities for students [17]. Active learning and assessment selection can improve thinking skills. This condition also increases student HOTS ability.

Jamal Rayn from Al Qasemi Academic College for Education conducted a study in enhancing HOTS abilities by creating a visual learning strategy with meaningful learning models. Learning by presenting visual information such as pictures, diagrams, flow charts and interactive simulations then evaluating by evaluating the SWOT model. By this strategy it is proven to increase HOTS students [18]. Case study in Malaysia conducted by Sulaiman to find out the perception of science teachers on the implementation of HOTS learning. The results show that teachers are aware to the importance of HOTS learning and they are trying to apply it in teaching and learning process. This study concluded that knowledge and competence are very important to ensure the quality of HOTS implementation [19]. There so many empirical evidences that HOTS in teaching and learning process improve students' ability achievement.

2. Methodology

This study used Research and Development (R&D) and trials by Quasi experimental method. Research used a qualitative approach to pre-development model and quantitative approaches to product trials. Research and Development was used as a procedure to develop a HOTS learning model and it was expected to produce HOTS learning model. The stages of R&D research carried out are: (1) collection of information; (2) planning, including defining skills, determining goals, feasibility tests on a small scale; (3) Initial product development, in this case preparation of instructional materials, guide books and evaluations; (4) preliminary trial, involve 6-15 education experts, stakeholders and practitioners hold discussion in focus group discussion (FGD) to obtain inputs and suggestions; (5) Product revision, this revision is based on FGD results; (6) Limited trial, involving 1 school with 15 - 40 subjects, by implementing of HOTS models, observation, questionnaire/test data collection and analysis; (7) Revision of product operations, this revision is based on the results of limited trials; (8) Product operational testing in the field, ideally involve 2-3 schools with 40 - 200 subjects; (9) Revision of the final product,

this revision is based on the results from trial of product operations; (10) Dissemination and implementation, finished product reports, journal publications [20].

There are two types of data in this study, namely qualitative data consist of interviews, classroom observations and documents, while quantitative data consist of test results and questionnaire scores conducted by students during the trial model in the form of questionnaires and test questions (pretest data). When the trial of HOTS learning model was complete, the students filled out the questionnaire and worked on the test questions (post test data). Quantitative data were used to determine whether there are differences in students' abilities before and after the application of the HOTS learning model. The independent t-test, paired t-test and ANOVA with the SPSS program were used to determine differences in the conditions of students before and after the trial.

3. Results and Discussion

Quantitative data of HOTS learning model research was obtained by quasi experiments which conducted in 2 phase model trial. The first phase of the trial was conducted at the sample unit of Muhammadiyah 3 Vocational high school (VHS) in the 10th grade students of the Automobile Technology program expertise in Automotive Basic Technology subject. Two classes were taken as research object. One class was applied by HOTS learning model and the other as a control class. The figure 1 is a chart of HOTS learning model that were applied.
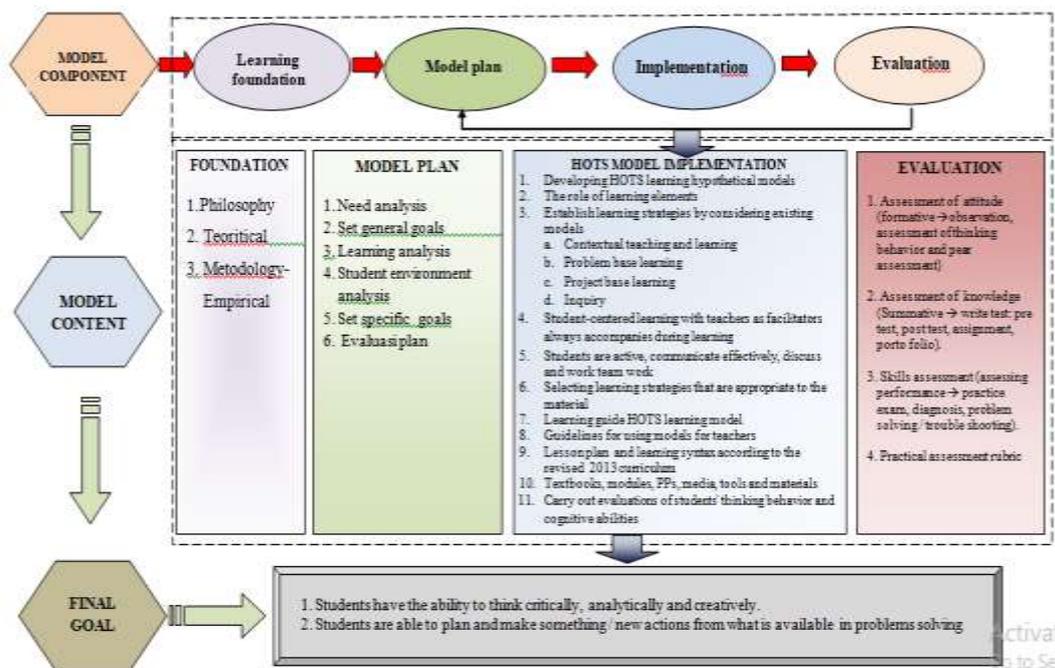

Figure 1. The final model of HOTS learning for vocational high school students

The results of the first phase model trials in Muhammadiyah 3 Vocational High School are shown in Table 1. The results of statistical analysis are shown that the phase I trial of the HOTS learning model in Vocational High School has a good impact to students in terms of cognitive abilities. This is shown by the summary of the results of statistical tests of the research data at phase I model trials is significant. Nevertheless, it is necessary to improve in the several aspects of the HOTS learning model that was used in the first trial. The second trial is expected the result is better.

Table 1. Summary of first Phase Trial Results in Vocational High School Muhammadiyah 3 Yogyakarta

Statistical Test		Mean	df =	Normality Test	Homogeneity Test	t-Independent Test	t- Paired Test
Class / Group			n-k	Sig. > 0,05	Sig. > 0,05	T = 0.015	
HOTS TEST	Pre test	T=65,8		Sig.= 0,830(T)	Sig.= 0,445	t = 0,014	
	Treat & Control	K=65,6	17	Sig.= 0,405(K)		Sig.= 0,211	
	Post test	T=69,06	t=2,07	Sig.= 0,347(T)	Sig.= 0,815	t = 4,881	
	Treat & Control	K=62,94		Sig.= 0,719(K)		Sig. = 0,00	
	Treat	Pe=65,8		Sig.= 0,864			t = 10,023
	Pre & Post test	Po=69,06					Sig. = 0,00
Thinking behavior	Pre test	T=115,42		Sig.= 0,864(T)	Sig.= 0,113	t = 0,161	
	Treat & Control	K=114,94		Sig.= 0,957(K)		Sig. = 0,354	
	Post test	T=121,63		Sig.= 0,690 (T)	Sig.= 0,058	t = 2,28	
	Treat & Control	K=114,38		Sig.= 0,942 (K)		Sig. = 0,030	
	Treat	Pe=115,42		Sig.= 0,864			t = -3,663
	Treat & Control	Po=121,63					Sig. = 0,02

In the second phase of the trial, it was carried out in two schools, namely VHS 2 Yogyakarta and VHS 2 Depok. The trials were carried out after making several improvements of the HOTS learning model. Both of VHS have similar standards and qualities and have applied the revised 2013 of VHS curriculum. The results of the second phase trial is show in Table 2. The results statistical analysis above is shown that the second phase trial HOTS learning model in both VHS gives a pretty good impact on students in terms of cognitive abilities. Even though the difference between pre and post test results is not too different, but it still within significant limits.

Table 2. Summary of the second phase trial in Vocational High School 2 Yogyakarta and Vocational High School 2 Depok Sleman

Vocational High School 2 Jogja	Statistical Test		Mean	df =	Normality Test	Homogeneity Test	t-Independent Test	t-Paired Test
	Class / Group			n-k	Sig. > 0,05	Sig. > 0,05	T = 0.015	
	HOTS TEST	Pre test	T=71,03		Sig.= 0,232(T)	Sig.= 0,348	t = 0,946	
		Treat & Control	K=69,11	28	Sig.= 0,476(K)		Sig. = 0,348	
		Post test	T=78,87	t=2,05	Sig.= 0,442(T)	Sig.= 0,019	t = 4,056	
		Treat & Control	K=70,43		Sig.= 0,840(K)		Sig. = 0,00	

		Treat	Pe=71,03		Sig.= 0,864			t = -9,862
		Treat & Control	Po=78,87					Sig. = 0,00
		Pre test	T=112,70		Sig.= 0,775(T)	Sig.= 0,013	t = 0,611	
		Treat & Control	K=110,82		Sig.= 0,345(K)		Sig. = 0,000	
		Post test	T=119,93		Sig.= 0,721 (T)	Sig.= 0,022	t = 3,353	
		Treat & Control	K=113,96		Sig.= 0,493 (K)		Sig. = 0,001	
		Treat	Pe=112,70		Sig.= 0,864			t = -6,518
	Thinking behavior	Treat & Control	Po=119,93					Sig. = 0,00
Vocational High School 2 Depok, Sleman	HOTS TEST	Pre test	T=65,28		Sig.= 0,139(T)	Sig.= 0,203	t = 0,439	
		Treat & Control	K=64,62	30	Sig.= 0,540(K)		Sig. = 0,663	
		Post test	T=71,94	t=2,05	Sig.= 0,066(T)	Sig.= 0,206	t = 3,401	
		Treat & Control	K=66,55		Sig.= 0,082(K)		Sig. = 0,001	
		Treat	T=65,28		Sig.= 0,864			t = -11,092
		Treat & Control	T=71,94					Sig. = 0,00
		Pre test	T=113,97		Sig.= 0,075(T)	Sig.= 0,094	t = 1,433	
		Treat & Control	K=112,21		Sig.= 0,615(K)		Sig. = 0,167	
		Post test	T=119,22		Sig.= 0,065 (T)	Sig.= 0,651	t = 3,548	
		Treat & Control	K=109,6		Sig.= 0,855 (K)		Sig. = 0,001	
		Treat	T=113,34		Sig.= 0,864			t = -4,116
	Thinking behavior	Pre & Post test	T=120,25					Sig. = 0,00

The differences between VHS 2 Yogyakarta and VHS 2 Depok is also not too different. Overall both classes have abilities that are not much different. The results of the trial and quantitative analysis can be used as material to develop the final learning model. So the HOTS learning model developed has fulfilled the requirement of field testing and proved to be quite effective. The value of effectiveness in the trial of the HOTS learning model can be seen in Table 3.

Table 3. Instruments for measuring the effectiveness of HOTS learning models

effectiveness	Score	1	2	3	max. Score	Aspects	max. Score	3	2	1	Score	effectiveness
			114	114	110	(150 x 2):3		(150 x 2):3	120	119	121		
75%	224	75	76	73	300	A	300	80	79	81	240	80%
67%	200	63	70	67	300	B	300	72	79	70	221	73%

Notes:

1. Phase I trial: 3 Muhammadiyah Vocational High Schools, Jogja
2. Phase II trial: Vocational High Schools 2 of Yogyakarta
3. Phase II trials: Vocational High Schools 2 of Depok, Sleman
A = student thinking behavior
B = HOTS test results

Based on Table 3, the overall maximum score is 300 and the maximum score for each aspect is 100. Data from the other learning model was shown that the scores on students ' thinking behavior aspects is 224 and HOTS test result is 200, then the effectiveness of other learning models within students' thinking behavior aspect is 224: 300 = 0.75 (75%) and the effectiveness of other learning models within HOTS test result aspect is 200: 300 = 0.67 (67%) from the expected criterion. While, the data from HOTS learning model was shown that the score on students' thinking behavior is aspect is 240 and HOTS test result is 221, then the effectiveness of HOTS learning model in VHS within students' thinking behavior aspect is 240: 300 = 0.80 (80%) and within HOTS students test aspects is 221: 300 = 0.73 (73%) from the expected criterion. So when it was compared between control classes and treatment class on HOTS test results the effectiveness of treatment class is 80% > 75% control class. Whereas in the aspect of students' thinking behavior, treatment class effectiveness is 73% > 67% for the effectiveness of the control class. When it noticed closely, the difference of effectiveness between treatment and control class is not too different. This is due to several factors including the limited duration of the trial, which is six meetings. The better trial result requires a longer duration of time, because changing the mindset is also requiring more time, beside more interactions intensity of teacher and students is also influential. Table 4 is the results of ANOVA test within the post test of students' thinking behavior in all classes of trials.

Table 4. ANOVA test results from the scores of students' thinking behavior treat all test classes with the SPSS program

Descriptive								
Students' achievement (The post test result of students' thinking behavioral all treatment class)								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
VHS 3 Muh. Jogja	19	119,110	9,865	2,263	114,350	123,860	103,00	134,00
VHS 2 Jogja	19	111,260	12,922	2,965	105,030	117,490	87,00	138,00
VHS 2 Sleman	19	121,050	14,508	3,328	114,060	128,050	98,00	153,00
Total	57	117,140	13,070	1,731	113,670	120,610	87,00	153,00

Test of Homogeneity of Variances				ANOVA					
Students' thinking behavior				Students' thinking behavior					
Levene Statistic	df1	df2	Sig.		Sum of Squares	df	Mean Square	F	Sig.
0,765	2	54	0,47	Between Groups	1020,46	2	510,228	3,224	0,048
				Within Groups	8546,42	54	158,267		
				Total	9566,88	56			

The results variance homogeneity testing with Levene statistics showed a value of 0.765 with sig. 0.470 > 0.01. It means that there is a change in students' abilities after the trial of the HOTS learning model has the same or homogeneous variant. From the ANOVA test results using the test F = 3.224 with sig. = 0.048. The test criterion if the sig value > α means that there is no difference between variables. If the value is sig. < α means that there are differences between variables [21]. Statistical test results showed that sig. = 0.048 > α = 0.01. So that it can be concluded that there are no significant differences in aspects of students' thinking behavior from the results of the HOTS learning model treatment at VHS in the three schools where the model trials were conducted. This evidence emerges because to change the students' mindset require more time and practices. While the trial model is limited by the time. However, when viewed from the mean score of the students' thinking behavior between pretest and posttest there was a slight increase in score. It showed that the HOTS learning model influence students' thinking behavioral and achievement. The further ANOVA test result is show at Table 5.

Table 5. Advanced ANOVA test results with Scheefe on score of students' thinking behavior

Post Hoc Tests						
Multiple Comparisons						
Dependent Variable: The post test result of students' thinking behavioral all treatment class						
Scheffe						
(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
(1) VHS 3 Muh.Jogja	2	7,842	4,082	0,168	-2,43	18,12
	3	-1,947	4,082	0,893	-12,22	8,33
(2) VHS 2 Jogja	1	-7,842	4,082	0,168	-18,12	2,43
	3	-9,789	4,082	0,065	-20,06	0,48
(3) VHS 2 Depok	1	1,947	4,082	0,893	-8,33	12,22
	2	9,789	4,082	0,065	-0,48	20,06
*The mean difference is significant at the 0.05 level.						

The results of the ANOVA follow-up statistics using the Schefee test (*) showed that there were no groups of groups that differed significantly between the test classes among VHS Muhammadiyah 3 Jogja, VHS 2 Yogyakarta and VHS 2 Depok of trial class. This means that in the entire trial class of three schools, there is no significant difference in HOTS students' thinking behavior, however there is still a slight difference in changes that are better when viewed from the mean pre test scores and posttests of HOTS students' thinking behavior.

The results of t-test showed that the treatment with HOTS learning model proved to have a significant influence on students' HOTS thinking ability. The following is a diagrams the condition of changes that occurred in the treatment class and control class before and after on phase I and phase II trials on three VHS.
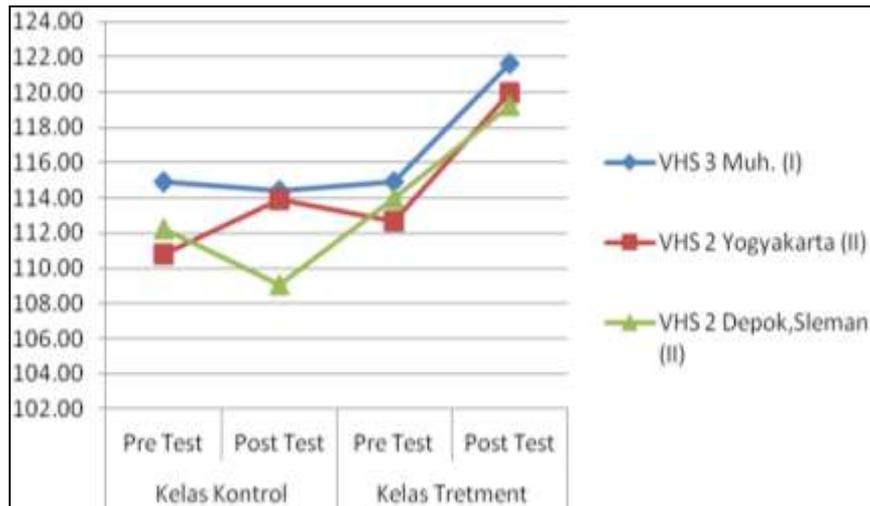

Figure 2. Diagram of students' thinking behavior (class average) trial stage I and II HOTS learning model in Vocational High School
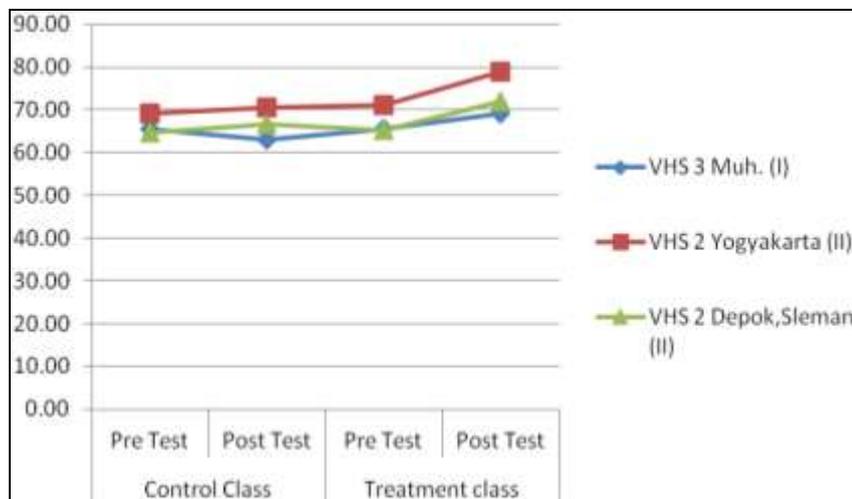

Figure 3. Results diagram of student HOTS questions test (class average) Trial phase I and II of the HOTS learning model in Vocational High School

The lines diagram drawing of HOTS test results and students' thinking behavior in all trials of HOTS learning models of VHS students, it shows that the difference between treatment class and control class. The results of the pretest and posttest showed that the control class was relatively the same. Its mean that no significant differences whereas in the treatment class showed a

tendency to change better (there were significant differences) before and after treatment in the three VHS.

The results of first phase trial is shown in table A about summary of the results first phase trials in VHS Muhammadiyah 3 Yogyakarta. It shows a change of students' achievement of HOTS questions and scores of students' thinking behavior, although there are light differences. The average class of HOTS test results on the treatment class between pretest and posttest, it shows that the posttest less pretest = 69.06 less than 65.80 = 3.26 points. While the difference in the average score of students' thinking behavior pretest and posttest, it shows that the treatment class 121.63 less than 115.42 = 6.21 points. The results by statistical analysis with SPSS program (see a significant difference) showed that the difference in treatment class before and after the treatment class of HOTS learning model was significantly different. However, with the existing results, it is necessary to revise HOTS learning model aimed the expanded trial results will be better.

In order to obtain the better result on HOTS learning model trial, revising model is needed. The revise syntax model includes: (1) The introductory section, the motivation is to emphasize the benefits of critical and creative thinking in strengthening; (2) Apperception, more often delivering material directly related to the real practice; (3) Questions and answers by giving questions with open answers so that students practice thinking creatively. Finding appropriate answers as much as possible; (4) Core activity: Teacher stimulates critical and creative thinking, teacher gives open questions for students to answer, group discussions and class discussions; (5) Resolving learning and real practice problems; (6) Responding, asking, evaluating, criticizing and trying to make other perspectives from the same problem; (7) Conclusion: Teacher directs student when they answer are not appropriate yet while students taught to find meaning from the lessons. Syntax diagram is a flow of learning activities which can be used effectively to assist teachers in improving students' high level thinking skills. HOTS learning activities train students to think creatively and critically. On the other hand, teacher can help and improve students' high level thinking skills by using appropriate methods, techniques and strategies [22].

The expanded trial (phase II) carried out on two VHS schools within the same criteria on implementing the revised curriculum 2013. They are VHS N 2 Yogyakarta and VHS 2 Depok, Sleman. The results of data analysis showed the achievement HOTS test and students' behavioral thinking scores show in table B. From the table B it showed that there was a changing on students' achievement of HOTS test and students' thinking behavior scores, although the difference is slightly. The average class of HOTS test results at VHS N 2 Yogyakarta within class treatment between posttest less pretest (78.87 - 71.03 = 7.84 points) and the difference score average of students' thinking behavior pretest and posttest within treatment class (119.93 less 112.70 = 7.23 points).

The difference point of second trial (VHS 2 Jogja and VHS 2 Depok) is greater than the point in the first trial (VHS Muhammadiyah 3 Yogyakarta). While on the average class of VHS 2 Depok, Sleman from the HOTS test results on the treatment class between pretest and posttest posttest less pretest (71.94 less 65.28 = 6.66 points) and the difference in average score students' thinking behavior pretest and posttest on treatment class (120.25 less 113.34 = 6.91 points). The difference points were obtained by students of VHS 2 Depok is greater than the results of the first trial VHS Muhammadiyah 3 Yogyakarta but slightly smaller than the VHS 2 Yogyakarta. Whereas according to the results of the statistical t-test (knowing the significant differences) with the SPSS program, the results showed that the difference in treatment classes before and after the treatment of HOTS learning models in both sample units of VHS 2 Yogyakarta and VHS 2 Depok, Sleman showed significant differences.

ANOVA statistical test result by SPSS program on three sample units on first trials and second trials for posttest HOTS as shown in table D and table E, the result was obtained three samples units showed significant differences. Whereas in the advanced test (Post Hoc Tests) with Scheffe shown the sample unit has a clearer difference is VHS Muhammadiyah 3 Yogyakarta

and VHS 2 Yogyakarta. The ANOVA statistical test on post test scores of students' behavioral thinking aspects on three samples unit resulting from first trials and second trials as shown in table A and table B, the results showed three samples units showed no significant difference in behavioral aspects from three samples unit. While the Post Hoc Test with Scheffe showed there is no sample unit has a clearer difference.

The difference between the first trial process and second trial as a whole both in the HOTS test results pretest and posttest is shown in Figure 1 and the results of students' thinking behavior questionnaire scores as shown in Figure 2 shows a change in score improvement. The changing of control group class was not significant or the difference was very slight, whereas in the treatment group class showed a significant difference. Statistical test on HOTS pretest and post test scores and students' behavioral thinking questionnaires in the first trials and second trials model trials using SPSS program for data analysis. In addition, a statistical test was carried out on score of the results vocational school students' thinking behavior questionnaire with factor analysis to determine the closeness of the relationship or correlation [23].

The research process examines the effectiveness of HOTS learning model on VHS in addition to producing main data of study such as student achievement shown from the HOTS test results and scores of students' thinking behavior before and after quasi experimental activities also get other observational data related to learning activities within sample unit where model was tested. The finding can be used as information and consideration to develop and improve learning model. The other findings include: (1) There is a difference between private schools and public schools within aspect of: student learning motivation, students' capacity, lack of learning duration; (2) HOTS learning model will be effective when it applied on team teaching; (3) HOTS learning model required more intensive monitoring teacher so that the learning process will run as well; (4) Students need to be accompanied and motivated continuously during learning process. Ideally 1 teacher holds 6 to 8 students; (5) HOTS learning model required more time, preferably around 6 to 8 hours of learning activities so that the learning syntax can be implemented effectively; (6) Teachers required sufficient experience on teaching and mastering the subject matter as well.

The difference student conditions were one of the obstacle in HOTS learning. It found by Sulaiman and his colleagues in 2017 case study research on the implementation of learning with HOTS. The result study showed that there are three main obstacles in the implementation of HOTS, namely differences in student level, class size, number of students, and teacher's understanding of HOTS and its application [19]. The trial activities within HOTS learning model is one of the strategies used by discussion (brainstorming) to stimulate students to express their creative ideas. The literature study also stated that to develop HOTS skills of VHS students by brainstorming activities [24]. Other studies on development high level thinking ability instruments state that application of HOTS learning can form generations to reach their full potential, quickly accept of changing, able to communicate in team work, make self-reflection, able to innovate and create new things [25].

Learning HOTS activities conducted and oriented towards improving high level thinking skills that are integrated to other skills as well. These skills are needed in the 21st century [26]. The learning model is carried out covers entire series of teaching and learning processes including HOTS based assessments. The assessment of HOTS learning can improve students' critical and thinking skills effectively [27]. It cannot be denied that a person's competence will also be influenced by his ability to think. Thinking skills are very important for success in every aspect of individual life. Therefore, it important to teach students with high level thinking strategies to optimize their potential [28].

4. Conclusion

The learning model Higher Order Thinking Skills on VHS students by trial the model showed that the learning model proved effectively enough to improve student achievement in cognitive

aspect and students' thinking behavior. The learning model is quite easy to implement and harmonize by school situation and condition such as facilities and infrastructure and varied abilities of students. The application of HOTS learning in VHS is proven to have an effective effect on students' thinking skills in terms of creative thinking, critical thinking, and problem solving. The learning model result can be developed to produce new models on the other type of education effectively.

Acknowledgments

References

[1] Murti, K., Sudjimat, D. A., & Nyoto, A. (2016). The Transformation of 21st Century Education as a Demand for Human Resource Development in the Global Era. National Mathematic Education Seminar, pp. 263-278.

[2] Sumarna, A. (2015). Solution The Incompatibility of Vocational School Graduates with Industry. Bandung: Alfa Beta.

[3] Ananiadou, K., & Claro, M. (2009). 21st Century Skills and Competences for New Millennium Learners in OECD Countries. OECD Education Working Papers, No. 14: OECD Publishing, pp. 1-34.

[4] Gardiner, M., Rahayu, I., Abdullah, A., & Effendi, S. (2017). Disruptive Era: Educational Opportunities and Challenges in Indonesia. Jakarta: Akademi Ilmu Pengetahuan Indonesia.

[5] Abosalem, Y. (2016). Assesment Techniques and Student Higher Order Thinking Skills. International Journal of Secondary Education, 4(2), 1-11.

[6] Subroto, R. (2018). Perspektif guru sekolah dasar terhadap Higher Order Tinking Skills: Pemahaman, penerapan dan hambatan. Premiere Educandum: Journal of Education and Learning, 8, 78-87.

[7] Weil, M., Calhoun, E., & Joyce, B. (2009). Models of Teaching. New Jersey: Pearson Education.

[8] Thomas, R. G., & Litowitz, L. (1986). Vocational Education and Higher Order Thinking Skills: An Agenda for Inquiry. Minnesota University: St. Paul Minnesota Research & Development Center of Vocational Education.

[9] Brookhart, S. M. (2010). How to Assess Higher Order Thinking Skills in Your Class. Virginia: ASCDI.

[10] Vijayaratnam, P. (2012). Developing Higher Order Thinking Skills and Team Commitment on Group of Problem Solving: A Bridge to the Real World. Procedia - Social and Behavioral Sciences, 66, 53–63.

[11] Yee, M. H., Mohd. Yunos, J., Othman, W., Hassan, R., Tee, T. K., & Mohamad, M. M. (2015). The Effectiveness of Higher Order Thinking Skill for Generating Idea Among Technical Student. Recent Advances in Educational Technology, pp. 113-118.

[12] Paul, R. & Elder, L. (2019). The Miniature Guide to Critical Thinking: The Concepts and Tools. Maryland: Rowman & Littlefield.

[13] Hamalik, O. (2005). Learning and Curriculum. Jakarta: Bumi Aksara.

[14] Piirto, J. (2011). Creativity for 21st Century Skills: How to Embed Creativity into Curriculum. Rotterdam: Sense Publication.

[15] Soeprapto, E., Fahrizal, P., & Basri, K. (2017). The Application of Problem Based Learning Strategy to Increase High Order Thinking Skills of Senior VHS Students. International Education Studies, 10(6), 123-129.

[16] Casagrand, J., & Semsar, K. (2017). Redesigning Course to Help Students Achieve HOTS: From Goals and Mechanics to Student Outcomes. Advances in Physiology Education, 41(2), 194-202.

[17] Pretorius, L., van Mourik, G. P., & Barratt, C. (2017). Student choice and higher-order thinking: Using a novel flexible assessment regime combined with critical thinking activities to encourage the development of higher order thinking. International Journal of Teaching and Learning in Higher Education, 29(2), 389-401.

[18] Raaiyn, J. (2016). The Role of Visual Learning in Improving Students' HOTS. Journal of Practice and Education, 7(24), 115–121.

[19] Sulaiman, T., Muniyan, V., Madhvan, D., Hasan, R., Syrene, S., & Rahim, A. (2017). Implementation of higher order thinking skills in teaching of science: A case study in Malaysia. International Research Journal of Education and Sciences, 1(1), 2550-2158.

[20] Borg, W. R., & Gall, M. D. (1983). Educational Research: An Introduction. Michigan: Longmans, Green and Co. Ltd.

[21] Sundayana, R. (2015). Educational Research Statistics. Bandung: Alfa Beta.

[22] Khalil, O. E. M. (2015). Students' Experiences with The Business Internship Program at Kuwait Univ. International Journal of Management Education, 13(3), 292–217.

[23] Bahrudin, A., & Tobing, L. (2003). Data Analysis for Survey Research. Bandung: FMIPA, Pajajaran University.

[24] Chinedu, C. C., Olabiyi, O. S., & Kamin, Y. (2015). Strategies for improving higher order thinking skills in teaching and learning of design and technology education. Journal of Technical Education and Training, 7(2), 35-43.

[25] Kamaruddin, (2014). Coaching of High-Level Thinking Proficiency Instruments. Malaysia: Institut Pendidikan Guru.

[26] Sudiyanto, S., Leni, W., & Soetarno, J. (2018). HOTS as Effect of Problem Based Learning in the 21st Century Learning. International Journal of Multicultural and Multireligious Understanding, 5, .

[27] Widana, W., Parwata, M. W., Parmithi, N., Jayantika, G. A. T., Sukendra, K., & Sumandya, W. (2018) Assessment of HOTS towards Critical Thinking on Mathematics Lesson. International Journal of Social Sciences and Humanities, 2(1), 2018, 24-32.

[28] Hugerat, M., & Kortam, N. (2014). Improving higher order thinking skills among freshmen by teaching science through inquiry. Eurasia Journal of Mathematics, Science and Technology Education, 10(5), 447-454.

[29] Rofiah, E., Aminah, N. S., & Ekawati, E. Y. (2013). Penyusunan Instrumen tes kemampuan berpikir tingkat tinggi fisika pada siswa SMP. Jurnal Pendidikan Fisika, 1(2), 17-22.