The Implementation of Stim HOTs Model to Improve Student’s Problem solving Skill of Metabolism Learning in Senior High School

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Abstract. The improvement of problem solving skills trained on worksheet learning activity through Stimulating Higher Order Thinking skills (Sim-HOTs) model. The goal of the research is improvement problem solving skill in Senior High School Surakarta in metabolism lesson. Subject of this research were students of twelve (12) grade MIPA SMAN 3 Surakarta. Data was collected by using open-ended test based on Mourtus, and divided into six indicators namely defining the problem, exploring the problem, planning solution, using solution, checking solution and evaluation. Technique analysis data was independent T-test. The result of this research show the aspects of improvement student’s problem solving skills that are defining the problem, checking solution and evaluation.

1. Introduction
The 21st century is marked as a century of transformation in various fields, especially education that requires a variety of skills, one of which is problem-solving skills [1]. The problem-solving skills are part of a high-level skill that of the 21st century demand. [2] A person with problem-solving skill can then be considered in the category of expert thinking. [3]. Problem solving skills define as an ability to solve the problem from a new condition from unknown condition [4]. Futhermore Carson [5] explain that problem solving is daily activity by someone to used cognitive skills to analys, evaluate and learn also applying hard skill and new experience to solve the problem. And te last expert education Mourtus [6] problem solving defined as a procces, used to obtain a best answer to unknown or make decision subject to some constraints. Form 3 expert education we can conclude that problem solving is a procces daily activity by someone form unknown kondisition to know condition using cognitive skill and hard skill to make a new product. There are six (6) indicator form [6] there are : (1) define the problem, (2) explore the problem, (3) plan the solution, (4) using solution, (5) check solution and (6) evaluation.

Based result observation on SMA Negeri 3 Surakarta about profil problem solving skills in learning Biology showed on XII MIPA not yet optimized and have percentage 47.74% it has moderate category [7]. According to Ulya [8] showed that problem solving skills in Kudus has not able to arrange the strategy to solvethe problem. In line to Widiasih et al [9] and [10] the result showed that problem solving skill in student in service Training of Primary Scholls Teacher Education and students of department in Comsats Lahore Campus showed that the student can’t clearly solve the problem, and t has is low category. The next result observation about teaching and learning in Biology in class showed that applying talkative, discussion, jigsaw and windows shopping models. On the procces learning and teaching the teacher using worksheet instrument on term student activity sheet. In learning Biologi its can be separated into knowledge and practice so we need combine between cognitive skill and hard skill to get a complex major. To improve problem solving skill we must have a new inovatin, such as innovation on models to acommodate problem solving skill.

Innovation on education can be shows on innovation of models and method used teacher. Innovation of models on education is important because the world always changing and the student need it to help student to adapted changing the world[11]. Applied models of teaching must be same with the curriculum on this scholl and uptodate. In this 21st century needed models to accommodate higher order thinking skill to bridge the low order thinking to stimulate high order thinking skills. Stimulating Higher Order Thinking Skill (Stim –HOTs) is one of models to accommodate student to used cognitive and skill to analysis, find a question also find out solution to solve a problem [12]. Stim –HOTs modele are develop base on
The fundamental philosophical framework of Stim HOTs models are (1) learning theory by John Dewey [14] that learning process students required to be active use skill and knowledge to build a concept so the student get a complex knowledge and mastery learning.: (2) theory of cognitive development by Jean Piaget explain that a child or someone who builds a concept on learning adapted to level, age and psychological [15], and the last learning theory by Vygotsky, are explain that a child construct their knowledge and the development can’t be separated from this socio context or this learning theory famous as theory zona proximal development [16]. Syntax of Stim-HOTS models consist of six step they are (1) orientation of knowledge, (2) questioning, (3) exploration, (4) discussion, (5) explanation, (6) reflection [13]. Stim–HOTS models is models can be called as a learning models constructivism causes the pattern of models is student center so the student can be active as long as learning and doing activity in classroom and this student can be uses full of cognitive skill to analyse the problem until solve it [13] [17]. In this research Stim –HOTS models applied on learning biology to improve problem solving skills. The aims of the research is implementation Stim-HOTS models in learning Biology to improve problem solving skills in senior highs School in class XII MIPA in SMA Negeri 3 Surakarta.

2. Research Methodology

This research is a qualitative research. In this study, the research design is non equivalent control-group design and the experimental and control group. The both group were given same pre-test and post-test. But only the experimental group is given different treatment, this class will be given different treatment with Stim HOTs Model. The purpose of this research was to implementation Stim-HOTS models to improve problem solving skill in 12th grade MIPA students in SMA Negeri 3 Surakarta in metabolism learning. The design of this research are

| Group   | Pretest | Treatment | Posttest |
|---------|---------|-----------|----------|
| Control | O₁      | X₁        | O₃       |
| Experiment | O₂      | X₂        | O₄       |

Note:
X₁ : Treatment control group
X₂ : Treatment using Stim HOTS models
O₁ : pretest on control group
O₂ : Pretest on experimental group
O₃ : Postest on control grup
O₄ : postests on experimental group [18]
The categories of formula find the score divided into 3 category. The describe about divided score can be showed at table 2.

| Value $<g>$ | Criteria |
|------------|----------|
| $<g> \geq 0.7$ | High |
| $0.7 <g> \geq 0.3$ | Moderate |
| $<g>< 0.3$ | Low |

The novelty of the research is calculate effect size. Effect size used to know impact used models on this research. Effect size can be calculate using Microsoft excel R-stat, an the calculate the score comes form analysis statistika independent T-Test. The calculate of effect size divide into 3 categories, that are following on this table 3

| Scores | Criteria |
|--------|----------|
| $0.2 > 0.4$ | Small |
| $0.5 > 0.7$ | Medium |
| $0.8 < 1.00$ | Large |

3. Result and discussion
Stim –HOTs models are ready to prepare student to changing the world and ready for challenges in the 21st century. Stim-HOTs models are instructional models from cognitive approach and contruktivism. Characteristics this models is teaching and learning is student center. Based on researcher the descriptive achievement and increasing problem solving skills between using Stim HOTs Model and Direct Instruction on metabolism learning. On this section researcher breakdown score form pre test and postes into 6 (six) indicator of problem solving skill and calculated increasing problem solving skills on every aspect in control class experiment class. And the result breakdown of score form preetes and postes can be view on table 4.

| Indikator | Eksperiment | Control |
|-----------|-------------|---------|
|          | Pre-test | Post-test | Gain | N-Gain | Category | Pre-tets | Post-tets | Gain | N-Gain | Category |
| Define problem | 58.4 | 75.1 | 16.7 | 0.4 | Low | 45.5 | 66.0 | 20.5 | 0.3 | Low |
| Explore the problem | 30.7 | 83.2 | 52.5 | 0.8 | High | 43.2 | 75.6 | 32.4 | 0.5 | moderate |
| Plan solution | 37.1 | 74.4 | 37.3 | 0.6 | Moderate | 42.0 | 67.1 | 25.1 | 0.4 | Moderate |
| Using solution | 10.9 | 61.0 | 50.1 | 0.6 | Moderate | 38.3 | 70.0 | 31.72 | 0.5 | moderate |
| Checking solution | 57.6 | 85.7 | 28.1 | 0.7 | High | 52.0 | 73.3 | 21.3 | 0.4 | moderate |
| Evaluation | 31.8 | 85.0 | 53.2 | 0.8 | High | 34.8 | 79.9 | 45.1 | 0.6 | moderate |
| Average | 37.75 | 77.4 | 53.8 | 0.8 | High | 42.6 | 71.9 | 45.1 | 0.6 | Moderate |
Based on the table 4, summarize the achievement scores pretest and posttest on experimental and control group. On the experimental group this class given Stim HOTs models and control group using teaching and learning usually use on this school. From this result average score on pretest class experiment is lower than control group ( 37.75 < 42.63), but on the achievement score posttest on experimental group is more higher than control group 77.4 >71.9. Its mean that on student on this class experimental success to used the models and the models given effectiveness to improve problem solving skills. Improve the problem solving skills can be showed from N-Gain score. N-Gain scores on class experimental can be improve 3 aspect problem solving skill, there are explore the problem, checking the solution and evaluation. Furthermore N-Gain on control group design it was 5 aspect has a moderate category and 1 category was low. On the average N-Gain score the experimental group design has a high category, while on the control group has a moderate category. Overall we can conclude that problem solving skills student on class XII MIPA in SMA Negeri 3 Surakarta can be improve using Stim HOTs Model. The present achievement score pretest and posttest on metabolism learning in SMA Negeri 3 Surakarta to improve problem solving skill using Stim HOTs model can be seen in figure 1:

![Achievement score pretest and posttest on SMA Negeri 3 Surakarta in metabolism learning](image)

Figure 1. the graph of achievement pre-test and post-test on metabolism learning in experimental and control group to improve problem solving skills in SMA Negeri 3 Surakarta.

Based on result table 4, shown, that improve problem solving skill on metabolism learning is rise on every aspect, but the increase problem solving from moderate category to high category can be showed in 3 aspect, there are explore the problem, checking solution and evaluation has a high categories. It can be shown on the figure 2 about 3 aspect from problem solving has a high categories and 3 aspect has a moderate categories. The describe increase of problem solving skill on metabolism learning can be shown on figure 2.
Figure 2. Graph of N-Gain problem solving skill student’s in term of metabolism learning in show there 3 aspect problem solving has high categories there is explore the problem, checking solution and evaluation.

### Table 5. Result of Independent T-Test

| Test Levine | Mean | T-test | Level of confidence 95% |
|-------------|------|--------|-------------------------|
|             |      |        |                         |
| f           | 0.7  | 0.39   |                          |
| sig         | 0.39 | 0.39   |                          |
| t           | 2.05 | 0.44   | 63                      |
| df          | 63   | 0.66   | 0.32                    |
| Sig 2-tail  | 0.44 | 0.32   | 0.017                   |
| Mean        | 0.66 | 1.3    | 1.3                     |
| Std. Error  | 0.32 |        |                         |
| Lower       | 0.017|        |                         |
| Upper       | 1.3  |        |                         |

Based on table 5, result of analysis statistic using Independent T-Tes from gain score on experimental and control group, according to calculate t value and meaningfulness level t is 2.05 <0.05 that its to say that used Stim –HOTs models is effective to learning biology on metabolism learning. Based Form the T test he value sig 2 tailed 0.44 < 0.05 its to say that the data is homogen. And from tes levinde value of sig 0.39 < 0.005, it to say that the data has a same varians. Based on the Independent t-Test, we can conclude that Stim HOTs model are efectifies in learning biology especially of metabolism learning.

### Table 6. Result of Effect Size and r² from Independent T-test

| Experiment clas | Analysis statistica |
|----------------|---------------------|
| N-gain         |                     |

Based on table 6, the value of Effect size is 0.509 it was medium category from r² value is 0.4 or 63%. Its mean that when the Stim –HOTs models applied in teaching and learning on metabolism learning has a influence the student is 63 %. Base on result on table 5 about Effect Size and r² we can knows that the value of Effect Size is 0.509 was moderate category. The result in line with research from John Hattie (2007), have a statement that on diagram S.Waack (2018), problem solving skills have a same value Effect Size are 0.6 on moderate category [22] of and value of r² are 0.4 or 63%, its mean when apply in learning metabolims learning have effect 63% and 37% influenced form external factor the external factor, such as classroom enviroment, family characteristic, psychological characteristic, and intellectual characteristic [23].

Base on result above, we can determine that there is link between cognitive skill used student to analyse the problem until find out design and procedural and hard skill to make new product, its called as the student weel done to solve the student. The result show that Stim-HOTS models improve the problem solving skills on 3 aspect form [24] that are exploring information, checking solution and evaluation, and 3 another aspect was moderate category that are define the problem, plan solution and using solution. on this aspect the student must be have a ful power to analys the problem coreectly, if
she/he doing false to analyze, they won’t not find the right answer or solution and they can be said fail to solve the problem or ill structure problem, causes they are can’t clear solve the problem [25]. Cognitive skill and hard skill used student to find the solution and solve the problem, problem can be explain as gap between hope and reality, so for make it true the people must be have best cognitive and hard skill to make it real [26].

In fact, problem solving skills are needed in the process of science learning remembering that science learning is not limited to concepts and facts, but also the process of learning science has procedures and metacognitive. In line [12] explain that to science learning is a reflection of thinking skills that use logical principles accompanied by empirical evidence combined with scientific methods to acquire new knowledge of nature about social life. This is similar to [27] which states that science learning is a learning process that emphasizes the experience of students combined with students' thinking skills to solve problems. According [28][29][30] that problem solving skills are simple formula to formalize a new answer to solve the problem. So if the student can’t be more cognitive skills so him/his will be difficulty to solve the problem.

Based on the opinion and the result, we can conclude that Stim -HOTs models can be improve the problem solving skill student on metabolism learning on the aspect explore the problem, checking solution and evaluation. Meanwhile on 3 aspects problem solving that are define the problem, plan the solution and use the solution has a moderate category. Concept student center on model Stim –HOTs can be student active on learning, and feel fun, so the student can be get the complex matter. According to [31] that problem solving is a daily activity to find out solution and used to survive for a long time, the benefit of problem solving skill in life is we can be innovative person, become ready to compete, ready to changing the world, ready changing the behavior, enhancing ability on problem solving and improving skills in term of thinking to analyze the problem until find the solution. If the people has a good problem solving she/he can be called as a problem solver and ready for all challenges.

Conclusion

Based on analysis and discussion of the result of researcher that has been describe obtained the following conclusion. Stim-HOTs models while apply on metabolism learning can be improve the problem solving student in class XII MIPA in SMA Negeri 3 Surakarta. Score N-Gain showed that Stim-HOTs models can be improve problem solving student’s in aspect exploring the problem, checking solution and evaluation. And the effect size on implementation models Stim –HOTs is 0.5 its has medium category and value of $r^2$ is 4%. Its mean that Stim –HOTS models has influence of teaching and learning in metabolism leaning as 4%.

Acknowledgment

The researcher would like to said thank you to LPPMP Sebelas Maret University who has provide funding support for PNBP. The number contract research is 543/UN27.21/PP/2018.

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