



DESIGNING OF THE INTUITIVE MATERIAL IN REAL ANALYSIS 1

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Abstract

The objective of this research is to design the intuitive material draft of the course Real Analysis 1. The materials using intuitive are real number & its property, absolute value, upper & lower bound, sequences, series, function, derivative and integral. This material draft is important for the students of Mathematics Education Department in Faculty of Teacher Training and Education, Sriwijaya University; because it can give simplicity in understanding the materials. This article discusses the designing part of development research that is designing the materials. The materials were developed by using Dick & Carrey Model. This research was began by identifying instructional goals, conducting instructional analysis, analyzing learners & context, writing performance objectives, developing assessment instrument, developing instructional strategy, and developing & selecting instructional materials. In identification of instructional goals, the goal of the course Real Analysis 1 was analyzed. The goal was to give competency for students so that they would be able to analyze the real number and its property. There for the instructional was given deductively. However, it was hard for the students to understand the materials so, in this research, the instructional is the combination of inductively and deductively instructional. After that, performance objectives and assessment instrument were arranged. Then the instructional strategy was developed. To understand the materials, the teacher must explain the definition or theorem by using teacher's and students' intuition. The intuition is to react immediately based on students' and teacher's knowledge. Therefore, in this research, the intuitive materials are defined as knowledge owned by the teacher and students that can be used intuitively. The intuitive materials of the course Real Analysis were designed when teacher was explaining in the class the course of Real Analysis 1 materials by using intuition. All of the intuitive materials are written in a module. The module consists of introduction, the subject matter and the intuitive materials, examples, exercises, evaluation, feedback and conclusion. The intuitive materials were constructed well by the teacher and the students in the class. Nevertheless, the developing & selecting instructional materials part by the researcher was not well constructed. Hence, the problem in the designing the intuitive materials draft was in rewriting the teacher's and students' intuitive materials. The results of this research are the intuitive materials of the course Real Analysis 1. The materials are about proving steps of algebra operation, the number line, the Venn diagram, and sketching a graph using *Microsoft Office Excel*. The proving steps of the algebra operation are used to explain real number and its property. Meanwhile the number line is used to explain the absolute value. Next, the Venn diagram is used to explain sequences. And the last, the *Microsoft Office Excel* is used to describe sequences, series, convergence of sequences and series. This research has produced the draft of the intuitive materials for the course Real Analysis 1. The draft has been valid by materials, but not valid by constructing the instructional.

Key Words: Real Analysis 1, intuitive, materials, designing.

INTRODUCTION

Real Analysis 1 is one of courses given for students of the Mathematics Education Department. The purpose of this course is to give students competence in mathematical reasoning, especially the ability to analyze the materials of school mathematics. In another

words, it makes students can give logical reasons. In giving the reasons, they are trained to prove theorems by definitions, axioms and other theorems. This competence can be achieved by studying Real Analysis 1.

The Real Analyze materials are so abstract that students have difficulty in analyzing the materials. This is illustrated by the test results of the students in the odd semester of 2011/2012, there are still students who scored less than 70 or that category enough value. There are some problems that had by students; (1) they are less mastered prerequisite (Mansyur, 2008), (2) they do not know the problems or if they know the problems, they have difficulty in solving problems (Usodo, 2011), (3) they do not know in determining the beginning step (Muttaqin, 2010). More detail, revealing Indaryanti that the students have not been able to do a proof of contradiction and direct proof. They failed to make the argument in the proof.

These weaknesses become a basis for improving the students's ability to analyze the materials. Inability of students in the use direct proof or proof of contradiction indicates that they do not understand about definitions, axioms and theorems. Based on the experience of teaching Real Analysis 1, they do not have meaningful of definitions, axioms and theorems, however it has terms explaining what it means. It is because they do not understand the terms contained in definition, and master prerequisite materials, so that they can analyze materials.

To handle the difficulties, there are few research have done. Susanti (2008) had developed Computer Aided Learning (CAL) for learning Real Analysis 1. Mansyur had researched using hierarchical approach (2008) and Iwan had researched using the M-APOS approach. These studies have yet to address student difficulties in understanding the definitions, and theorems. To overcome it, the intuitive materials are designed.

The intuitive materials are the materials that can be used to analyze definitions or theorems based on student's knowledge. In learning with the intuition, the students can use their existing knowledge to themselves without looking for it first. So, designing the intuitive materials is done by adding the materials being studied with materials that are in the student's own. With these materials the students can be used to analyze definitions, theorems or the other Real Analysis problems immediately. The materials are concepts had learned, graphic, sketch and arrow diagram (Indaryanti, 2013a).

The purpose of designing it is to produce draft of the intuitive materials that valid in content and construct.

THEORETICAL BACKGROUND

Mathematical reasoning is the process of linking the facts or evidences that have been previously assumed to obtain conclusions (Shodiq, 2004). Each step is performed to decide something must be based on the rules, so even in mathematics. Mathematical reasoning is conducted by definitions, axioms or theorems.

The ability to reason is marked when the students can ask questions, can perform mathematical reasoning, can draw conclusions or collate evidence to provide a reason or proof to the truth of the solution, can draw the conclusion from the statement, to check the validity of the argument, can find the pattern or nature of symptoms mathematically to make generalizations. The same thing also expressed CAHSEE (2010), reasoning has a standard recognizing and generalizing patterns, indentifying and organizing relevant information, validating conjectures both inductively and deductively. Signs of this reasoning can be practiced when learning Real

Analysis 1. At Real Analysis 1, students are trained to reason with theorem proving based on definitions, axioms or theorems are known

In addition to completing the calculation, or mathematical reasoning is done with the proof. According to Farrell, et al. (2011), proving that either starts with a set of axioms and using the axioms toward the conclusion. The process of creating a presumption that is necessary for students to understand the problems they face, so that the allegations can be determined from the initial steps of a proof. Making allegations is a mental activity that is not included in the formal cognition, but the intuitive cognition or intuition.

Intuition is that people have the ability to do something based on the existing knowledge on him at the time. For example, to understand definition of sequence in real numbers, students should pay attention to the concepts contained in the definition. Consider the following definition: a function from a subset of the natural numbers to the real numbers. There are some terms that are known or available to students as a function, subset, natural numbers and real numbers. The key word of this definition is function. They know what is function. Function is a mapping from domain natural number to range real number. It is illustrated by arrow diagram (figure 1).

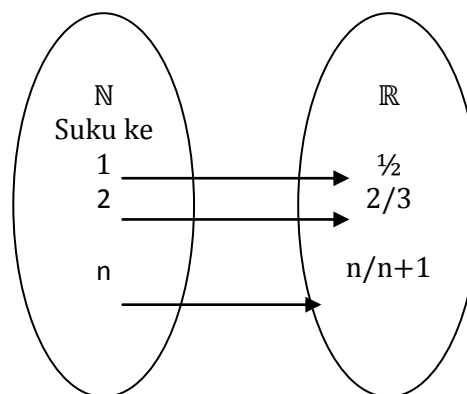


Figure 1. Sketch of arrow diagram for sequence $(n/(n+1))$.

All of the terms in students are called the intuitive materials. The materials can be used intuitively. Intuitive mathematical material can be either construct a sentence with its own language, create charts, and graph (Indaryanti, 2013b). Moreover, it can also make a number line. At the time of making the graph can be created manually or using a software program excel.

The materials that are already present in the student and used to analyze or understand the material Real Analysis 1, without having to search information about the material being discussed is called the intuitive teaching materials. This material is collected in the form of what are termed draft intuitive teaching materials.

METHOD

The research method used is design research with Gravemeijer & Cobb model (2006). There are 3 phases: (1) preparing for experiment, (2) design experiment, and (3) retrospective analysis. In preparing for experiment, activities carried out are: analyze the learning objectives of Real analysis 1 to be achieved, determine and establish baseline conditions of the student, discuss the conjecture of

local instructional theory to be developed, determine the characteristics class and the teacher's role, and establish a theoretical goals to be achieved through research.

This step is test whether the draft and local instructional theory works or not. Besides that, this step is to test and develop local instructional theory that have been developed as well as understand how the theory works for experiments took place.

Next step is restrospective analysis. The purpose of this phase is to analyze the data which has been obtained to support to see whether or not appropriate with the conjecture that has been designed.

The data collection technique used is walktrough.. Walktrouh technique is used to review the draft of intuitive materials. At this time observed is intuitive material that appears when lecturing implemented. From here held intuitive recording and preparation of the material being taught becomes intuitive draft instructional materials.

RESULT AND DISCUSSION

The Real Analysis 1 materials are presented in the lecture covers four topics that include: (1) Real Number, (2) Sequence, (3) Function, (4) Derevative and integral, and (5) Series.

On the subject of Real Numbers field, the material used is intuitive steps theorem proving, as in Figure 1. This step is an intuitive instructional materials that help students to perform the analysis of the existing theorems on Real Analysis 1.

Teorema 1.
 Jika $z, a \in \mathbb{R}$, $z + a = a$ maka $z = 0$.
 Dalam pembuktian berikut diperlihatkan langkah perlangkah yang disertai alasan.
 Bukti:

No	Langkah	Alasan
0	$z + a = a$	
1	$(z + a) + (-a) = a + (-a)$	Postulat
2	$z + (a + (-a)) = a + (-a)$	A1
3	$z + 0 = 0$	A3
4	$z = 0$	A2

Figure 1. Steps of proving theorem

To aid understanding of the absolute value is used the number line, as figure 2

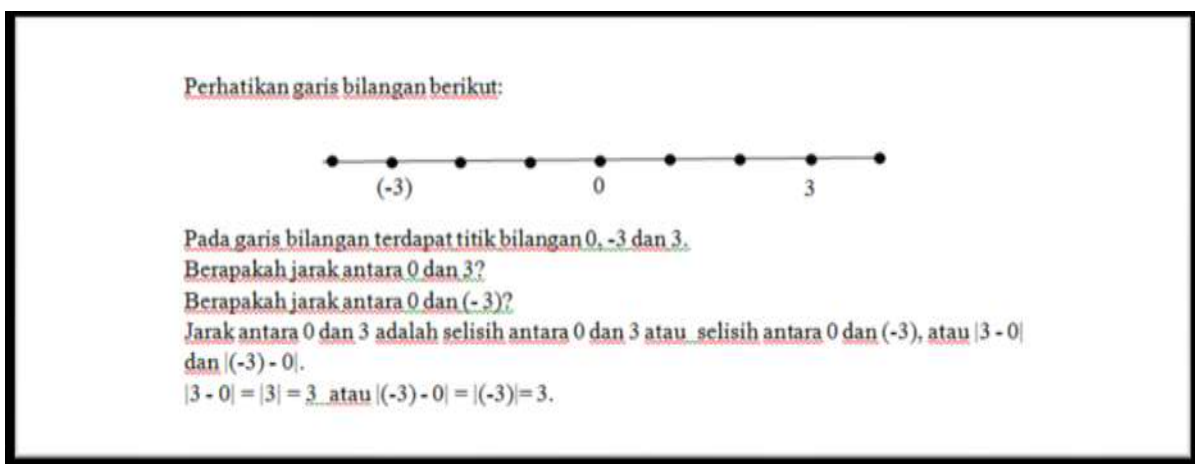


Figure 2. The number line that can help the students to understand the materials
Further understanding of the absolute value of the material is used to explain neighborhood by a number line, as figure 3.

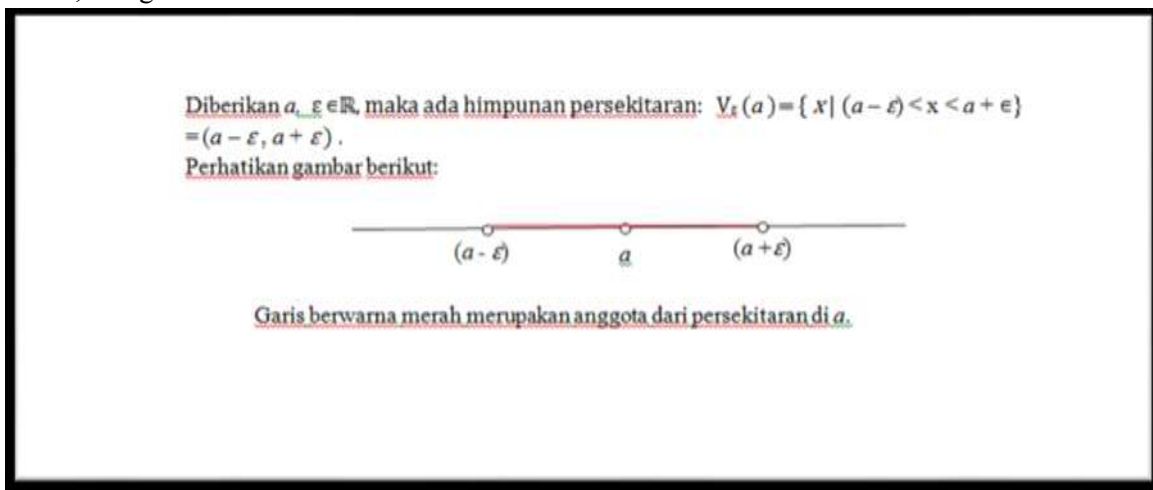
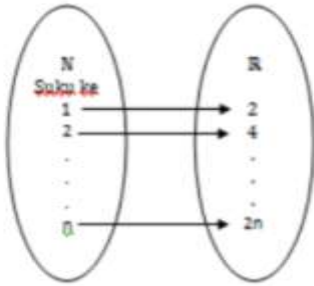


Figure 3. Number Line in the Neighborhood.

Understanding for sequences of Real Number, it is used the arrow diagram as figure 4.

Definisi Barisan Bilangan Real adalah suatu fungsi yang didefinisikan pada himpunan N dengan range R .

Contoh 1: Barisan bilangan genap:
Ditulisikan seperti berikut: 2, 4, 6, 8, ..., $2n$.
2 adalah suku pertama, 4 merupakan suku ke-2, 6 adalah suku ke-3 dan seterusnya, sehingga $2n$ merupakan suku ke- n . Andaikan U_n adalah suku pertama $U_1 = 2$, $U_2 = 4$, $U_3 = 6$ dan $U_n = 2n$ untuk $n \in N$.
Coba perhatikan definisi barisan bilangan Real. Definisinya mengatakan fungsi dari himpunan N ke himpunan R .
Hal ini dapat ditelusuri dengan menggunakan diagram Venn sebagai berikut:



Gambar 1. Sketsa diagram panah dari barisan $(2n)$.

Figure 4. the arrow diagram in sequences of Real Number.

Discontinuous function can be understood by excel program, as figure 5. Besides that, it can be used to learn Riemann integral as figure 6.

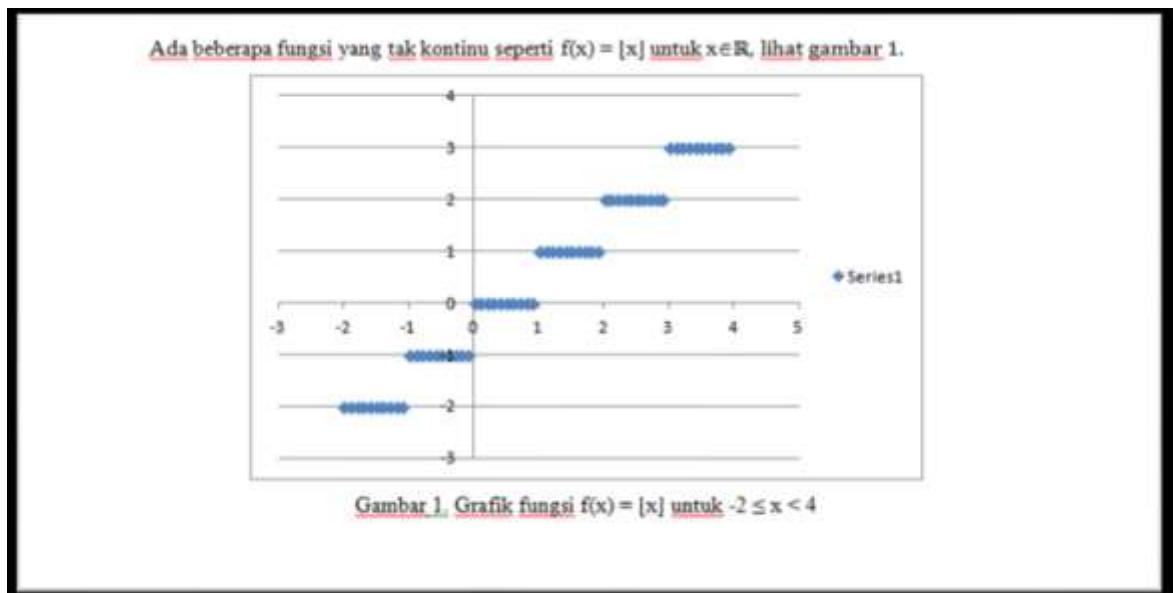


Figure 5. Excel program is used to understand the discontinuous function.

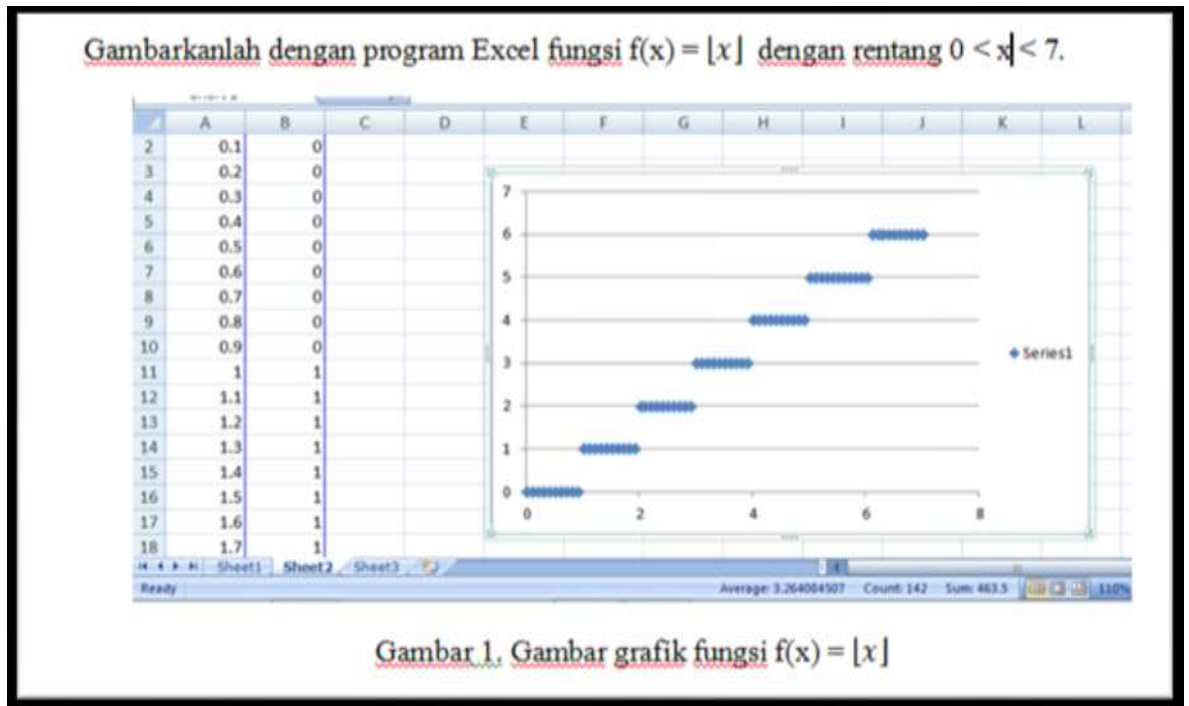


Figure 6. Excel Program is used for Riemann Integral.

That's the intuitive material contained in intuitive teaching materials. Such material may be the concept of functions, graphs created using the excel program and arrows diagrams.

The intuitive material is very helpful to understand for students in the Real Analysis 1 material, it is reflected upon learning the sequences Real Numbers. At the time of not using materials intuitive, the student was not thought that the sequence is a function that links between the natural numbers to the said estate are related with certain relationships. Having given the question that led to the concept of function, then the students understand that the sequence is a function.

Likewise with concept of neighborhood, students are also confused by the concept of neighborhood. Once the image is given a number line, then the student can understand the concept of neighborhood.

In designing intuitive teaching materials, researchers have difficulties at the time of pouring the teaching materials in the form of writing. This happens because at the time it is easier to teach students herded toward the target concept, while at the time stated in the form of writing, there are things that are spoken, can not be recorded or stated in writing. Or in other words is not valid construct. As a result, the draft still needs to be intuitive material tested in the course and needs to be done visually and audio recorder. Thus the results of this recording can be contained in the written form.

CONCLUSION AND REMARK

The results were obtained intuitive teaching materials on the course Real Analysis 1. These teaching materials have content, or content may provide insight on the student to learn Real Analysis 1, but still needs to be tested in the course in order to obtain a valid teaching materials in the content, language and constructs.

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