# The Effectiveness of Inquiry Based Instructions Module on Excretory System Material to Improve Student Learning Outcomes in 11th Grade Science Senior High School

**I Nyoman Tri Bayu Tanaya[1], Suciati[2], Maridi[3]**
[1] Sekolah Tinggi Agama Hindu Lampung, Bandar Lampung, Lampung 35227, Indonesia
2,3 Universitas Sebelas Maret, Surakarta, Jawa Tengah 57126, Indonesia
Coressponding Author. E-mail:
[1] nyomanbayu029@gmail.com
[2]suciati.sudarisman@yahoo.com
[3]maridi_uns@yahoo.co.id

*Received:* January 19th, 2023 *Accepted:* January 27th, 2023 *Online Published:* January 31st, 2023

**Abstrak**

Learning outcomes have three domains that consist of cognitive, affective and psychomotor, important part of a learning process to determine the level of learning objectives. This research aims to determine the effectiveness of inquiry based instructions module on the material excretion system on student learning outcomes consist of cognitive, affective and psychomotor in 11th Grade Science Class of Senior High School. This research uses a learning model that has never been used, namely by using the syntax of the inquiry based instruction model. Researcher used quasi experimental research and pre-test and post-test control group design for the research design in this paper. The samples of this study are 36 students of 11th Grade Science Class 4 as experimental class using module and 36 students of 11th Grade Science Class 6 as control class using lecture method. Data were collected using a 30-item multiple-choice test technique and they were analyzed by t-test using SPSS. The results show that the t-test in the experimental class was obtained by probability (p) 0.00 ($p < 0.05$), so $H_0$ was rejected. The results of the analysis show that there is a significant difference between the pretest and posttest score of the students using a module with gain scoring of 0.45. The learning outcomes in the control class also improved but not as large as the gain scoring in the experimental class of 0.24. It can be concluded that the inquiry based instruction module on the effective excretion system material improves students' learning outcomes in 11th Grade Science Class of Senior High School.

**Keywords:** module, inquiry based instructions, learning outcomes

**How to cite this article :**

Tanaya, I.N.T.B., Suciati, & Maridi.(2023). The Effectiveness of Inquiry Based Instructions Module on Excretory System Material to Improve Student Learning Outcomes in 11th Grade Science Senior High School. *IJIS Edu : Indonesian Journal of Integrated Science Education, 5*(1), 15-24. doi:http://dx.doi.org/10.29300/ijisedu.v5i1.9650

## INTRODUCTION

Entering the world of global competition, the most basic thing is the need to prepare students to be communicative, collaborative, creative, innovative, to think critically and analytically, and to be able to effectively solve real world problems (Zivkovic, 2016; and Dwi, 2015).

Learning is a psychical activity occurring in active interaction with environment resulting in a number of changes in knowledge, skill, value, and attitude that is constant and permanent in nature (W. S. Winkel, 2009). In similar vein, Slameto (2010) says that learning is an attempt taken by an individual to acquire a completely new behavioral change, as the result of his experience in interaction with its environment. Considering some arguments above, an individual is considered as learning when there is a change in his/her behavior; the change in learning is not only related to the increase of knowledge, but also in the form of competency, attitude, definition, self-esteem, interest, self-adjustment and etc to achieve learning objective.

Learning objective is a number of learning outcomes showing that the students have done learning action, generally including new knowledge, skills and attitudes, expected to be achieved by students. Learning objective is a description of behavior expectedly to be achieved by students during the learning process. Learning objective is an accurate way of determining learning outcome (Oemar Hamalik, 2008). The implementation of 2013 curriculum is conducted by practicing skill among the students as reflected on learning activity to improve the learning outcome (Education and Culture Ministry, 2013).

Learning outcome, according to Suprijono (2012), is action patterns, values, definitions, attitudes, appreciation, and skill. Learning outcome is the result of interaction between learning and teaching actions. Viewed from teacher aspect, teaching action is ended with learning outcome evaluation process. Viewed from student aspect, learning outcome is the end of learning process culmination. Learning outcome for some people is due to teacher's action, an achievement of teaching objective. On the other hand, it is the improvement of students' mental ability (Dimyati & Mudjiono, 2009). In addition, learning outcome is a culmination of learning process. A teaching-learning process is considered as successful when the result meets its objective. Learning outcome can be seen from its evaluation. As Supraktiknya (2012) suggests, learning outcome evaluation is an activity of attempting to find out the students' successfulness in achieving the specified objective. Evaluation of learning outcome has target in the form of domains contained in objective. The domain of education objective based on students' learning outcome generally can be classified into three: cognitive, affective, and psychomotor domains (Anderson et al, 2001).

Considering the result of early observation on SMA Negeri 1 Madiun, it can be seen that the mean score of the 11$^{th}$ graders in previous daily quiz has not been maximal yet or still below Minimum Passing Criteria (KKM). The Minimum Passing Criteria (KKM) enacted in SMA Negeri 1 Madiun is 75. In 2016, the mean score of the 11$^{th}$ Science Graders for Biology subject was still below KKM (50-70). It is because in teaching-learning process, the students' understanding is only acquired from listening to teachers' explanation during teaching process, no students' handout (textbook and etc) available, and students are only given student worksheet containing exercises only with limited material. Therefore, it impacts on the students' less maximal understanding and no material to deepen the students' understanding. Considering the result of National Exam scores for the human excretion system material of 72.50%, 89.70% and 97.56% for 2013, 2014 and 2015 respectively, there is an improvement despite below the score of regency/municipal and province (education and culture ministry, 2016). Therefore, there should be a supporting medium to increase the students' understanding, in this case printed media, because for other media, the facility provided in this school is less supporting. One medium that can be applied is module media in excretion system.

Module is a learning source organized systematically using language understandable and learnable to students. Module can be used corresponding to the students' learning speed, in the sense that the good module has five characteristics: *self instruction, self contained, stand alone, adaptive, and user friendly* (National Education Department, 2008 & Prastowo, 2013). Some studies found that the module used for independent learning helps understand the concept and the use of module affects positively

the students' learning outcome (Esmiyati et al., 2013; Jannah et al., 2013; Dita, 2014).

Wang et al.'s (2015) study reveals that the students in three classes (A, B, C) using Inquiry Based Instruction learning model have higher learning motivation and interest than those in the classes not using Inquiry Based Instruction; the indicator of learning participation shows the increase in score from 2.69, 3.20, 3.34, and 3.59 (pretest) to 3.89, 4.05, 3.94, and 3.76 (*post-test*). The advantages of the IBI learning model are learning models based on questions, students who ask questions using the IBI model are greater than those who do not use the IBI model which has an impact on understanding and student learning outcomes (Aulls, et al., 2015). IBI adalah model pembelajaran yang mengaktifkan aktifitas peserta didik, dalam bentuk organisasi yang berbeda dengan memberikan suatu fenomena atau masalah dalam pembelajaran, guru tidak mentransfer materi pelajaran dengan menggunakan ceramah tapi mengkonstruksi pengetahuan peserta didik dengan penggunaan pemecahan masalah dan sistem pertanyaan yang diajukan (Serafin, *et al.,* 2015). IBI mengembangkan kemandirian dan kemampuan untuk mencari informasi baru, inkuiri ini dapat menjadi dasar untuk mendapatkan pengetahuan yang baru melalui pemecahan isu dari suatu fenomena untuk menciptakan rasa ingin tahu siswa (Dostal & klemen, 2015).

Teaching modules can be taught in various science activities to train cognitive, affective and psychomotor abilities. Modules that are taught using a process scientific approach can improve scientific process abilities (Cruz, 2015).

IBI module follows the procedure of IBI learning activity including: observing, devising question, developing hypothesis, formulating strategies for testing, performing the tests, analyzing data and communicating data (Moore, 2011). Considering the elaboration above, the author conducts a research entitled "The Effectiveness of Inquiry Based Instructions Module to Improve the Learning Outcome of the 11th Science Graders of Senior High School in Excretion System Material.

## METHOD

This study was a research and development aiming to develop an inquiry based instruction (IBI) learning model-based module in Human Excretion System, with syntax: Observing, Devising questions, Developing hypothesis, Formulating strategies for test, Performing the test, Analyzing data, dan Communicating data (Wang, et al, 2015). The development was carried out using procedural model adapted from Borg and Gall (1983)'s development model.

The modified development procedure based on the Borg and Gall (1983) method consists of ten steps including: (1) research and information gathering including literature review, class observation and creating a research framework; (2) carry out planning including identifying, stating goals, determining sequences for research and determining small-scale feasibility; (3) developing the initial product; (4) conduct initial field trials; (5) revise the initial product; (6) conducting limited field tests; (7) make a second product revision; (8) carry out operational field tests; (9) revise the final product; and (10) carry out product dissemination and implementation. The implementation of IBI-based module development did not reach the product application and implementation stage and only fulfilled the ninth stage, namely the revision of the final product according to research needs.

This research was taken place in SMA Negeri 1 Madiun in the Even Semester of School Year of 2016/2017. The subject of research consisted of 36 students in the 11th Science 4 grade as experiment class using module and 36 students in the 11th Science 6 grade as control class using lecturing method. The research design used in operational field test was *pre-test and post-test nonequivalent control group design*. The test design employed two classes: control (using lecturing method) and treatment classes (using inquiry based instruction-based module). Both classes took pretest first before receiving treatment and posttest later (Sugiyono, 2012). The research design can be seen in Table 1.

| Group | Pretest | Treatment | Posttest |
|---|---|---|---|
| Control | $O_1$ | $X_1$ | $O_2$ |
| Experiment | $O_3$ | $X_2$ | $O_4$ |

Note:
$X_1$ : control class (lecturing method)
$X_2$ : treatment class (using *inquiry based instructions*-based module)
$O_1$ : Pretest given to control class
$O_2$ : Posttest given to control class
$O_3$ : Pretest given to treatment class
$O_4$ : Posttest given to treatment class

Data were collected using test technique consisting of 30 multiple-choice questions for cognitive learning outcome and non-test technique or observation sheet for affective and psychomotor learning outcomes. The data was analyzed descriptively and qualitatively, the normal homogenous data was tested further using parametric test with t-test using SPSS and the size of learning outcome increase can be seen in the gain score of students' pretest and posttest. IBI module is considered as effective when there is a difference between pretest and posttest in t-test and gain-score. The normalization of gain score, according to Hake (1999) can be estimated using the formula below:

$$\langle g \rangle = \frac{\text{Skor } posttest - \text{Skor } pretest}{\text{Skor ideal} - \text{skor } posttest}$$

**TABEL 2**. Gain Score Criteria

| Gain Score Scala | Criteria |
|---|---|
| $g \geq 0{,}7$ | Hight |
| $0{,}7 > g > 0{,}3$ | Moderat |
| $g \leq 0{,}3$ | Low |

(*Sumber*: Hake, 1999)

Learning outcomes in affective and psychomotor domains in the form of students' activity during learning (process) and in the end of learning (product) analyzed descriptively with value criteria according to Suwandi (2009) can be presented in Table 3. The formula used to analyze the gain score is:

$$\textbf{Score} = \frac{\sum gain\ score}{\sum Total\ score}\ x\ 100$$

**TABLE 3**. Criteria of Assessment for Affective and Psychomotor Domains

| Conversion | | Catagory |
|---|---|---|
| Figure | Letter | |
| 81-100 | A | Verry goog |
| 61-80 | B | Good |
| 41-60 | C | Fair |
| 20-40 | D | Poor |

(*Sumber*: Suwandi, 2009)

## RESULT AND DISCUSION

Considering the result of research, the mean score of students' learning outcome obtained from pretest and posttest in the 11th Science 4 grade as experiment class and the 11th Science 6 grade as control class. The mean scores of learning outcome obtained from pretest and posttest is presented in Table 4.

TABLE 4. The Mean score of Learning Outcome in Pretest and Posttest

| No | Learning outcome | Experiment class | | Control class | |
|---|---|---|---|---|---|
| | | pretest | posttest | pretest | posttest |
| 1 | Cognitive | 60.56 | 78.80 | 47.22 | 61.20 |
| 2 | Affective | 25 | 79 | 20 | 24 |
| 3 | Psychomotor | 15 | 84 | 10 | 13 |

Table 4 shows that the mean score of learning outcome for experiment class increases from 60.56 (pretest) to 78.80 (posttest) in cognitive, from 25 (pretest, poor category) to 79 (posttest, good category) in affective, and from 15 (pretest, poor category) to 84 (posttest, very good category) in psychomotor domains. The mean score of learning outcome for control class increases from 47.22 (pretest) to 61.60 (posttest) in cognitive, from 20 (pretest, poor category) to 24 (posttest, poor category) in affective, and from 10 (pretest, poor category) to 13 (posttest, poor category) in psychomotor domains. Those scores indicate that the use of Inquiry Based Instructions module in excretion system material improves the students' learning outcome effectively.

The increased of learning outcome score in cognitive aspect can be seen from the estimation of pretest and posttest scores in individual students to achieve the gain score. The use of gain score refers to Hake's (1999) guidelines. The result of gain score in experiment and control classes is presented in Table 5.

**TABLE 5.** Gain score in experiment and control classes

| Group | Gain Score | Category |
|---|---|---|
| Control | 0.24 | Moderate |
| Treatment | 0.45 | Low |

From Table 5, it can be found the significance value in experiment and control classes, in which the gain score of experiment class belongs to moderate category higher than that of control class belonging to low. The score shows that the use of Inquiry Based Instructions module in excretion system improves the students' learning outcome. Having obtained gain score, prerequisite test was conducted (normality and homogeneity test) and advanced test. Prerequisite test is the first stage conducted to obtain normality and homogeneity values in experiment and control classes. The data of prerequisite test is presented in Table 6.

**Table 6**. The result of Prerequisite Test for Learning Outcomes of Experiment and Control Classes.

| Data | Test | Type of test | Result | Decisions | Conclusion |
|---|---|---|---|---|---|
| Experiment Class | Normality | Kolmogorov-smirnov | Sig. *pretest*=0.01 | $H_o$ is supported | Data is normal |
| | | | Sig. *posttest*=0,05 | $H_o$ is supported | Data is normal |
| | Homogeneity | Levene statistic | Sig=0.384 | $H_o$ is supported | Data is Homogeneous |
| Control Class | Normality | Kolmogorov-smirnov | Sig. *pretest*= 0.025 | $H_o$ is supported | Data is normal |
| | | | Sig. *posttest*=0.01 | $H_o$ is supported | Data is normal |
| | Homogeneity | Levene statistic | Sig=0.03 | $H_o$ is supported | Data is normal |

Table 6 shows that the normality test in experiment class obtain significance value of pretest of 0.01 (> 0.05), so $H_0$ is supported. Data of pretest is distributed normally. In normality test, the significance value of posttest is 0.05 (≥ 0.05), so $H_o$ is supported. Data of posttest is distributed normally. The result of homogeneity test in experiment class shows significance value of 0.384 (> 0.05), so Ho is supported. Data of homogeneity in experiment class can be concluded as homogeneous. The result of normality test in control class shows that significance value of pretest is 0.025 (> 0.05), so $H_o$ is supported. Data of pretest is distributed normally. In normality test, the significance value of posttest is 0.01 (> 0.05), $H_o$ is supported. Data of posttest is distributed normally. The result of homogeneity test in experiment class shows that significance value is 0.03 (> 0.05), so $H_o$ is supported. Data of homogeneity tests in control class can be concluded homogeneously. Having conducted prerequisite test with normal and homogeneous data in all classes, t-test is presented in Table 7.

**TABLE 7.** The result of t-test for Experiment and Control Classes

| Data | Type of test | Result | Decisions | Conclution |
|---|---|---|---|---|
| Experiment Class | *t- test* | $-t_{statistic}$ = -16.701 P=0.000 | $H_o$ is not supported | The result is not same (there is a difference) |
| Control Class | *t-test* | $-t_{statistic}$ = -6.800 P=0.000 | $H_o$ is not supported | The result is not same (there is a difference) |

Table 7 shows the result of t-test for experiment and control class. The result of t-test in experiment class shows $-t_{statistic}$ value = -16.701 with probability score (P) = (P) =0.000 (P< 0.005), so $H_o$ is not supported. The result shows the significant difference of learning outcome before and after using Inquiry Based Instructions module in the experiment class students in excretion system. It can be concluded that the use of Inquiry Based Instructions in excretion system material improves the learning outcome effectively. The result of *t-test* also shows that $H_o$ is not supported. The result shows that there is a significant difference of learning outcome in control class students but the significance value is not high as that in experiment class.

Considering the elaboration above, it can be seen that the use of Inquiry Based Instructions module in excretion system material improves the students' learning outcome (Veloo, *et al.,* 2013). The significance value of gain score for experiment class (0.45) much different from that for control class (0.24) in cognitive domain; the gain score of students using module is 25 (pretest) and 79 (posttest) in affective domain and 15 (pretest) and (84) (posttest) in psychomotor domain; it is because the use of module can improve the learning outcome. IBI module has advantages of making the students find knowledge independently corresponding to their own ability, without face-to-face (direct) contact with teacher. It is in line with Depdiknas (2008) and Prastowo (2013) stating that module has some advantages: students can learn without face-to-face contact with teacher, students can learn according top learning time and speed, students can find out their weakness and strength in achieving the competency existing in the module. Mbulu (2011) states that the advantage of module use is that it gives immediate feedback so that the students can find out their learning outcome level, it guides the students to achieve good learning outcome through regular procedures, thereby generating strong motivation to endeavor vigorously. IBI Module accommodates the students to find concepts they have not understood yet thereby will affect the students' learning outcome. Some studies found that the module used for independent learning can help the students understand the concept and affect positively the students' learning outcome (Esmiyati, 2013; Jannah, 2013; Dita, 2014).

IBI model included in the model evidently improves the pretest-posttest scores. It is indicated with the increase in score from 60.56 (pretest) to 78.80 (posttest). Wang et al (2015) suggests that the three classes (A, B, C) using Inquiry Based Instruction learning model in learning participation indicator also shows the increase in score from 2.69, 3.20, 3.34, and 3.59 (pretest) from 3.89, 4.05, 3.94, and 3.76 (post-test). It is because the stages in IBI learning model give the students the opportunity of appreciating and understanding any form of scientific research. *Inquiry Based Instruction* has a significant effect on the students' science achievement, indicating that the higher the Inquiry Based Instruction, the higher is the students' learning outcome (Veloo, *et al.,* 2013).

IBI-based modules are effective in increasing student knowledge because the IBI-based learning presented increases student activity and motivation in learning. This is in accordance with the opinion which states that the IBI model can increase motivation and learning outcomes of students' knowledge through collaborative learning between teachers, libraries, and the IBI model (Montiel & Grimes, 2013).

Better knowledge learning outcomes because learning based on the IBI model is integrated by students with teaching modules. This is in accordance with the opinion that states by integrating modules with learning models to solve problems through cognitive training (Surya & Syahputra 2017). This is in line

with the opinion of (Abdullah, et al., 2013) that learning using modules increases students' knowledge. These results were reinforced by research which stated that the use of model-based modules increased students' cognitive learning outcomes with an N-gain of 0.7 (Hairida & Kartono, 2016). This is in line with the results of research which states that the use of model-based modules increases cognitive learning outcomes by 86.00 (Handoko, Sajidan and Maridi, 2016).

IBI develops students' thinking and knowledge through discovery learning to construct their knowledge (Dostal, 2015). This is in accordance with the opinion which states that social learning with constructivism can develop students' knowledge (Amineh & Asi, 2015; Trif, 2015). IBI learning constructs knowledge based on previous student experiences and the application of knowledge in relevant contexts, learning activities in the form of scientific activities based on solving a problem, this inquiry also increases student achievement (Taylor, 2011).

The IBI-based module is effective in improving attitude learning outcomes because IBI is a scientific discovery-based model that requires students to have a scientific attitude like a researcher. This is in line with the results of research which states that by collaborating on the IBI model, student attitudes, and teacher motivation can improve student learning outcomes through inquiry by 7.80% (Veloo, *et al.,* 2013).. The learning outcomes of student attitudes are also better because the IBI model is integrated into the teaching modules. This is consistent with research which states that using teaching modules can improve student learning outcomes with a mean value of 3.03 (Klop, et al., 2010). This is reinforced by the results of research which states that integrating modules in learning designs or models can improve student learning outcomes by 100% (Puti & Jumadi, 2015)

IBI-based modules are effective in improving skills learning outcomes because IBI-based learning is designed so that students practice inquiry skills. This is in accordance with the opinion which states that IBI-based learning improves science process skills through inquiry (Arslan, 2014). Better skills learning outcomes because IBI learning is integrated with teaching modules that can train process skills. This is in line with the results of research which states that the post-test results show that more than 50% of students using the module improve students' skills well (Higgins, Carrolls, & Sharek, 2016). This is reinforced by research which states that classes using modules in learning increase student learning outcomes by 84.89% (Husniati, Suciati, & Maridi, 2016).

## CONCLUTION

The use of Inquiry Based Instructions module in excretion system material improves the students' learning outcome effectively. The effectiveness of module can be seen from the significant increase in the students' learning outcome score after the application of module. The gain score of students' learning outcome in experiment class is 0.45 belonging to moderate category in cognitive students. The learning outcome score increases from 25 (pretest, poor category) to 79 (posttest, good category) in affective domain, and from 15 (pretest, poor category) to 84 (posttest, very good category) in psychomotor domain. The result of advanced test with t-test shows that there is a significant difference of students' learning outcome in experiment class before and after using module. It can be concluded that inquiry based instruction module can improve effectively the learning outcome of the 11$^{th}$ Science Graders in SMA Negeri 1 Madiun in excretion system material.

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