

Standarize Diagnostic Test of Elementary School Student's Learning Difficulties on The Digestive System Material

I Maryani¹, N E Pramesti², L Fatmawati¹, and V E Erviana¹

¹Elementary School Teacher Education, Ahmad Dahlan University, Jl Ki Ageng Pemanahan 19 Sorosutan, Indonesia, 55162

²Watukeyo Elementary School, Jl Raya Glondong, Blimbingsari, Banyuwangi, East Java, Indonesia, 68462

e-mail: -

Abstract. This research aims to determine the feasibility of the standardized diagnostic test for learning difficulties in the digestive system learning material. Also, to determine the quality of the standardized diagnostic test. The design of this research and development refers to the 4D model which consists of four stages, there are define, design, develop, and disseminate. The feasibility test was conducted on material expert, evaluation expert, teachers, and students. Data collection was conducted by interview, questionnaire, and tests which were then analyzed with statistic descriptive and cycle method of qualitative analysis. The results of the feasibility test were carried out on small scale trial and field trial, the results of these calculation was very significant with an average score of 84.45 with very good categories. Furthermore, the results of the research indicated that there are questions that considered difficult by students, i.e. 11 items of A questions package, 14 items of B questions package, and 12 items of C questions package. From these results, it can be concluded that the instrument is suitable to be used to diagnose learning difficulties in students.

1. Introduction

The success of a nation can be measured by the progress of technology and science [1]. Mastery of the technology and science can be trained by the mastery in Natural Sciences. It is in accordance with the education purpose in Indonesia, which is to make humans independent and sensitive to the surrounding environmental conditions. In realizing this purpose, there needs to be a cultivation of the character value of independent, and also sensitive to environmental conditions. There are various subjects at every level of education in Indonesia, one of which is the subject of Natural Sciences Learning. Natural Sciences is an important learning in life, thus humans can distinguish business fields, identify arguments, and other scientific explanations [2]. In addition, Natural Sciences learning can familiarize students in constructing their own knowledge [3], thus it will familiarize students to be independent in solving problems of the surrounding environment. It can be concluded that Natural Sciences learning in schools plays an important role, especially at the elementary school level, which is the first stage of formal education [4].

Natural Sciences knowledge is gained from collecting data through experiments, observations, and deductions in order to obtain an explanation [5]. Natural Sciences learning will also train and develop an understanding on the types of natural symptoms that are useful in everyday life. In addition, Natural Sciences learning benefit is that it can develop an attitude of curiosity and awareness to manage, maintain, and preserve the environment and natural resources [6]. Thus, the students' challenge in Natural Sciences learning is very high. Therefore, Natural Sciences learning is emphasized and oriented

towards students' activities [7]. The teachers' role is not only as a learning source but as facilitator, manager, demonstrator, mentor, and motivator to achieve Natural Sciences learning purpose optimally

Natural Sciences learning contains knowledge about natural life that functions to develop process skills to investigate the environment, solve problems, make decisions, and develop awareness about the role and importance of understanding natural life [8]. Natural Sciences is a phenomenon that is brought and seen from birth in everyday life, so that Natural Sciences will be close to life on earth. Many Natural Sciences concepts are found in everyday life.

Learning failure is not only influenced by the students' level of intelligence and health, but also by not mastering the good learning methods. It turns out that there is a correlation between learning methods applied and the results achieved. Classroom learning will have consequences for the teachers to increase their role and competence, because competent teachers will be better in managing classes and carry out evaluations for students, both as individuals and class[9]. Based on the results of in-depth interviews conducted on December 8, 2017 at the Muhammadiyah Bodon Karangturi Elementary School Yogyakarta, it can be identified that some of the Natural Sciences learning material in elementary school is difficult to understand. The learning material is about the digestive system and bloodstream system, many students found difficulties in the learning material because there are terms that must be understood by students. Whereas the learning process is based on memorization that makes it difficult for students to understand it in Long Term Memory. This triggers learning difficulties in students so that learning objectives are not optimal. Knowing learning difficulties in students is very difficult, because each individual has a different natures, abilities, and characteristics so that teachers need the tools to know and diagnose learning difficulties in students (10). One tool that is easy to use in students' learning evaluation process is a test tool. In the evaluation process, test tool that commonly used is the form of evaluation instruments of multiple choices, short answers, and essays. Although, it did not yet developed in accordance with the students' characteristics and in the context of the learning material.

Essentially, Natural Sciences learning focus in the interaction between students and objects or nature directly. Therefore the teachers, as a facilitator, need to create conditions, and also provide a means so that students can observe and understand Natural Sciences objects. Therefore, students can found concepts, and then build it in their cognitive structure. Considering the essence of Natural Sciences is not only as a product but also as a process and scientific attitude [11], the teachers are obliged to provide a vehicle or media, and also improve the students' learning experience in order to achieve the Natural Sciences learning purpose. However in reality, Natural Sciences learning in the educational world, especially in elementary schools, is still complex and abstract [9]. The learning material contained in it uses a lot of scientific terms that students found it difficult to understand. The impact is that students found it difficult to develop the Natural Sciences concepts, and also students found it difficult to construct it in Long Term Memory [LTM]. The solution is that media, methods, strategies, techniques, and evaluations in the learning process need to be adjusted to the students' learning characteristics. If it is not overcome by adjusting learning to the students' characteristics, it likely leads to students' learning difficulties. Whereas learning difficulties will inhibit students in achieving complete learning goals.

Several researchers have conducted the development of the learning diagnosis instrument. A diagnostic instrument for studying chemistry in 9th grade High School is developed [12]. The research used a teslet model that increases the curiosity of students who working on the instrument. Therefore, this research only for high school students and in 9th grade Chemistry class, while diagnosing learning difficulties need to be applied to elementary schools in order to know and diagnose learning difficulties at the primary education level. Therefore, diagnosis can be done as early as possible before misconceptions occur in Natural Sciences learning because the Natural Sciences learning material is complex and abstract. Other developments related to diagnostic instruments of learning difficulties were also carried out[13].

The research was conducted in Natural Sciences learning at junior high schools, in which same with previous studies, diagnosing learning difficulties should be done in the primary education system, so that in the learning process can be known before it occurs at the next level of education. While in the

research also developed m-diagnostic test worthy to use for diagnose the level of student's concept understanding [14]. Knowing the importance of students' evaluation in accordance with their understanding level, it is necessary to have instruments as a diagnosis to elementary school students' learning difficulties in Natural Sciences learning. The learning materials in Natural Sciences learning are classified as complex and abstract so that it is necessary to have a diagnosis instrument for students' learning difficulties [14,15] The analysis result from the error answers and problem solved by students are very useful to know the students' misconceptions and also the students' achievement in the learning process. Hopefully, after there is a diagnosis instrument for 5th grade students' learning difficulties in the digestive system learning material, the teachers can diagnose students' learning difficulties [16]. Therefore, learning difficulties can be handled early on, before students gain wider knowledge.

Diagnosis is a complex process in an attempt to draw a decision from the results of an examination of symptoms, causes estimation, observations, and adjustments. Diagnostic tests are used to observe certain diseases. When linked to the world of education, diagnostic tests can be used to determine the students' actual abilities, including learning difficulties [17].

The diagnostic assessment component is considered the same as with the assessment in general, the purpose of diagnostic assessment is to find out the students' strengths, weaknesses, knowledge, and skills in learning [18,19]. Diagnostic assessment includes making decisions about an undergoing series of predetermined provisions. The following are the principles that become the reference for diagnostic assessment in learning: associated with previous learning objects; systematic in the curriculum; must be able to identify the next step; students must be involved in the process of identifying learning needs; the teacher must innovate in the learning approach; valid, reliable, acceptable, and practicable in learning; honest; language must be clear and not damage the results; can test key skills taught in the curriculum; students must understand the causes and how they are tested.

The purpose of this research is to determine the feasibility of evaluation instrument for diagnosis of 5th grade students learning difficulties in the digestive system learning material. To find out the quality of diagnostic instruments of 5th grade students' learning difficulties in the digestive system learning material. The practical benefit from this research and development is that it can help the teachers in the evaluation process to diagnose students' Natural Sciences learning difficulties in the digestive system learning material, furthermore helping the teachers in knowing learning achievement, so that they can do appropriate follow-up for students.

2. Method

This research and development used 4D model [19] i.e. define, design, develop, and disseminate. The define stage aimed to find out the needs analysis of the problems that were happening. In this stage were analysis of field problems, analysis of material, and literature studies. Depth interview used to get data from 5th grade teacher.

At the design stage, there were several steps, i.e. formulating an evaluation, material, and the product design. In the instrument for learning difficulties diagnosis was equipped with a diagnostic guide for the teachers, making it easier for the teachers to self-taught. Furthermore, the instrument was equipped with digestive system questions consisting of three questions packages. The three questions packages were used to minimize students in cheating the test. In addition, the instrument was also equipped with tabulations to facilitate teachers in analyzing students' learning difficulties individually.

At the develop stage, there were the instrument pre-making, instrument preparation, instrument validation to experts. The researchers conducted literature studies to get the material about the human digestive system. The authors also provided material with pictures and internet sites. Pictures and illustrations used to support students' visual capturing. The next stage in the preparation of evaluation instrument for learning difficulties diagnosis in the digestive system learning material. Researchers needed to adjust it to the characteristics of students and teachers. So that teachers and students can easily apply it well. The components of the evaluation instrument for learning difficulties diagnosis were Cover Page, Preface, Table of Contents, Definition of Diagnostic Test, Core Competency, Basic Competency, and Indicators, Guidelines for Diagnosis of Students' Learning Difficulties, Question Packages of the

Evaluation Instrument for Learning Difficulties Diagnosis, Answer Keys, Scoring guide, Tabulations of Correction of Students' Achievement, Tabulation of Errors in Answering the Questions, Tabulation of Analysis of Students' Learning Errors.

Small scale trial was conducted on 9 students of Muhammadiyah Miliran Elementary School and field trial was to 30 students of Muhammadiyah Karangturi Elementary School. This research analyzes the data to get the results of the learning evaluation in the form of valid and effective diagnostic evaluation instrument. When these conditions are met, then the results of the development of instrument for diagnosis of learning difficulties in the digestive system is feasible. In analyzing data based on questionnaires, levels up to 4, the alternatives are determined as follows:

Table 1. Score Category

Chosen Answer	Scores Value	Category
First Choice	4	Very Good
Second Choice	3	Good
Third Choice	2	Less Good
Fourth Choice	1	Not Good

Then when an assessment has been made, the score calculated by the formula, as follows:

$$NP = \frac{R}{SM} \times 100 \tag{1}$$

Information:

- NP : Percentage value sought or expected
- R : The raw score obtained
- SM : Ideal maximum score of the test
- 100 : Constanta

The next was testing the level of difficulty. The level of difficulty can be expressed in several ways which are [1] proportions of correct answer, [2] linear difficulty scale, [3] Davis index, and [4] bivariate scale [20]. The equation used to determine the level of difficulty with the proportion of answers is:

$$p = \frac{\sum x}{SmN} \tag{2}$$

- p : Proportion of correct answer or level of difficulty
- $\sum x$: The number of test participants who answered correctly
- Sm : Maximum score
- N : Number of test participants

After knowing the level of difficulty of the questions, it was necessary to know the discrimination power of the questions. Discrimination power test can be done by the following formula:

$$D = \frac{\sum A - \sum B}{n} \tag{3}$$

3. Result and Discussion

The data used to process data obtained from the results of research by material expert, learning expert, students, and teachers. First step, in terms of suitability with learning objectives. Instrument of learning difficulties diagnostic is in accordance with Core Competencies, Basic Competencies, indicators, and learning purposes. Evaluation instrument for diagnosis of learning difficulties in the digestive system learning material are in accordance with the students' characteristics in elementary schools. Therefore, the evaluation instrument for diagnosis of learning difficulties in the digestive system can be easily

applied in learning. The questions used do not make students feel anxious in the process. Moreover, the teachers also able to easily apply the instrument.

Second step is in terms of the suitability of the material with the curriculum. Evaluation instrument for diagnosis of learning difficulties in the digestive system contain questions that cover all material in the curriculum. In the delivery of the test questions use effective language that easily understood by students. Therefore, in the process of working the question, the students do not feel uneasy.

Third, in terms of practicality, there are user guideline with clear steps intended for teachers. Therefore, in the implementation process, the teachers are able to carry it out independently. In addition, instructions for working on questions also use language that is easily understood by students. In terms of the display of evaluation instrument for diagnosis of learning difficulties in the digestive system use writing types that can be easily read by students, and use supporting pictures to clarify the questions delivery to students. Then a product test was conducted to the evaluation expert carried out by the learning evaluation expert. The final score from the media expert validation is 76.9 ("Good" category).

Evaluation instrument for diagnosis of learning difficulties in the digestive system need to be equipped with diagnostic guidelines to facilitate the teachers in analyzing students' learning difficulties. Furthermore, it is also important to add tabulations to facilitate the teachers in analyzing using tables related to students' learning difficulties. To distinguish the A package, the B package, and the C package, it is needed a divider, thus it will be easier for the teachers to find out, understand, and determine the desired questions packages. The second assessment was conducted by the learning evaluation expert with the final score validation of 76.9 ("Good" category). First is in terms of objectivity which includes several things. Evaluation instrument for diagnosis of learning difficulties in the digestive system is practical and easy to use. In practice, it does not make students feel anxious and does not difficult to be implemented by teachers. In addition, evaluation instrument for diagnosis of learning difficulties in the digestive system is equipped with clear work instructions that make it easier for teachers and students to applicate it independently.

The questions contained in the product are in accordance with the curriculum 2013. Furthermore, the questions also do not use ambiguous language, also covering the whole aspects of students' comprehension. Moreover, in the aspect of deception and answers choice are clear and short answer choices. In adjusting to the students' characteristics and development, it use the questions complexity that are in accordance with the students' development.

The product is also equipped with answers keys in the teacher's book. It is to facilitate the teachers in correcting students' answers. Then to find out the students' scores, it is also contain a students' scoring guide to facilitate the teachers in determining students' achievement. In the second assessment by a learning evaluation expert, it was stated that there is a need to improve the writing, and also detailing the steps in the diagnosis guidelines for students' learning so that it is easier to understand by the teachers. The result of field trial step can be seen in table 2.

Table 2. Result of Field Trial

Trial Data	Score	Category
Material Expert Test	75	Good
Learning Evaluation Expert Test	76,9	Good
Limited Scale Trial	78,8	Good
Field Trial	89,7	Very Good
Muhammadiyah Miliran elementary school teacher	92,7	Very Good
Muhammadiyah Karangturi Elementary School Teacher [Grade VA]	85,4	Very Good
Muhammadiyah Karangturi Elementary School Teacher [Grade VB]	92,7	Very Good
Total	591,2	
Mean	84,45	
Category	Very Good	

This score indicates that the evaluation instrument for diagnosis of learning difficulties in the digestive system learning material is feasible to be applied to classroom learning by the teachers.

Table 3. A Questions Package of Evaluation Instrument for Diagnosis of Learning Difficulties

Multiple Choice	Question	Discrimination	Difficulty
	Number	Power	Level
	1	0,2	0,7
	2	0,4	0,6
	3	0,6	0,3
	4	0	0
	5	0,4	0,6
	6	-0,6	0,3
	7	-0,4	0,2
	8	0	0,4
	9	0,6	0,7
	10	0,6	0,7
	11	-0,2	0,1
	12	-0,2	0,3
	13	-0,2	0,9
	14	0,2	0,3
	15	0,2	0,1
	16	0,6	0,7
	17	-0,2	0,5
	18	0	0,6
	19	0,6	0,7
	20	0,4	0,8
Match up	1	0,6	0,5
	2	0,8	0,4
	3	0,8	0,6
	4	0,2	0,9
	5	0,4	0,8
	6	0	0,6
	7	0,4	0,2
	8	1	0,5
	9	0,2	0,1
	10	0,2	0,1

Based on the 0 questions analysis, it can be seen that each question has a different difficulty level and discrimination power. In A questions package, which consists of 20 multiple choice questions and 10 match-up questions, there are 11 items indicated as difficult for students. The questions that are considered difficult by students is multiple choice questions number 4, 6, 7, 8, 11, 12, 13, 17, 18 and match-up items number 6 and 8.

In the B questions package which consists of 20 multiple choice questions and 10 match-up questions, there are 14 items indicated as difficult for students. The questions that are considered difficult by students is multiple choice questions number 2, 5, 7, 8, 10, 13, 14, 15, 16, 17 and match-up items number 2,3,5,8.

Table 4. B Questions Package of Evaluation Instrument for Diagnosis of Learning Difficulties

Multiple Choice	Question Number	Discrimination Power	Difficulty Level
	1	0,2	0,5
	2	0	0,1
	3	0,4	0,6
	4	0,6	0,7
	5	0	0,6
	6	0,6	0,5
	7	0	0,3
	8	-0,2	0,7
	9	0,4	0,8
	10	0	1
	11	0,6	0,5
	12	0,4	0,4
	13	0	0,2
	14	0	0,2
	15	-0,2	0,1
	16	-0,2	0,9
	17	-0,2	0,1
	18	0,2	0,5
	19	0,2	0,3
	20	0,4	0,4
Match up	1	0,4	0,8
	2	1	0,5
	3	1	0,5
	4	0,4	0,8
	5	0	1
	6	0,4	0,6
	7	0,2	0,9
	8	0	0,8
	9	0,4	0,4
	10	0,4	0,2

Whereas in the In the C questions package which consists of 20 multiple choice questions and 10 match-up questions, there are 12 items indicated as difficult for students. The questions that are considered difficult by students are multiple choice questions number 1, 2, 6, 7, 8, 15, 20 and match-up items number 1, 2, 4, 5, 6.

In the question items analysis, there are questions that have different discrimination power and difficulty levels. The difficulty level category was divided into three categories [20]. Questions that have $p < 0,3$ are called difficult questions, questions that have $0,3 \leq p < 0,7$ are called moderate questions, and questions that have $p > 0,7$ are called easy questions. While the category in questions' discrimination power is when the questions has a discrimination power $< 0,2$, it has a bad or poor discrimination power. When the questions has a discrimination power $0,2 - 0,4$ it has a satisfactory discrimination power. When the questions has a discrimination power $0,4 - 0,7$ it has a good discrimination power. When the

questions has a discrimination power 0,7 – 1,0 it has a very good discrimination power. When the questions has a discrimination power [-] it has a very poor discrimination power. However, the difficulty level that has a score of 0 or 1 will not contribute to students' abilities. So that the questions tends to be unusable

Table 5. C Questions Package of Evaluation Instrument for Diagnosis of Learning Difficulties

Multiple Choice	Question Number	Discrimination Power	Difficulty Level
	1	0	0
	2	0	0,9
	3	0,5	0,5
	4	0,8	0,6
	5	0,3	0,6
	6	0	0
	7	0	0,2
	8	-0,4	0,8
	9	0,5	0,5
	10	0,3	0,8
	11	0,4	0,2
	12	0,3	0,5
	13	0,1	0,6
	14	0,4	0,2
	15	0	0,2
	16	0,2	0,3
	17	0,1	0,3
	18	0,5	0,6
	19	0,3	0,7
	20	0	0,2
Match up	1	0,1	0,6
	2	-0,1	0,5
	3	0,2	1
	4	0	1
	5	0	1
	6	-0,1	0,4
	7	0,4	0,3
	8	0,3	0,5
	9	0,3	0,5
	10	0,4	0,4

This is most likely due to different factors. The things that might lead to students' learning difficulties can be classified as permanent physiological conditions (students' physical condition from birth, such as intelligence, vision, and hearing impairments, as well as perception problems that can inhibit learning); temporary physiological conditions (it can be cause by food problems, as well as the weak tendency and achievement in learning); the permanent effects of social environment (it influence towards students' learning achievement; and temporary effects of social environment.

This is depicted that learning difficulties can be caused by several conditions that must be known by teachers and parents. Therefore, students do not experience learning lags and misconceptions in their

thinking. Moreover, learning difficulties can also be caused by misconceptions. Sustainable problems in Natural Sciences learning can lead to students' misconceptions. Misconception is the differences of scientists theory with a theory that is obtained by students. Misconception happen when the construction results of students' knowledge do not match to the construction results of scientists' knowledge. If misconceptions have occurred to students, it will be difficult to change the knowledge that have been rooted.

4. Conclusion

Researchers have successfully developed three standardized test packages to diagnose elementary school students' learning difficulties on the digestive system material. In A package, there are 11 items indicated as difficult for students. The questions that are considered difficult by students is multiple choice questions number 4,6,7,8,11,12,13,17,18 and match-up items number 6 and 8. In the B package, there are 14 items indicated as difficult for students. The questions that are considered difficult by students is multiple choice questions number 2,5,7,8,10,13,14,15,16,17 and match-up items number 2,3,5,8. Whereas in the In the C package, there are 12 items indicated as difficult for students. The questions that are considered difficult by students are multiple choice questions number 1,2,6,7,8,15,20 and match-up items number 1,2,4,5,6.

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