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Development of Laboratory Worksheet with Argument-Driven Inquiry Model to Enhance the Student's Argumentation Skills

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***Abstract*—Successful investigation in the laboratory was supported by a student worksheet. This study aims to measures the validity and effectiveness of laboratory worksheet on a topic the Excretory Systems in Humans that has been developed based on the Argument-Driven Inquiry Model. The result of the research shows that the laboratory worksheet is proper to use as learning resource that validity average is 84.25% are considered theoretically feasible and student response average is 96.40% is considered very good. Improvement of argumentation skill is shown with gain scores of 0.43.**

Keywords—laboratory worksheet; argument-driven inquiry; argumentation skills

I. INTRODUCTION

Many advances in agriculture, health, and environmental control on the one hand bring us all closer to an understanding of how the human mind works, how to produce multiple cells from a single cell and how such diverse lives are formed from only one cell resembling a virus. However, on the other hand, the explosion of information about so many discoveries can make it difficult for people who study them. Most students have not gotten a good way of utilizing science concepts to sort through and give meaning to new things in their thinking [1]. Students are still difficult to internalize the concepts obtained as a basis for thinking. Therefore, science should be taught with an approach as experienced by researchers or scientists when developing knowledge. Including when scientist defends theories and explanations by offering evidence and arguments, this is what is called argumentation.

Someone who is an expert in argumentation can form and choose the reasons that support the claim stated, can explain the situation in which the argument is invalid and evaluate the arguments that are contrary to the others [2]. This relates to the accuracy of arguments as an effort to find out which views are best and are a way for someone to explain and maintain an idea [3]. Student tends to have basic skills to develop argumentation skills, so they need guidance and a supportive environment [4]. The class culture that supports discourse of argumentation and reasoning can help in actively building knowledge. Students need to be given the opportunity to be actively involved in arguments so that they can use scientific language or communicate scientifically [5]. The process of building knowledge is a social process that involves people in their environment [6]. Meanwhile, argumentation activity is part of a social process that can develop scientific discourse in learning. Argumentation plays an important role in knowledge development because through it knowledge is communicated to gain recognition and justification [7-9]

There are a number of researchers who are interested in strategies to integrate argumentation into science teaching and learning with inquiry [9, 10-13, 14]. There are several studies of argument-based inquiry, especially in Indonesia [15-16]. Including research that has been conducted by researchers to design Argument-Driven Inquiry (ADI) learning models in teaching biology in Indonesia [17]. This study can be considered as an effort to design and implement the ADI learning model in the context of biology in Indonesia for students in higher education and evaluate the effectiveness of the model with experimental design. Thus, the current study is also important in terms of introducing the ADI learning model for science education in Indonesia, especially about how learning devices should be used by teachers.

The use of the ADI model in science learning has been put forward by several researchers. The ADI learning model can produce scientific arguments from the search for answers to the research questions given to them [18]. ADI familiarizes students with developing critical thinking by emphasizing the important role of knowledge argumentation and validation [19]. The ADI learning model which consists of a series of laboratory activities can develop students' active participation in argumentation arguments and improve the quality of their arguments. The ADI learning model also increases students' ability to develop arguments and communicate productively through writing [20].

Learning about the excretion system in humans is studying the different structures of each of its constituent organs (skin, liver, and lungs) and the different functions in life. Learning the excretion system in humans in the eighth grade of junior high school in curriculums 2013th is directed towards the achievement of basic competencies 3.10 that is analyzing the

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excretion system in humans and understanding the disruption in the excretory system as well as efforts to maintain the health of the excretory system. The ADI learning model is believed to be right to use because the material of the excretion system in humans can be more easily obtained through real objects and can be seen directly by students. Students can observe phenomena related to the excretion system in humans in everyday life so that they will not experience difficulties when designing scientific investigations.

Based on interviews with teachers from 25 public and private junior high school in Bandar Lampung, it is known that 92% of teachers use student books in the excretion systems in human laboratory activities, while 8% of other teachers use worksheets prepared by themselves. The components contained in student books and worksheets compiled by the teacher only include observing, trying and reasoning. While the questioning and communicating activities have not been presented, so that the shortcomings of the worksheets are not facilitating students in developing the ability to argue. This is in accordance with the results of the worksheet review that a characteristic of the traditional practicum is to use a recipe book that emphasizes student obedience in following procedures for data collection purposes [21]. Almost no attention is given to planning the investigation or to interpret results. Activities like this have been criticized for emphasizing little thought, very ineffective for conceptual change, and unrealistic in describing scientific experiments. Moreover, in building their knowledge students are more focused on fair testing and confirmation of existing truths and only apply theories and concepts that already exist in practice situations [22]. Meanwhile, students need activities that allow them to ask questions, put forward hypotheses and test them, and share ideas clearly so that it is very useful in fostering their skills in argumentation and critical thinking.

Based on the background above, the researcher felt the need to develop teaching materials for the excretion system in humans in the form of laboratory worksheets with the Argument-Driven Inquiry (ADI) model it was more complete because it facilitated activities investigation, argumentation, reading, and writing. In this study also carried out the development of the key to laboratory worksheet of excretion systems in humans. This is so that the teacher can confirm and correct the level of accuracy of student answers and examine which parts are wrong.

II. METHOD

Research and development (R & D) of the laboratory worksheet was adapted from the development of the 4-D (Four-D Models) which includes: define, design, development, and disseminate stage [23]. The choice of developing devices using the 4-D model is based on the advantages and suitability of the research problems.

The defining stage aims to define learning conditions. This stage includes five main steps, namely: front-end analysis, student analysis, concept analysis or concept analysis, task analysis and specifying instructional objectives. The front end analysis aims to bring up and determine the fundamental problems faced in the laboratory activities of the Excretory systems in Humans. Student analysis is a study of the background of students' academic abilities. Task analysis aims to analyze the main tasks in the laboratory worksheet of the Excretory systems in Humans who must be mastered in order to achieve an increase in argumentation skills. Concept analysis includes the identification of concepts taught and characters related to the concept. Formulation of learning objectives includes activities to formulate learning objectives based on basic competencies and indicators of achievement of competencies. From this stage, it is obtained an overview of important concepts and activities in the laboratory worksheet that are developed, which will be used as the basis for drafting the Excretory systems in Humans.

The design stage aims to produce text and image formats related to activities to train students' argumentation skills. This includes discussion questions that must be done by students who direct them to find important concepts related to teaching material. The implementation of this stage consists of 4 steps, namely criterion-test construction, media selection, format selection, and initial design (according to ADI format).

The development stage aims to produce the laboratory worksheet that is theoretically feasible. This development phase consists of several activities. The first, review and validation of the laboratory worksheet that was first made (Draft 1) then reviewed by five reviewers, namely two biological education expert, two biology teacher to get input. Validation carried out is pedagogic validation, content validation, and design validation. Pedagogic validation is used to get an overview of the suitability of laboratory activities with the principles of science learning. Content validation is used to get an overview of the suitability of the material in the laboratory worksheet that students want to master with the learning objectives. While design validation is used to get an overview of the design alignment that is applied in the laboratory worksheet. The input is used as a consideration for perfecting draft 1 into draft 2 the laboratory worksheet that is ready to be tested on students. The second is readability test, draft 2 the laboratory worksheet is then given to 30 eighth grade junior high school students to find out the readability of the practical instructions. Student response data on the readability the laboratory worksheet is used as consideration for perfecting draft 2 into draft 3 the laboratory worksheet with the ADI model.

Further, the laboratory worksheet of the Excretory systems in Humans with the ADI model that has been developed tested through experimental research on two classes of research subjects, namely students of junior high school grade VIII *MTsN* 1 Bandar Lampung. The experimental research used in this study is a quasi-experiment. The experimental design used in the study was the Pretest-Posttest Non-equivalent Control Group Design.

The instruments used in this study consisted of validation instruments, legibility questionnaires and argumentation skills tests. Validation instruments for the laboratory worksheet of the Excretory Systems in Humans with the ADI model for Grade VIII Junior High School Students are used to determine the quality of laboratory worksheet of developed and to get input. This validation instrument is a checklist containing a series of statements regarding pedagogical validity, content

validity, and design validity. The validator is asked to respond to the statement by giving an assessment score provided that: 1 = not good/inappropriate; 2 = poor/inappropriate; 3 = good/appropriate; 4 = very good/very appropriate. The percentage of ideal scores obtained from each indicator is calculated by using the formula:

$$\%\ ideal\ score = \frac{\text{Average score for each aspect}}{\text{highest score in each aspect}}\ X\ 100\%$$

The ideal score percentage criteria are divided into several categories, namely: Very Good: >70, Good: 40< % ideal score< 70, Poor: <40.

The questionnaire is used to determine the response of students to the readability of laboratory worksheet with the ADI model. This is presented in the form of positive statements and students are asked to respond to statements with answers to Yes or No. This was given to every student who has carried out the laboratory worksheet of the Excretory systems in Humans using instructions with the ADI learning. The percentage of scores obtained from each indicator is calculated by using the formula:

$$\%\ ideal\ score = \frac{\text{Average score for each aspect}}{\text{highest score in each aspect}}\ X\ 100\%$$

The ideal score percentage criteria are divided into several categories, namely: Very Good: >70, Good: 40< % ideal score< 70, Poor: <40.

Tests are used to measure students' skills in writing scientific arguments. This argumentation skill test in the form of essays and developed refers to the competing theories strategy by Osborne et al. [24]. The rubric used to analyze argumentation skills based on the ability of students to write scientific discourse refers to the Toulmin Argumentation Pattern (TAP) based on the framework of Osborne et al. [24] as in table 1.

TABLE I. ANALYTICAL FRAMEWORK USED FOR SCORING THE ARGUMENTATION SKILLS

Score	Criteria
5	Argumentation consists of arguments that are a simple claim versus a counter-claim or a claim versus a claim
4	Argumentation has arguments consisting of a claim versus a claim with either data, warrants or backings but contain any rebuttals.
3	Argumentation has arguments with a series of claims or counterclaims with either data, warrants or backings with the occasional weak rebuttal.
2	Argumentation shows arguments with a claim with a clearly identifiable rebuttal. Such an argument may have several claims and counterclaims as well.
1	Argumentation displays an extended argument with more than one rebuttal

To facilitate the assessment of students' argumentation skills based on the Osborne framework, a coding system based on linguistic features is used in accordance with the indicators by Brudvik [25] as in table 2.

TABLE II. CODING IN THE ARGUMENTATIVE ASSESSMENT

Alphabet Code	Meaning	Linguistic Features
C/CC	Claim/ CounterClaim	I agree with…; I support….; I think ... it's right ... or I don't agree ... I disagree with ... In my opinion ... it doesn't fit ...
W	Warrant	I agree with ... because ... Why do I support ... because ...; The thing that makes me disagree is ...
B	Backing	Based on what I've experienced ...; According to what is contained in the book ... If we look at the facts about ... From the theory I read ...; I've heard about ...; The following phenomena /data /facts prove …….
R	Rebuttal	I do not agree….; I disagree with ... I think …… is not appropriate; Your statement seems inappropriate ……
RW	Rebuttal against warrant	I disagree with your reasons ...; The basis that you put forward doesn't seem to support ...
RB	Rebuttal against Backing	Actually I agree with the reason only the data about ... ... is not right ...

Before the argumentation skills test is used, validity analysis is first carried out including content, construct, and empirical validation. Test questions are chosen based on items that meet the representativeness of the subject matter of the excretory systems in humans after considering the results of the validity and reliability test. Tests of students' argumentation skills are carried out before the use of laboratory worksheet (pre-test) or after the use this (post-test). The results of the pre-test and post-test were processed to determine whether or not there was an increase in students' argumentation skills by calculating N-Gain (g) with the formula:

$$g = (Spost\text{-}Spre)/(Smaks\text{-}Spre)$$

The acquisition rate is categorized into three categories, namely: Height: g> 0.7; Medium: 0.3 <g <0.7; Low: g <0.3 [26].

Data analysis techniques used in this study are descriptive statistics and inferential statistics. Descriptive statistics are used on validation results data and readability questionnaire data to show descriptions or quality profiles of laboratory worksheet for the excretory systems in humans developed. Meanwhile, inferential statistics are used to test differences in N-gain critical thinking skills between the two sample classes. The difference test used is the Paired Sample T-test at a significant level of 5%. The test criteria are if Sig> α then the hypothesis is accepted and if Sig <α then the hypothesis is rejected. The t-test assumption is that the data is normally distributed and has homogeneous variance. Testing the normality of the data in this study using One-Sample Kolmogorov-Smirnov Test. Decision making in this test is based on a comparison of the probability or significance value (sig) with a 5% confidence level (α = 0.05) in the results of the analysis. The test criteria used are if the Sig> α then the data is normally distributed and are the Sig < α then the data is not normally distributed. The variance homogeneity test of the data is done after the data is known to be normally distributed. Homogeneity test in this study uses The Levene Test of Equality of Error Variances. The homogeneity test criteria are if Sig > α then the data group

variant is the same and if Sig < α then the data group variant is different.

III. Results and Discussion

The results of this study are presented based on the define, design, and develop stages.

A. The Define Stages

The results of the front end analysis through interviews with 12 teachers from 25 public junior high schools in Bandar Lampung City showed that laboratory worksheet for the excretory systems in humans used by teachers as much as 92% are contained in student textbooks and 8% prepared by the teacher themselves. That is only contained activities to observe, collect data, associate, and there is no questioning process and communicate. In addition, the work steps presented lack training for students to conduct investigative activities, understand concepts, and lack of developing arguments.

Most of the teachers surveyed stated that students' argumentation skills were categorized as low because they had difficulty displaying certain facts that were relied on to support opinions, provide supporting and relevant evidence and make causal explanations related to the phenomenon given. The results of this study support the results of similar previous studies. It concluded that after students succeeded in providing explanations or suitable solutions, they then had difficulty giving justification in explanations with appropriate evidence and reasoning based on a scientific perspective [27]. Meanwhile, argumentation skills are the ability to provide reasons (data, justification/backing, and warrant) to strengthen or reject an opinion (claim) [24].

The results of student analysis obtained through questionnaires about self-concept towards argumentation skills show that the potential of students is large enough to skillfully argue for learning activities. As many as 52% of 1100 junior high school students in Bandar Lampung City feel the need for argumentation skills to be developed in learning. In part (50%) students feel challenged to argue when they are in a forum, 50% of students believe they are able to speak fluently and confidently to speak in front of the class, 46% of students are interested in commenting on other people's opinions, and 76% of optimistic students can show evidence and justify defending opinions.

The survey results on the students' self-concept above show that there is a large potential for students to support the development of argumentation skills in lectures. Students feel challenged in discussion forums, commenting on other people's opinions, and justifying their opinions. The students tend to have basic skills to develop argumentation skills [4], so they need guidance and a supportive environment. The class culture that supports discourse of argumentation and reasoning can help in actively building knowledge. Students need to be given the opportunity to be actively involved in arguments so that they can use scientific language or communicate scientifically [5].

The concept analysis carried out in this study is based on the Curriculum 2013th on the subject matter of the Human Excretory Systems in the eighth grade of junior high school. Learning for this topic aimed at achieving basic competencies namely analyzing the excretory systems in humans and understanding the disruption in the excretory systems as well as efforts to maintain the health of the health excretory systems. This concept analysis involves identifying the concepts taught and the characters related to the concept as reference material for students as summarized in the concept map in figure 1.

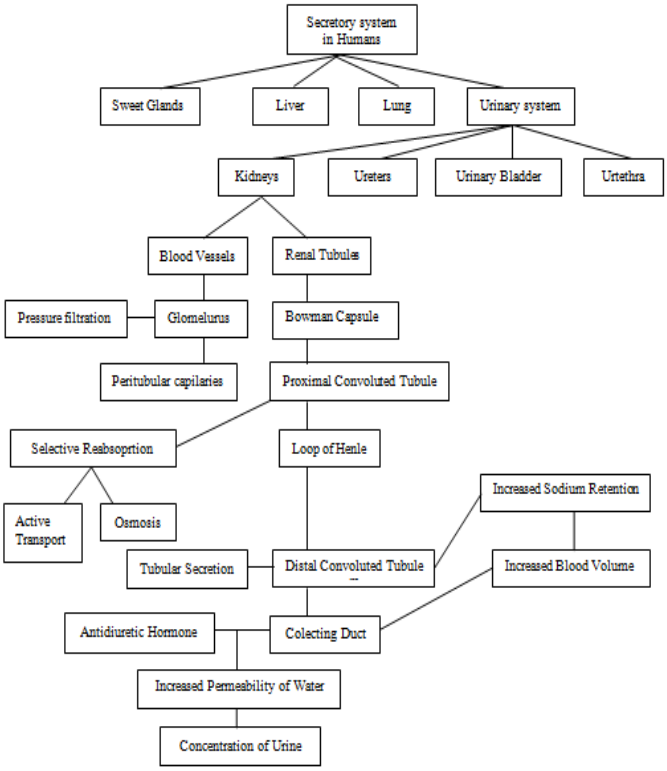

Fig. 1. Concept maps of the excretory sytems in humans.

The task analysis in this study produces the details of the main tasks that must be done by students to be able to empower the argumentation skills is designing investigative activities, preparing tools and materials, conducting experiments and collecting data, writing arguments in the form of schemes in a whiteboard (by making claims, data, warrant and backing), after that the arguments that have been compiled are discussed through interactional sessions of arguments, and finally students must compile written inquiry report as homework. Formulation of learning objectives concerning basic competencies and indicators of the achievement of competencies in a topic of the excretory systems in humans is shown in table 3.

TABLE III. BASIC COMPETENCE, INDICATORS, AND TOPIC

Basis Competence	Indicator	Topic
Analyze the excretory systems in humans and understand the disruption in the excretory systems and efforts to maintain the health of the excretory system	Detailing kidney parts as constituent organs of excretory systems in humans. Describe the structure of the kidney as the constituent organ of the excretory system in humans.	Kidney as an excretory organ
	Detailing skin parts as constituent organs of excretory systems in humans. Describe the structure of the skin as the constituent organ of the excretory system in humans.	Skin as an excretory organ
	Detailing lung parts as constituent organs of excretory systems in humans. Describe the structure of the lung as the constituent organ of the excretory system in humans.	Lungs as Organ Excretion
	Record disturbances in the human excretion system. Explain efforts to prevent and how to overcome interference in the human excretion system	Disruption of the Excretion System and Efforts to Maintain the Health of the Excretion System

B. The Design Stage

The draft laboratory worksheet has been produced which contains texts, drawings, and discussion questions for the Excretory Systems in Human with the ADI model in accordance with the integrated indicators. The laboratory worksheet for the Excretory Systems in Humans developed to follow the laboratory sheet format of Sampson and Gleim [13]. Preparation of laboratory worksheet is arranged in several sections including the cover, preface, table of contents, laboratories activity rules, rules of argumentative discussion, argumentation guide, inquiry report review sheet, and bibliography. The physical appearance of the laboratory worksheet with attractive the cover, neat arrangement and clear picture. The cover of the laboratory worksheet includes the title of the book, the name of writer, class, semester, year of publication, and illustrations that can provide precise information about the contents of the laboratory worksheet. The content of the laboratory worksheet consists of student identity, practicum title, theoretical basis, objectives, questions, tools, materials, work steps, arguments on the board, argumentation and report sessions. The laboratory worksheet format uses Baskerville Old Face letters with a font size of 12, using sentences that are easy to understand and do not have a double meaning and use the enhanced spelling that is good and true. The laboratory worksheet can be seen in figures 2 to 5.

Name: **Class:** **Date:**

KIDNEY AS AN EXCRETORY ORGAN

Introduction

Your body consists of many systems that work, one of which is an excretion system. The excretion system is responsible for removing metabolic waste in the form of urea and ammonia. The excretion system is composed of several organs. One of the constituent organs of the excretory system is the kidneys. Every human has a pair of kidneys, left and right kidneys, which are located in the waist region. Kidney has a function to form urine through various stages that occur in the kidney nephron. These stages start from filtering the blood, absorbing what is needed, and finally becoming urine. The kidneys excrete urea and ammonia through urine.

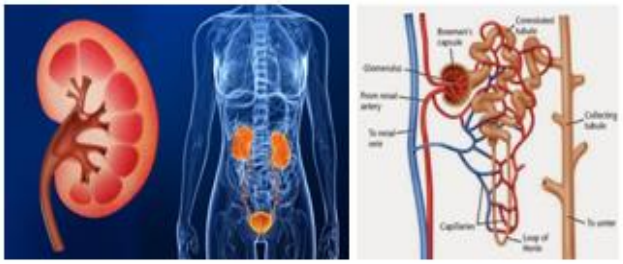

Fig. 2. Kidney and nefron.

Objective

In this learning you will do a filtering solution that shows simply the filtration process.

Research Question

Why is there a difference between the filtered solution and the starting material before being filtered?

Tools and Materials:

You may use any of the following tools and materials during your investigation.

1. Becker glass kimia 500 ml
2. Corong plastik
3. Filter Paper
4. Stick
5. Water
6. Wheat Flour

Fig. 3. Laboratory worksheets consisting of student identity, title, introduction, objectives, research questions, tools and materials.

Procedure

1. You need to do an investigation using the tools and materials provided to answer research questions. You also have to use student books which can be downloaded from http: // bse. kemdikbud.go.id compares your data.

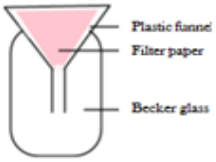

Figure 2. Blood filtering model device

2. Arrange the tools as shown in Figure 2. Then make the solution by mixing flour and water to form a solution with a ratio of 4: 1 flour. Observe the solution then carefully pour some of the solution that has been made on filter paper.
Observe the solution formed, compare it with the first solution, what distinguishes it? This is a trial of kidney function as a blood filter for filtration.

3. To complete this task, you must determine the type of data to be collected, how to collect it, and how to analyze it. For this reason, answer the following questions:
   - What data should you collect from this experiment?
   - How do you collect data?
   - How can you ensure that your data is of high quality (ie, how will you reduce errors)?
   - How do you organize the data collected?
   - How can you analyze the data that has been collected?

When you work through this activity, be sure to think about how valid and relevant data and evidence are. Also, think about the exact method as commonly used by scientists to answer questions.

Argumen:
After your group collects and analyzes data, develop the initial argument. The argument needs to include claims, evidence to support claims, and justifications. Claims are answers to research questions. Evidence is the result of data analysis and interpretation. Justification contains reasons why you support claims with available evidence. Justification is very important because scientists can use various types of evidence to support their claims. Your group must write the initial argument on the board and must include all information as shown in Figure 3.

Fig. 4. Laboratory worksheets consisting procedure and argument.

Argumentation Session

To share your findings with others, one group member must stay at the group table to share ideas. While other members must go to one of the other groups to listen and criticize the arguments developed by your friends. When criticizing the work of others, you must decide whether their claim is legitimate or acceptable based on how well the evidence and the basis of truth can support their ideas. To do this, answer the following questions by checking (√) in the appropriate selection column.

- *Are their claims sufficient to answer research questions and need not be contested?*
  ☐ *Yes* ☐ *No*
- *Do they use original evidence to support their claims?*
  ☐ *Yes* ☐ *No*
- *Do they use sufficient evidence to justify their ideas?*
  ☐ *Yes* ☐ *No*
- *Is their evidence high quality? In other words, their evidence is valid (using the right method to collect and analyze data) and is reliable (they try to reduce errors)?*
  ☐ *Yes* ☐ *No*
- *Are their claims in accordance with the theories used in Science?*
  ☐ *Yes* ☐ *No*
- *Is their reason adequate (explaining by including evidence and why the evidence supports their claim) and is appropriate (logical and rational)?*
  ☐ *Yes* ☐ *No*

When the argumentative discussion session is complete, your group has the opportunity to share information and revise the argument. Remember! Your goal is to develop the most valid answers or be accepted by research questions.

Report
After completing the investigation, you need to compile a report consisting of three parts, namely: objectives, method of inquiry, and arguments, the objectives section containing the problem, objectives, and benefits of the investigation. The second part contains the methods you used during the investigation and the reasons why you did it. The third part contains your arguments which consist of claims, evidence, warrant and backing. Your report must be written in 2 pages or less (no more than 2 pages). This report must be typed and each diagram, picture, or table must be listed in it. Be sure to write in a persuasive style, because you have to convince others that the claim is accepted or valid!

Fig. 5. Laboratory worksheets that contain tasks for argumentation session and writing reports.

C. The Development Stage

Data from five validators are obtained. This is in the form of recapitulation of the validation results of the laboratory worksheet of the Excretory Systems in Humans can be seen in table 4.

TABLE IV. VALIDATION RESULTS FOR THE LABORATORY WORKSHEET

No.	Aspect	Indicator	Average Score	% ideal score
1.	Identity completeness laboratory worksheet on the cover page	The cover consists of 6 identities: the title of the book, the name of the writer, class, semester, year of publication, and illustrations that can provide precise information about the contents of the practical manual	4	100
2.	Clarity of practical objectives	a. Practical objectives are formulated operationally	3,4	87
		b. Conformity with practical objectives with basic competencies	3,6	
		c. Suitability of practical objectives with indicators	3,4	
3.	Presentation of material	d. The topics in the practical guide are in accordance with the material	3,8	90
		e. Conformity of material with the purpose of practicum	3,6	
		f. Suitability of material to the grade level of students	3,8	
		g. The material is logical and traceable	3,4	
		h. Conformity of submission of research questions with the purpose of practicum	3,4	
		i. Suitability of the selection of tools and materials for practical purposes	3,6	
		j. Suitability of procedures for practicum purposes	3,6	
		k. Keakuratan ilustrasi berupa gambar	3,4	
		l. Suitability of table presentation	3,8	
4.	Use of language	m. Sentences are easy to understand and there are no writing errors	3,4	88
		n. Sentences are not double meaning and do not use figurative words	3,6	
		o. The accuracy of the use of spelling and punctuation	3,6	
5.	Readability level	p. Readability clarity of writing	3,6	95
		q. Clarity of type, size (font), and writing style	3,6	
6.	Physical appearance	r The physical appearance of the book can attract students' attention to learning	3,6	90
7.	Implementation level of laboratory activities	s. Practicum is safely carried out by students	4	100
		t. Practicums can be carried out during school hours and the tools and materials are easily obtained	4	

Table 4. Cont.

8.	Student self-development is in accordance with the ADI model	u. Practical activities can provide direct experience to students	3,8	93
		v. Practicum activities are able to invite students to be active in practicum activities	3,8	
		w. Practical activities can stimulate active students to collaborate in groups	3,8	
		x. Practicum activities can encourage active students to argue	3,6	
		y. Practicum activities can encourage students to compile arguments with a complete structure, consisting of: claims, data, warrant, and backing	3,8	
		z. Practical activities can stimulate active students to think critically	3,6	
		a a. Practicum activities can improve students' psychomotor skills	3,6	
		Average of % ideal score		93

Table 4 shows that all validated aspects obtain an average percentage of ideal scores ≥ 90 except in aspects clarity of practical objectives (86%). This result shows that the laboratory worksheet of the Excretory Systems in Human is very good criteria so that it is theoretically feasible. The highest percentage of ideal scores is 100 given a validator for aspects of identity completeness on the cover page and implementation level of laboratory activities. This shows that the cover of the laboratory worksheet can provide precise information about the contents of the laboratory worksheet. Other than that, the result of validation also shows that all laboratory activities can facilitate student activity in investigation and argumentation.

Based on the description above, it can be said that the laboratory worksheet developed has fulfilled didactic, construction and technical requirements. Laboratory worksheets are learning activity signs used to guide students to do and find their own concepts and or skills according to basic competencies and corresponding competency standards. Didactic requirements regarding the use of universal student worksheets can be used well for slow or smart students, emphasizing the process of finding concepts, there are variations in stimulus through various media and student activities, and prioritizing the development of social, emotional, moral and aesthetic communication skills [28]. Construction requirements relate to language usage, sentence structure, vocabulary, level of difficulty, and clarity. Technical requirements emphasize the presentation, namely in the form of writing, pictures, and appearance.

Based on the results of the validation test, some suggestions, responses, or input provided by the validator on the laboratory worksheet are recorded. The advice given regarding the suitability of the material in the laboratory worksheet of the Excretory Systems in Humans developed with basic competencies is to reduce misconceptions, for example: “the kidneys in the lower abdomen” should be “located below the waist”. Then the suggestion in terms of the choice of words for this sentence, "this unknown part of the skin" is replaced with "the skin part and the X mark", so that it is clear which part is meant.

In addition to the data collected from the results of the validation also obtained data readability the laboratory worksheet of the Excretory Systems in Humans of 30 students presented in table 5.

TABLE V. READABILITY OF LABORATORY WORKSHEET OF THE SECRETORY SYSTEMS IN HUMANS

No.	Aspect	Indicator	% answer ‘yes’
1.	Physical display	a. Interesting book cover	90
		b. The writing is clear	100
		c. Color image	100
2.	Fill in the laboratory worksheet	d. Loading activity objectives	100
		e. The explanation of the working procedure is clear	93
		f. The tasks given are interesting and challenging	80
3.	Implementation of laboratory activities	g. Easy to implement	93
		h. Provide direct experience	90
		i. Safe to carry out	100
4.	Use of language	j. Clear sentence	100
		k. Sentences are easy to understand	100
5.	Self-development in accordance with the ADI model	l. Inviting active students to practice	100
		m. Stimulate working in groups	100
		n. Encourage arguments	100
Average readability the laboratory worksheet			96

Table 5 shows that the average readability of the laboratory worksheet of 96% means that students give very good grades for readability the laboratory worksheet of the Secretory Systems in Humans. All students positively respond about aspects the use of language and self-development in accordance with the ADI model. In other words, students assume that the laboratory worksheets that are developed can describe the learning process that can make students active in developing group collaboration skills and arguing. Laboratory activities are not always successful in involving students in finding their own concepts but will succeed if the activities within them are thought processes and clear objectives [29]. This is in line with the theory that said learning provides opportunities for students to engage in argumentation [30], not only provides a place to construct scientific ideas but also increases their understanding of science well.

D. Quasi-Experiment

The quasi experiment using students of class VIII A and VIII B MTs Negeri 1 Bandar Lampung results showed that students in both classes experienced an increase in argumentation skills with a value of N-Gain = 0.43 in the medium category in the experimental class and N-Gain = 0.10 in the low category in the control class. In addition, the results of the Paired Sample T-test showed that the value of the significance level was 0.00 ($p < 0.05$), meaning that there was a significant difference in the average argumentation skill scores between the two classes of samples. In addition, students who use laboratory worksheets with the ADI model have higher argumentation skills than those who do not use them.

Related to students' self-development through laboratory worksheets the excretion system in humans in relation to the improvement of argumentation skills cannot be separated from the role of the ADI model used. ADI helps students develop the habit of developing reasoning and critical thinking by emphasizing the important role of argumentation in generating and validating scientific knowledge [31]. Some of the following are the main characteristics of ADI, namely: emphasizing student activities to the maximum in designing and carrying out investigations, arguing, writing, and reviewing [31,19]. In learning using ADI, students are directed to design and carry out investigations, collect and analyze data, communicate, and justify their ideas with each other. Next, students write an investigative report in the argumentation session to share arguments and engage in peer-review. Thus, students have the opportunity to practice scientific methods and engage in scientific argumentation, so they can develop their critical thinking skills. ADI helps students develop the habit of developing reasoning and critical thinking by emphasizing the important role of argumentation in generating and validating scientific knowledge [31]. The development of critical thinking can be done through learning that provides epistemological understanding [32]. Epistemological understanding is an understanding of the ways knowledge is developed. Students are given the opportunity to explore and provide arguments in obtaining an objective and logical knowledge so that they can use their intellectual abilities such as analysis, evaluation, and reflection.

IV. CONCLUSION

Based on the results of the study, it can be concluded that the laboratory worksheet of the Excretory Systems in Humans has been produced with the right Argument-Driven Inquiry model to be used as teaching material for Grade VIII Middle School Students. This is supported by the results of validation on all aspects of obtaining an average percentage of an ideal score of 93% which is categorized as theoretically feasible. In addition, the readability of the laboratory worksheet gained an average positive response of 96% which was categorized as very good. Furthermore, the laboratory worksheet of the Excretory Systems in Humans with the ADI model is effective in improving students' argumentation skills. This is supported by the existence of significant differences in argumentation skills between students in the experimental class and students in the control class. The improvement of students' argumentation skills in the class using the laboratory worksheet of the Excretory Systems in Humans with the ADI model (N-gain score = 0.43) was higher than the students who did not use the laboratory worksheet with the ADI model (N-gain score = 0.10). Teachers must be encouraged to use experiments using the laboratory sheet with the ADI model which facilitates 4 types of activities, namely: inquiry, argumentation, reading, and writing. Thereby, the whole laboratory activity can emphasize the thinking process so that it is very effective for conceptual and realistic changes in the depiction of scientific experiments.

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