# Problem Based Module Development as Preparation for Selection of Science Olympicers in Biology Field

**Rina April Latipah✉, Retno Sri Iswari, Siti Harnina Bintari**

Pascasarjana, Universitas Negeri Semarang, Indonesia

| Article Info | Abstract |
|---|---|
| | The National Science Olympic (OSN) is a prestigious event in the world of education organized by the Ministry of Education and Culture ( Kemendikbud ). OSN is implemented with the aim of facilitating and motivating students who have talent in the field of science, so that they can improve their abilities and select students to the international level. The good achievements of Indonesian sons and daughters in academia provide promising Human Resources (HR) solutions. However few students are aware of and interested to participate and compete with other academic institutions at national level even during international. The module is a supporting medium for the preparation of the selection of candidates for the regency level high school science Olympic participants. The development of a question-based module for high school biology Olympic is expected to improve school human resources to involve students in various national and international competitions. The results showed that "Problem Based Module Development as a Preparation for Selection of Science Olympic Participants in Biology for High School Level" found three findings. First, a module based on biology Olympic questions is valid for use in the learning process based on validation by material experts and media experts with a percentage of 86% with very valid criteria. Second, the module based on biology Olympic questions is effectively used to improve student learning outcomes seen from the N-gain value of 0.70 high criteria. Third, the module based on the SMA biology Olympic questions is practically used by teachers and students, based on the results of the teacher's response assessment of 93%, the criteria are very feasible to facilitate the task of the teacher in preparing lesson plans, facilitate the implementation of learning, and make it easier to evaluate student learning outcomes. The student response is 85.2%. The criteria are very suitable for students to use both in terms of good presentation, easy to understand, and can increase learning motivation and interest in participating in the Olympics. |

✉ correspondence:
Jalan Kelud Utara III No.37, Kota Semarang, Jawa Tengah,
Indonesia 50237
E-mail: hasna.adibah22@gmail.com

**INTRODUCTION**

The National Science Olympic (OSN) is a prestigious event in the world of education organized by the Ministry of Education and Culture (Kemendikbud). OSN is implemented with the aim of facilitating and motivating students who have talent in the field of science, so that they can improve their abilities and select students to the international level ( Kemendikbud , 2017).

Based on the results of observations from three schools that included their students in the Olympics, the initial selection was carried out by the school by looking at students' achievements in the Olympics subject. Apart from relying on rankings, the selection is carried out with intensive coaching to test students' abilities through the question drill method . Karnadi (2017) revealed that to choose students to be delegated to take part in the Biology Olympic (OSN), it is not enough to see the student's learning value, another important aspect is the level of intelligence and motivation of students to take part in the Olympics. These two aspects are considered important aspects in selecting candidate OSN participants. So it is necessary to develop a learning model and learning resources that are credible so that it can motivate and increase students' higher order thinking skills.

Achievement good sons and daughters of Indonesia in the world of academia give sumbangsi h Human Resources (HR) is promising . however few students are aware of and interested to participate and compete with other academic institutions at national level even in the midst of internasionl (PISA, 2016). Based on survey results from four high schools in the region of Cirebon , students have little motivation to participate in the national level competition .other causes is because students have not been trained to deal with problems of *high order thinking* as well as on matters Olympics . There are similar findings in the research of Septiyani and Susanti (2015), where students who participated in the high school biology olympic in Pesisir Selatan Regency in 2015 had low mastery of OSN material. Wikoyo et al. (2014) stated that the failure of students in the learning process and learning outcomes to low motivation places teachers as the cause of failure in the eyes of some students. Therefore we need a solution to respond to these various problems. To increase student motivation and achievement, special training must be carried out in preparation for the Olympic selection (Marlina, 2017).

Empowerment of learning resources and studying various learning sources is one way to improve learning outcomes and student interest in learning (Mulyasa, 2008). Interest or motivation to learn has a direct effect on learning achievement (Inayah *et al.* 2012). To develop interest, improve learning outcomes and critical thinking skills, it is necessary to design a complete learning activity, to be carried out both in the classroom and in the laboratory, or to provide experience directly to students (Alimah. 2014). This is very important so that what is learned is in accordance with the conditions and developments and needs of students, so that there are no gaps in students' thinking patterns. The use of media in learning is very important, because the material presented will be clearer and easier to understand, and motivates students to be more enthusiastic about learning (Pradilasari et al. 2019). Nurrita (2018) revealed that the learning media is a tool that can help facilitate the delivery of content and achievement of learning goals Media study has many types . One of the alternative materials that can be used for coaching the Olympics is a module . Modules have design flexibility and are deliberately designed for independent learning, so that they can be tailored according to student needs.

Modules generally have a design in which theory development is prioritized as a step to deepening the concept and ends with several questions to cover the evaluation stage. The design was less effective for Olympic guidance students. students will have a little experience and training in answering high-level questions when the module focuses on concepts. A good module for olympic guidance students is a module with an inverted design, namely from questions to produce theories. The development of problem-based multimedia is very effective in increasing students' motivation and critical thinking skills

(Sari & Sugiyarto, 2015; Susilo, 2012; Muspita *et al* , 2013).

The question-based module shows the problem-solving process using the scientific process, which uses the stages of analysis, observation, reflection, argumentation, to finding problem solutions that are strengthened by theoretical studies so as to form broad and deep learning, as a step of understanding and deepening concepts. Nugraha et al (2017) revealed that the scientific process has a strong relationship with critical thinking. The question-based module directs students to think critically, analysts and deeply, so that it can train students to face various levels of high-order thinking questions (Fauzi ah. 2010; Fanani. 2018: Sumar y a nta .2018) . The development of a module based on Hight Order Thinking Skill (HOTS) can improve student learning outcomes (Anisah & Lastuti, 2018; Ilhamuddin. 2019).

Based on the many problems in the high school level OSN participant selection preparation process , more economical teaching materials are needed and provide opportunities to increase students' interest and skills in answering questions . The module is a supporting medium for the preparation of the selection of candidates for the regency level high school science olympic participants. The development of a question-based module for high school biology olympic is expected to improve school human resources to involve students in various national and international competitions.

Based on the description above, there are several issues that will be discussed in this journal. The problems are as follows:
1. What is the level of validity of the question-based module in preparation for the Olympic participant selection?
2. What is the level of effectiveness of the question-based modules in preparation for the selection of Olympic participants?
3. What is the practical level of question-based modules for prospectiveOlympic participants?

## METHODS

The research was conducted using a *mixed methods* method with the research design used in the form of Reaserch and Development *(R & D).* Mixed methods is a procedure for collecting, analyzing and mixing qualitative and quantitative methods in a study (Creswell, 2015). The research design used is Reaserch and Development *(R & D)* or better known as Research and Development. *R & D* is a method with research stages so as to produce new products, and then testing the effectiveness of the developed product (Sugiyono, 2017). The Reaserch and Development *(R & D)* model used is the 4D model ( Define, Design, Develop, Dissemination*)* proposed by Thiagarajan, Semmel, and Semmel (1974) developed by Trianto (2007).

The research procedure adopted was adopted from the 4D method (Thiagarajan, Semmel, and Semmel, 1974 ) referring to the R & D concept of Trianto (2007).
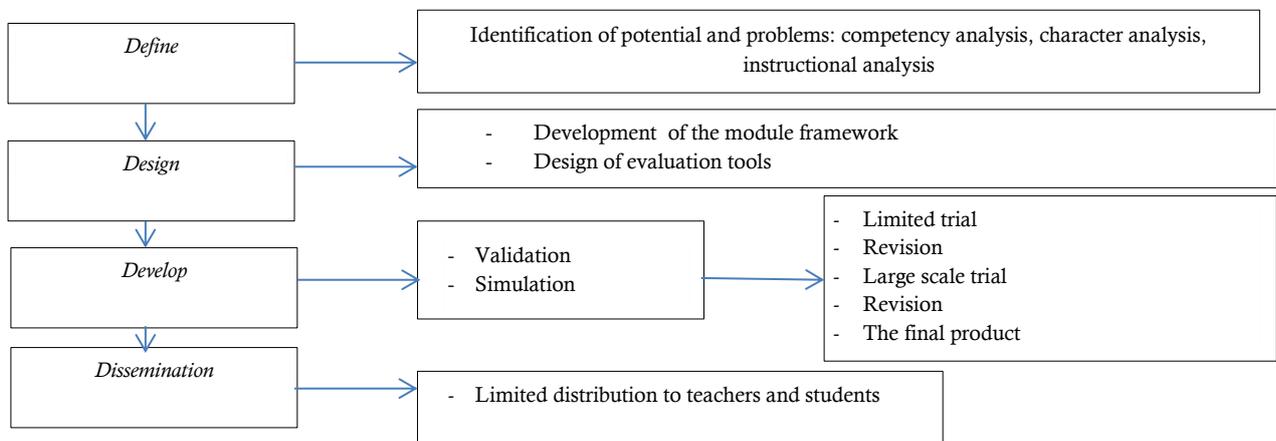


**Figure 2. 1 .** 4D method research flowchart outline

Define aims to determine and define the terms of learning carried out by the analysis process (Trianto, 2007). Define through three steps, namely: (1) Competency analysis, obtaining the standard of ability that must be achieved by prospective OSN participants. (2) Analysis of student character is obtained from information on student motivation and interest in participating in OSN and OSN guidance in schools. (3) Analysis of student character instructional by analyzing the OSN

Competency Standards (SK) so that indicators can be determined which must be developed in the preparation of the module.

After going through the stages *define,* the next stage adalaha *design* or the design of the prototype is done through several steps: preparation of the framework modules, and design evaluation tool. The stage of compiling the module framework is adopted from the components of teaching materials according to Prastowo (2011).

**Data Collection Techniques and Instruments**

**Table 2. 1.** Data collection techniques, sources, instruments and data analysis

| Research stages | Data | Data collection technique | Data source | Instrument | Data analysis |
|---|---|---|---|---|---|
| Field study | The state of the school | Observation | 2014-2017 OSN question files | Observation guide | Qualitative descriptive |
| | | Interview a | Teachers and students | Interview guide | Qualitative descriptive |
| Validity test | The validity of learning tools | Questionnaire | Expert lecturer | Validation sheet | Quantitative descriptive |
| Limited scale test | Student responses to question-based modules | Questionnaire | Students | Questionnaire sheet | Quantitative descriptive |
| Large scale test | The effectiveness of the module in learning (learning outcomes) | Written test | Students | Test questions | T test & N Gain |
| | Practicality of question-based modules | Questionnaire | Students | Student response questionnaire | Quantitative descriptive |

The questionnaire is a data collection method using a list of questions that are distributed to respondents (Arikunto, 2013). The questionnaire method is used to determine student responses to the question-based module and to validate the device by experts (validators). The tools that were validated were questionnaires, interview guides and observations . Validation uses logical validation with the *expert judgment* method .

There are three types of questionnaires that will be used in the research, namely: 1) a questionnaire for the availability of teaching materials in the development process for Olympic

selection preparation and development needs analysis, 2) a questionnaire for the readability of teaching materials developed, 3) a questionnaire for validation of learning instruments (syllabus, lesson plans, student worksheets) , and teaching materials), 4) learning process assessment questionnaire. Assessment aspects include content feasibility , presentation techniques, language, graphic, and scientific concept content.

**Table 2 . 2** Questionnaire Answers Scoring Categories Based on a Likert Scale

| Alternative Answers | Score |
|---|---|
| Very good / very agree | 4 |
| Fine / agree | 3 |
| Not good / disagree | 2 |
| Very badly / totally disagree | 1 |

## RESULTS AND DISCUSSION

**Module Validation by Media and Material Experts**

The validation of the biology olympic question-based module is carried out by expert lecturers who are highly competent in the field of plant physiology and animal physiology anatomy and are experts in the field of learning media. Validation is carried out before testing is carried out on students. Recapitulation value of media experts and material d isajikan in Table 3. 1.

**Table 3. 1** Summary of Validation by Matter Expert and Expert Media

| No. | Expert | Aspect | Score (%) | Criteria |
|---|---|---|---|---|
| 1 | Theory | Anatomy of Plant Physiology | | |
| | | Material / content | 75.0 | Valid |
| | | Language | 75.0 | Valid |
| | | Average (material validation) | 75.0 | Valid |
| | | | | |
| | | Animal Physiology Anatomy | | |
| | | Material / content | 93.0 | Very valid |
| | | Language | 83.9 | Very valid |
| | | Average (material validation) | 88.5 | Very valid |
| | | | | |
| 2 | Media | Praise | 93.75 | Very valid |
| | | Graphics | 95.45 | Very valid |
| | | Average (media validation) | 94.60 | Very valid |
| Average | | | 86.0 | Very valid |

Table 3 .1 shows that the validation of material taken from two experts. namely experts on plant anatomy and physiology and animal physiology anatomy material experts. The validation value obtained for the anatomy and plant dysiology material was 75% with valid criteria. The validation value of animal anatomy and physiology is 88.5% with very valid criteria. The second validation was carried out by media experts, with the validation value obtained of 94.6 with very valid criteria. So that the average value of module validity obtained based on material experts and media experts is 86% with very valid criteria. The assessment data from both material experts and media experts are then used as the basis for revising the development of module based on biology Olympic questions.



**Figure 3.1** Patterns of discussion of high school biology Olympic questions

Suggestions from experts on plant anatom and physiology are to write the purpose of making modules; photo of the documentation itself is labeled "own photo". The discussion of the theory starts from the chloroplast theory which explains the location, properties of chloroplasts to chlorophyll performance; additions to the form theory of light; additions to the overall photosynthetic process diagram and the total reaction conclusion; addition of photorespiration theory in a separate section. Suggestions from experts in animal anatomy and physiology are the

use of standard Indonesian words; information must match / follow the picture; in one page (theory study) do not need to be full of sentences / pictures. The advice from media experts is that the opening of the module is enough with a preface, so that the introduction is removed, change the color of the box in the Module Usage Guide to a smoother color, try to use your own photo images. all of which are the basis for the formation of appropriate modules that can be used by students in the learning process.
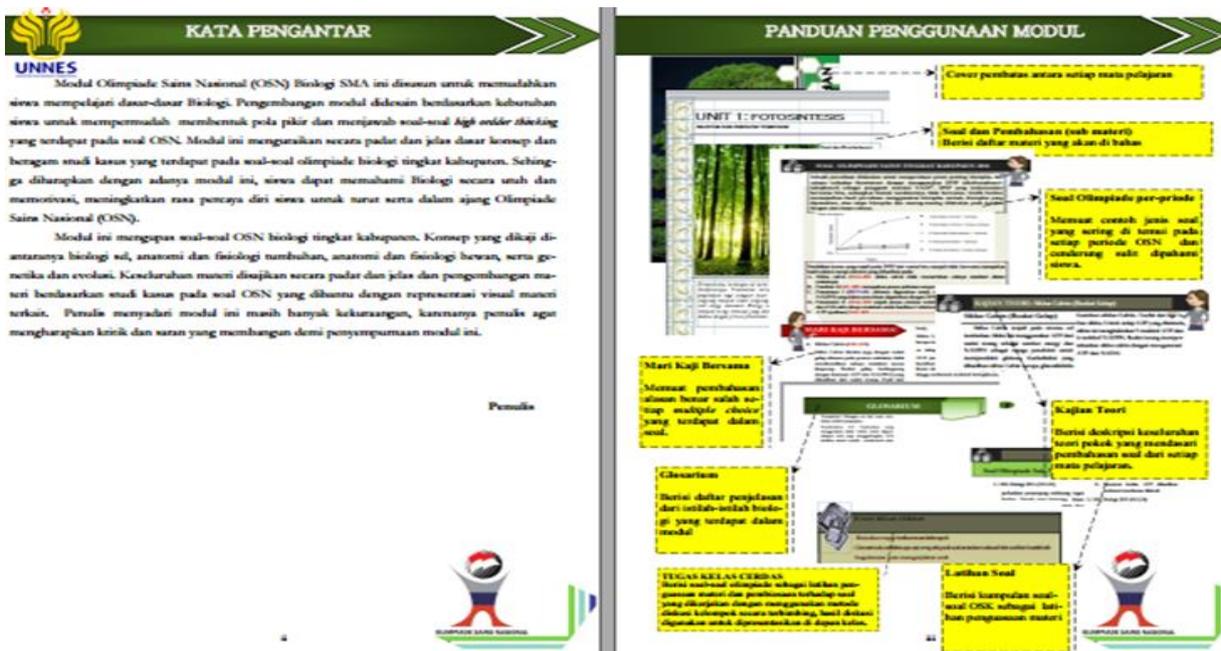


**Figure 3. 2** Display module before revision. There is an introduction on the second page, and on the next page there is a manual on using the module.

### Effectiveness Module based Learning Outcomes Cognitive Students

The effectiveness of the biology olympic question-based module is measured based on student learning outcomes using pretest and post-test questions after carrying out learning using a biology olympic question-based module. The pretest and posttest questions used are questions that have been used during small-scale trials.

The effectiveness of the module is obtained through testing the use of pretest and posttest questions (taken from OSK, OSP, and OSN questions) in large-scale trials. Then the test value will be analyzed using normalized gain (N-gain). Student learning outcomes data can be seen in Table 3.2 .

**Table 3 . 2** Results of the Value Analysis of Student Learning Outcomes

| No. | Data | Results are average | | Gain | N-gain | N-gain category |
|-----|------|---------------------|--|------|--------|------------------|
| | | Pretest Value | Posttest scores | | | |
| 1 | Research Samples 15 students | 2.00 | 7.6 | 56.0 | 0.70 | High |
| 2 | The highest score | 40.00 | 90.00 | | | |
| 3 | Lowest Value | 10.00 | 60.00 | | | |
| 4 | Number of Incomplete Students | 15 | 0 | | | |
| 5 | Classical Completeness | 100% | | | | |

Table 3 .2 shows that there is an increase in the average score of student learning outcomes through the application of the biology olympic question-based module. The value of student learning outcomes at the pretest stage was 2.00 in the post test, which increased to 7.6. After using the biology olympic question-based module, the student's score obtained could meet the classical requirements. In addition, the N-gain value that is generated is with high criteria.

**Practicality Module Based Assessment Respondents**

The practicality of the biology olympic question-based module is measured based on the results of the respondent's assessment, namely students and teachers using a questionnaire sheet. Student response to determine the usefulness of the module for students in learning and training to work on OSN questions. The teacher's response is to determine the usefulness of the module for teachers in learning and in the process of making learning instruments. The results of the teacher's response score on the use of the biology olympic question-based module can be seen in Table 3 . 2 . The results of student response scores to the use of the biology olympic question-based module can be seen in Table 3 . 2.

**Table 3 . 2** Teacher's Response to the Biology Olympic Question-Based Module

| No. | Statement | Average score (%) | Criteria |
|-----|-----------|-------------------|----------|
| 1 | Prepare RPP | 87.5 | Very Worth it |
| 2 | Implementation of Learning | 91.7 | Very Worth it |
| 3 | Evaluation of Learning Outcomes | 100 | Very Worth it |
| Average | | 93.0 | Very Worth it |

Table 3 . 2 shows that the teacher gives a positive response to the implementation of learning through the application of a biology olympic question-based module with a percentage of 93% fulfilling very feasible criteria. This biology olympic question-based module makes it easier for teachers to design learning activities, implement learning and evaluate student learning outcomes. In addition to reviewing teacher responses, student responses after using a module based on the biology olympic questions were monitored and presented in Table 3 . 2.

**Table 3 . 3** Scores of Student Responses to the Biology Olympic Question-Based Module

| No. | Statement | Average score (%) | Criteria |
|-----|-----------|-------------------|----------|
| 1 | Presentation | 84.7 | Very Worth it |
| 2 | Convenience | 85.0 | Very Worth it |
| 3 | Usefulness | 86.0 | Very Worth it |
| Average | | 85.2 | Very Worth it |

Based on the results of student responses presented in table 3.3, students gave a positive response to the implementation of learning using a biology Olympic question-based module with an average percentage of 15 students (research sample) of 85.2% which entered the very feasible criteria. Based on student responses, the module based on the biology olympic questions has an attractive design, the material is concise and easy to understand so that it can be used for learning and practicing olympic independently. The use of module based on biology olympic questions can provide convenience and as an alternative to students' independent learning, students feel they have an increased sense of self-confidence and are motivated to practice preparing for the biology science olympic.

**Module Validation by Material Experts**

Olympic questions commonly faced by Olympic participants are questions that have been designed and calculated as best as possible between the weight of the material and the quantity of questions presented. The quality of the questions is based on *high order ranking* so that it needs extensive analysis and reasoning, as well as continuous practice. Based on the syllabus of the National Science Olympic (OSN), there is a percentage of material taking from 100 questions presented in the *International Biology Olympic* (IBO). In 100 questions, cell biology material has a weight of 20%, plant physiological anatomy material has a weight of 15%, animal physiology anatomy is 25%, etiology is 5%, genetics and evolution is 15%, ecology is 10%, and finally biosystematics has a weight about 5%.

The complexity of the material studied in preparation for the selection of the biology olympic, and the results of the analysis of the needs of students and teachers / supervisors of the OSN make the basis for the development of question-based modules for the high school biology olympic as a supplement to students' independent learning. Based on the percentage of question presentation at IBO, the development of a biology olympic question-based module focuses on two materials, namely the anatomy of animal physiology which has the largest percentage, and is based on the results of interviews with OSN teachers / supervisors which reveal that animal physiology anatomy material is complex material and causes many misconceptions. . The second material chosen was plant anatomy and physiology because in addition to having a large percentage, the material has the same scope as animal anatomy and physiology. The biology olympic syllabus details each material consisting of chapters that must be prepared by students to master because there will be OSN questions in each period. The material on plant anatomy and physiology consists of four chapters, namely; photosynthesis; transport of water, minerals and other materials; growth and development; plant reproduction. The material on animal anatomy and physiology consists of seven chapters including; digestion and nutrition, respiration; circulation; excretion; Settings; reproduction and development; However, this does not negate the possibility of further development so that it can complement the module based on questions for the high school biology olympic which is more complete and in accordance with the biology olympic curriculum.

The development of module based on biology olympic questions was adopted from the development design according to Thiagarajan, semmel, and semmel (1974) with the stages of identifying potentials and problems; preparing the module framework and planning evaluation tools; validation and simulation; distribution module. Of the whole development steps, the most essential stage is the validation stage which determines which modules can be used and are relevant to be tested. So that in the process of developing a module based on Olympic questions, the module is validated first by an expert lecturer, in which case the module consists of two materials, namely the anatomy of plant physiology and animal physiology anatomy.

Module validation is carried out based on the opinion of Rahayu and Sudarmiatin (2010) where modules that are valid and suitable for use are modules that have writing systematics that are easy to understand, material that is relevant to measured competencies, and up-to-date references. To find out all that, the module is validated by three experts, namely experts in the field of plant anatomy and physiology, experts in

the field of animal anatomy and physiology, and experts in the field of media.

**Results of the Validation of Plant Anatomy and Physiology Experts**

The biology olympic question-based module is compiled and developed according to the indicators contained in the biology olympic syllabus, according to the intensity of difficulty and student needs. The module design is adopted from the opinion of Prastowo (2011) where the module component provides learning instructions, competencies to be achieved, modified practice questions into questions that produce concepts, supporting information, and evaluation.

The module design based on questions from the high school biology olympic was adapted to the module structure according to Sejpal (2013) and Winarno *et al* (2015). The module structure consists of (1) a guide to using the appropriate modules to meet the aspects of learning instructions. (2) the information from the sub-material to be reviewed fulfills the competency aspects to be achieved. (3) OSN questions accompanied by reasoned answers and discussion of questions that meet the aspects of the questions produce concepts, (4) The theoretical study fulfills the supporting information aspects. (5) the content of smart class assignments and practice questions fulfills the evaluation aspects.

The results of material validation by experts are used as a reference for improving the module based on biology olympic questions. Validation is carried out before the simulation stage or module implementation in students to minimize material errors or misconceptions when used in the learning process in the classroom. The expert on plant anatomy and physiology gave an assessment in terms of material / content 75% with valid criteria; and in terms of language used 75% with valid criteria. So, the average validation result of the expert on plant anatomy and physiology is 75% with valid criteria.

There are seven points of improvement suggestions delivered by lecturers who are experts in plant anatomy and physiology. Among the expert suggestions, namely attaching the purpose

of making the module; in the image with own photo is given the description "own photo"; open the initial theory with the concept of chloroplasts, their properties and criteria; added the concept of light shapes; add a diagram of the overall photosynthetic process; create a section on photorespiration maeri.

**Results of the Validation of Animal Anatomy and Physiology Experts**

The results of material validation by material experts on animal anatomy and physiology are used as a reference for improving the module based on questions in the SMA Biology Olympic. Animal anatomy and physiology material experts gave an assessment in terms of material / content 93.0% with very valid criteria; and in terms of language used 83.9% with very valid criteria. So, the average validation result from animal anatomy and physiology material experts is 88.5% with very valid criteria.

There are three points of improvement suggestions delivered by lecturers who are experts on animal anatomy and physiology. Among the expert suggestions are the use of standard Indonesian words; information must match / follow the picture; dalah one page (theory study) does not need to be full of sentences / pictures.

**Module Validation by Media Experts**

The Olympics question-based module must have material that is accurate and relevant, therefore validation is carried out by two material experts, namely plant physiology anatomy material experts and plant anatomy and physiology material experts. It is not enough to get validation from material experts, to find out how the quality of the presentation components and graphic components presented in the module, it is necessary to validate the media experts before applying them to learning activities by students. The validation of the module validation by media experts in terms of presentation is 93.75% with a very valid category, and in terms of graphics it is 95.45% with a very valid category. The average result of validation by media experts was 94.60 % with very valid criteria.

There are several suggestions for improvement from the results of the media

validation including; First, the elimination of the introductory sheet, because the introduction is sufficient to open the module based on questions for the SMA Biology Olympic. Both p engubahan colors on the box module user becomes more color *soft* . Third , use your own photos, if you use your own photos, the module is good.

**Module Effectiveness Based on Student Learning Outcomes**

The effectiveness of the module based on questions from the high school biology olympic in learning can be determined by conducting a usage test. In the trial process, two phases were made, namely a small-scale trial and then a large-scale trial. Small-scale trials were carried out to obtain optimal learning instruments in the data collection process in usage trials.

Question-based modules for high school biology olympic can effectively improve student learning outcomes. This can be seen from the increase in the achievement of students who had the lowest score at the pretest experienced an increase in learning outcomes. The increase in student learning outcomes can be proven by the n-gain value which is in the high category. The high n-gain value comes from the comparison of the students' pretest and posttest scores. The post-test score shows an increase in students' understanding of concepts after learning using a biology olympic question-based module. N-gain value indicates the application pembe l teachings by using module-based high school biology Olympic matter has the advantage that can help improve student learning outcomes.

The module based on SMA biology olympic questions is a module arranged systematically, based on syllabus analysis and OSN questions, and analysis of student needs. The module contains examples of OSN questions in the previous period (period 2014 - period 2020). The OSN problem is a question that has been designed in such a way that it falls into the category of *hight order thinking skill* (HOTS) questions. Wilso n (2006) b erpendapat that matter with a high difficulty level can improve students 'critical thinking skills and can be used as an instrument to measure students' critical thinking skills.

The module based on high school biology olympic questions makes the available questions not only presented as an evaluation material for students' conceptual mastery, but OSN questions are also provided to be discussed directly by conditioning the discussion patterns such as in discussion forums, so that students are led to develop problem-solving patterns. From the questions and discussion presented, the understanding of the concept will be more stable with the existence of a theoretical study that is prepared in a concise, concise and clear manner. At the end of the content, there are class activities that require students to analyze questions in groups, this activity requires students to analyze questions from various perspectives so that, arguing with each other to get solutions, produce intrigues or creative points of view to solve questions and test students' courage to present the results of their discussions in front of the class.

**Practicality of the Module based on Teacher and Student Responses**

The practicality of the module can be seen through how the teacher and student respond after implementing the learning using question-based modules in the SMA biology Olympic. Practicality is assessed from whether the module is easy to understand by users, and can increase student motivation.

The teacher response questionnaire contains 10 statement items, with the highest score of 4 and the lowest score 1. The results of the teacher's response to the module based on questions in the SMA Biology Olympic are to facilitate the task of the teacher in preparing RPP by 87.5% with very feasible criteria, 2) to simplify the teacher's task in the implementation of learning by 91.0% with very feasible criteria, 3) to facilitate the teacher's task in evaluating student learning outcomes by 100% with very feasible criteria. The average teacher response to the use of question-based modules for high school biology olympic was 93.0% with the very feasible category.

Based on the results of the assessment on the teacher response questionnaire, the teacher gave a positive response to the development of a module based on the SMA biology Olympic

questions. Question-based modules for high school biology olympic can help make it easier for teachers to prepare lesson plans for students in preparation for biology olympic selection, make it easier to carry out active learning activities, and to evaluate student learning outcomes.

**Student Response**

The student response questionnaire contains 11 statement items, with the highest score 4 and the lowest score 1. Student response questionnaires were given to 15 students as respondents to assess the ease and usefulness of the module in the implementation of learning. The results of the assessment of student responses to the use of question-based modules for high school biology biology olympic after learning are 1) in terms of presentation of 84.7%, 2) in terms of ease of 85.0%, 3) in terms of usefulness of 86.0%. The average student response to the use of question-based modules for high school biology olympic was 85.2% with the very feasible category.

The development of a module based on high school biology biology olympic questions is very suitable for use in the learning process in terms of presentation, because the use of question-based modules for high school biology olympic presents content that can direct students how to build understanding to find solutions to the questions presented from various types of questions, such as those presented at the beginning of the chapter opener. The questions are discussed briefly from various points of view to lead to one conclusion, namely the answer to the question.

The biology olympic question-based module is very easy to understand. After the discussion of module questions facilitates students with theoretical study content to strengthen the concepts studied in the discussion of the material, the theoretical study contains the material as a whole and the material is discussed briefly, concisely and clearly. In addition to providing theoretical study content to reinforce concepts, there is also 'Smart Classwork' content which contains student class activities. Class activities are carried out when the coaching process with the teacher / supervisor of the Olympics takes place (offline learning). Coaching

specifically for prospective Olympic participants is an important aspect that must be provided or facilitated by schools. Because the olympic coaching process can improve student competence in working on OSN questions (Wikoyo *et al* . 2019). Therefore the content of 'Smart Classwork' is tailored to the conditioning of critical thinking and active classroom activities. Class activity conditioning is adjusted to the character of critical thinking according to Adinda (2016), which is being able to conclude what is known, knowing how to use information to solve problems and being able to find relevant information sources as support for problem solving.

Students are asked to study in groups to solve OSN questions, analyze questions, find various possible sources of problems, find various possible solutions to problems, discuss solutions, and present the results of discussions in front of the class. Marpaung (2018) states that discussion and presentation activities carried out by students can increase self-confidence because in it students learn to analyze problems, the ability to argue and how to defend arguments. The content available in the module helps students analyze the problems contained in the questions, directs student understanding, makes it easier for students to understand the lesson and reinforces the concepts being learned. The content provided in the module can improve students' critical thinking skills. This is based on the opinion of Ennis (1986) which states that the involvement of mental, strategy, and representation that is done to solve problems, make decisions, and learn new concepts is part of the concept of critical thinking. The activities provided by the module are also included in the indicators of critical thinking skills including: students can ask questions, plan strategies, and evaluate decisions (Rofiah *et al.* 2013). Students with critical thinking skills are able to review the opinions given based on their existing knowledge (Nugraha). , *et al.* 2017) . Besides being able to hone students' critical thinking skills, the existence of an argumentation system in discussion forums can also improve student learning outcomes (Agusni *et al* . 2015).

Apart from the aspect of presentation and easy understanding, the module also makes it

easy for students to be able to study independently at home. This is because the module is easy to understand and can be studied independently at home. Hartono & Aisyah (2008) stated that a practical module is a module that is in accordance with the applicable curriculum and can be used for self-study. The module based on high school biology olympic questions not only facilitates students in terms of understanding the concept, but the module also facilitates Olympic questions from various periods, so that students can practice their independent learning outcomes at home. If there is a concept that has not been understood, students can ask the teacher or olympic coach for the concept at school.

The flexibility and practicality of the biology olympic question-based module fosters students' interest in studying biology and increases student motivation to continue learning and preparing for the selection process for OSN participants. As the opinion of Pebruanti & Munadi (2015) which states that the use of modules can increase student learning motivation and can even improve student learning outcomes both in terms of affective , cognitive and psychomotor .

## CONCLUSION

Based on the description above, there are several conclusions. *First, m* odule based biology olympic valid question is used in the learning process based on validation by subject matter experts and media experts with a percentage of 86% with the criteria very valid . *Secondly, m* odule based biology olympic problem effectively used to improve student learning outcomes seen from the N-gain of 0 , 70 kri Teria high . *Third, the* module based on the SMA biology Olympic questions is practically used by teachers and students, based on the results of the teacher's response assessment of 93%, the criteria are very feasible to facilitate the task of the teacher in preparing lesson plans, facilitate the implementation of learning, and make it easier to evaluate student learning outcomes. The student response is 85.2%. The criteria are very suitable for students to use both in terms of good presentation, easy to understand, and can

increase learning motivation and interest in participating in the Olympics .

## REFERENCES

Adinda, A. 2016. Critical Thinking in Mathematics Learning. *Logarithmic Journal* . 4 (1): 125-138

Agusni, HP, Abdurrahman & Wahyudi, I. 2017. The Effect of Argumentation Skills Using the Problem Based Learning Model on Student Learning Outcomes. Journal of Learning Physics. 5 (4) , 97-104.

Alimah, S. 2014. "Experiential Learning Model Exploring the Surrounding Nature. Strategies to Improve Students' Critical Thinking Ability ". Journal of Educational Research (JPP). 31 (1): 47:54

Anisah & Lastuti, S. 2018. Development of HOTS-based teaching materials to improve students' mathematical problem solving skills. *KREANO* , 9 (2), 191-197.

Arikunto, S. (2013). Research Procedure: A Practical Approach. Jakarta: Rineka Cipta.

Creswell, John W. 2015. Qualitative Research & Research Design. Yogyakarta: Student Library .

Ennis. 1986. A Logical Basis for Measuring Critical Thinking Skills. *Educational Leadership* , 43 (2), 44-48.

Fanani, MZ (2018). Strategy for Developing HOTS Questions in the 2013 Curriculum. *EDUDEENA* , 2 (1), 59-76.

Fauziah, A. 2010. Improved understanding and problem solving skills of junior high school students through the REACT strategy. *Forum K ependidikan ,* 30 ( 1 ) , 1-13 .

Hartono, Y. & Aisyah, N. 2008. Development of Individual Learning Modules in Mathematics for Class XI SMA Negeri 1 Palembang. *Journal of Mathematics Education* , 2 (2), 35-44.

Ilhamuddin, I. 2019. The development of HOTS-based teaching materials to improve the mathematical problem solving skills of students of SMAN 8 Makasar. *SIGMA: Journal of Mathematics Education,* 11 (2), 106-113

Inayah, R., Martono, T., & Sawiji, H. 2012. The Influence of Teacher Competence, Student Motivation, and Learning Facilities on Learning Achievement in Economics Subjects in Class XI ips SMA Negeri 1Lasem. Journal of Insan Mandiri Education. 1 (1), 1-12.

Karnadi, Very. 2017. Student Election of Science Olympic Participants at SMA Negeri 2 Sungai Penuh Using Mamdani Fuzzy Logic. Journal of Processor, 11 (1). 697-708.

Ministry of Education and Culture. 2017. Guidelines for Implementing the 2017 National Science Olympic . National Science Olympic.

Marlina, R., Puspaningrum, H., & Hamdani. 2017. Differentiation of Test Items Between The High Shool Biology Olimpiad in Nort Kayong and The National Science Olimpiad. *Journal of Indonesian Science Education.* 6 (2), 245-251.

Marpaung, D. (2018) Application of Discussion and Presentation Methods to Increase Interest and Learning Outcomes of Class XI IPS-1 Students of SMA Negeri 1 Bagan Sinembah. *SEJ (School Education Journal),* 8 (4), 360-368

Mulyasa. 2009. *Becoming a Professional Teacher Creates Creative and Fun Learning* . Bandung: PT Remaja Rosdakarya

Muspita, Z., Lasmawan, IW, & Sariyasa , 2013. The influence of problem-based learning models on critical thinking skills, learning motivation, and social studies learning outcomes of class VII SMPN 1 AIKMEL students. *e-Journal Undergraduate Program Ganesha University of Education Study Program of Basic Education* , 3, 1 - 8 .

Nugraha, AJ, Suyitno, H. & Susilaningsih, H. 2017. Analysis of Critical Thinking Ability in terms of Science Process Skills and Learning Motivation through PBL Model. Journal of Primary Educatication, 6 (1): 35-43

Nugraha, AJ, Suyitno, H. & Susilaningsih, H. 2017. Analysis of Critical Thinking Ability in terms of Science Process Skills and Learning Motivation through PBL Model. Journal of Primary Educatication, 6 (1): 35-43

Nurrita, T. 2018. Learning Media Development to Improve Student Learning Outcomes. *PEOPLE.* 3 (1), 171-187.

OECD. 2016. Program For International Student Assessment (PISA) Results from PISA 2015. [online], (http://www.pisa.oecd.org).

Pebruanti, L. & Munadi, S. 2015. Increasing Motivation and Learning Outcomes in Basic Programming Subjects Using Modules at SMKN 2 Sumbawa. *Journal of Vocational Education,* 5 (3), 365-376 .

Pradilasari, L., Gani, A., & Khaldun, I. 2019. Development of Audio Visual-Based Learning Media on Colloid Materials to Increase Motivation and Learning Outcomes of High School Students. *Indonesian Journal of Science Education.* 7 (1), 9-15

Prastowo. 2011. *Creative Guide to Making Innovative Teaching Materials* . Yogyakarta: Diva Press.

Rahayu, W ., & Sudarmianti. 2010. Entrepreneurship Module Development at SMK. *Journal of Educational Sciences,* 17 (2), 157-161

Rofiah E., Aminah SN, & Ikawati, EY 2013. "Compilation of High Level Thinking Ability Test Instruments in Physics for Junior High School Students". *Journal of Physics Education* . 1 (2), 17-22.

Sari, D., & Sugiyarto, K. 2015. Development of Problem-Based Multimedia to Increase Student Motivation and Critical Thinking Ability. *Journal of Science Education Innovation.* 1 (2), 153-166.

Sejpal. 2013. Modular Method of Teaching. *International Journal of Research in Education.* Vol 2: 169-171 .

Septiyani, R., & Susanti, D. 2015. Mastery of Participant Materials and Quality of Questions at the 2015 South Coastal High School Biology Olympic. State University of Padang (UNP). 1-5.

Sugiyono. 2017. *Quantitative, Qualitative, and R & D Research Methods* . Bandung: Alfabeta

Sumaryanta, (2018). HOTS Assessment in Mathematics Learning. Indonesian Digital

Journal of Mathematics and Education, 8 (8), 500-509

Susilo, AB (2012). Development of Problem Based Science Learning Model to Increase Student Motivation and Critical Thinking of Junior High School Students . *Journal of Primary Educational* , 1 (1), 57 - 63.

Trianto. 2007. *Constructivist Oriented Innovative Learning Models* . Jakarta: Preatasi Pustaka.

Wikoyo, T., Megawati, Aprizan, & Avana, N. 2019. Increasing Student Competence through the Development of the Science Olympic (OSN). *Journal of Community Service Institution News* . .22 (2), 67-75.

Wilson, Suzane, M., & Petersion, PL 2006. Theories of Learning and Teaching What Do They Mean for Educators *?. National Education Association* . USA: Washington, DC.

Winarno, Sunarno W & Sarwanto. 2015. Development of an Integrated Science Module Based on High Order Thinking Skills (HOTS) on the Energy Theme. *Journal of Inquiry.* Vol 4 (1): 82-91.