

Discrete Mathematics' Textbook Development based on Multiple Intelligences

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Abstract: The purpose of learning Discrete Mathematics is to improve students' abilities to organize reasons or develop intelligence. However, students learning outcome is still low. One of the students' weaknesses of mastering Discrete Mathematics is that it is difficult to understand the lesson that involves less students' logical thinking. For that reasons and many obstacles in learning discrete mathematics, so the researcher develops discrete mathematics textbook based on multiple intelligences. The problem statement of this research is "How to increase Multiple Intelligence of University of PGRI Adi Buana of Surabaya's student using Discrete Mathematics textbook that was developed?". The Multiple Intelligence developed only limited to 3 intelligences: linguistic intelligence, logical mathematical intelligence, and visual spatial intelligence. The development of teaching materials is based on a modified 4D model consisting of four stages: definitional, design, development, and disseminate phases. To know the learning progress based on multiple intelligences, the researcher develops some problems containing applied of discrete mathematics. The problem is given to students before using textbooks that have been developed and after using textbooks. The results of the research are linguistic intelligence increased by 78%, logical mathematical intelligence increased by 80.13% and visual spatial intelligence increased by 67.47%.

1 INTRODUCTION

One of the things that also become an obstacle for students in learning mathematics is the approach and way of organizing learning material in higher education due to the teacher's point of view. In the learning process, the lecturer must be able to conduct a conducive learning atmosphere, so that he is able to pay attention to several variables in learning such as teaching methods, learning conditions and learning outcomes. There are many characteristics of students such as background, gender, learning style, interests, talents and intelligence (intelligence). On some occasions lecturers sometimes do not provide enough motivation and applications when they will give a certain subject matter because they know that the material to be taught generically is definitely very important for students. Especially for intelligence, it is generally defined as the ability to understand information that forms knowledge and awareness. Intelligence is the ability of students to think abstractly and logically so that they can adapt to new

situations. According to Gardner (2003) there are seven types of student intelligence and then developed into eight by Lazear (2004), namely linguistic intelligence, mathematical logic, space-dimension (visual-spatial), music, kinesthetic, interpersonal, intrapersonal, and intelligence. naturalist. Intelligence does not improve but can be developed.

The theory of intelligence proposed by Gardner (2003) is known as the theory of multiple intelligences. Each individual has eight intelligences, but the level is different, depending on which type of intelligence is more dominant. Intelligence plays an important role in achieving student success. The multiple intelligence theory proposed by Gardner (2003) can help lecturers to maximize student learning outcomes by utilizing the type of intelligence held by students.

Learning in Discrete Mathematics courses has a strategic position to develop students' reasoning abilities and can be seen as an exercise to organize reason or develop intelligence. However, conditions in the classroom indicate that student learning

outcomes from Discrete Mathematics subjects are unsatisfactory. One of the constraints of students in mastering Discrete Mathematics is that students find it difficult to understand the lesson because the learning process does not involve students to think critically about the problems given by the lecturer. Another obstacle in the process of learning Discrete Mathematics is the limited learning resources, references, books, modules and teaching materials that are easily understood by students. In fact, Discrete Mathematics material is books that use foreign languages. From the problems described earlier, students were not motivated to learn Discrete Mathematics. So, thinkers think that it is necessary to develop a learning resource for Discrete Mathematics. Compound intelligence is one of the keys to teaching students to solve non-routine problems. Multiple intelligences are important because they will be an important component in developing students' analytical skills and critical abilities.

In this study, researchers developed what needed to be done to solve the problem was to develop teaching materials that could increase multiple intelligence. Double intelligence is one of the keys to teaching students to solve non-routine problems. Double intelligence is important because it will be an important component in developing students' analytical and critical skills.

Based on the description above, we will present a research article on the subject matter "How does the increase in Multiple Intelligence of PGRI Adi Buana Surabaya University students after using the results of the development of textbooks on Discrete Mathematics courses?". Multiple Intelligence developed is limited to 3 intelligences, namely: linguistic intelligence (linguistic intelligence), mathematical logic intelligence (logical mathematical intelligence), and spatial visual intelligence (visual spatial intelligence).

2 BASIC THEORY

2.1 Discrete Mathematics Textbooks

Based on Wikipedia (2010), the definition of a textbook is a manual of instruction in any branch of study. Textbooks are produced according to the demands of educational institutions. (accessed on July 9th, 2018 on <https://en.m.wikipedia.org/wiki/Textbook>).

Textbook is a book used in teaching and learning activities that contain teaching materials based on the curriculum applied. In this study the teaching materials produced is a textbook. The textbook is a basic knowledge base and used as a learning tool and is used to accompany lectures and independent learning (Kurniawan, 2014 and Suroso, 2004).

The textbook in this study is the result of module development of the research in the first year. This teaching material as an educational process supporter and implementation of the material as an exercise. The teaching materials development is done based on a systematic process so that the validity and reliability of teaching materials can be guaranteed. There are several factors that can affect the quality of teaching materials and should always be considered in the development process of teaching materials, namely content, scope, legibility, language, illustration, covering and packaging. The quality of instructional materials is highly dependent on the accuracy in implementing of these factors in developing teaching materials.

2.2 Multiple Intelligences

Based on Gardner's research there are eight different human intelligences of the students, then the other researchers was added two more intelligences, so that on the last research explained, there are 9 intelligences owned by the students. The following explanation will be briefly described the ten intelligences.

1. Verbal/linguistic Intelligence

This intelligence is an intelligence related to the ability of the students in speech, writing, and how to express oneself in words. The ability in using language, poetry, stories, grammar, symbolic thinking, is the expression of this intelligence.

2. Logical-Mathematical Intelligence

Logical-mathematical intelligence is often called scientific thinking, including deductive and inductive thinking. This intelligence is a linear brain intelligence that is activated when a person faces a new problem or challenge and tries to solve it.

3. Visual-Spatial Intelligence

Visual intelligence is the intelligence related to drawing, painting, using charts and maps, and searching for different places/route. Other expressions of this intelligence are visual art, navigation, viewability space, architecture, chess games. The visual-spatial intelligence is related to the senses of view and imagination. The

students with the visual-spatial intelligence start their work by describing something in their head and then redrawing it into a medium of paper, a computer, or something.

4. Body/Kinesthetic Intelligence

The Body/kinesthetic intelligence is the ability to control the body to do the activity and to express feelings. The expression of this intelligence is Dancing, sports games, clowns, pantomimes, typing, and others.

5. Musical/Rhythmic Intelligence

Rhythmic intelligence involves the ability of the students to recognize and to use rhythm and tone, and sensitivity to sounds. In over the world, music and ritmik can be changed the human awareness.

6. Intrapersonal Intelligence

Interpersonal intelligence is the ability to understand the condition of the other people and to make a good relationship. In other hand, Interpersonal intelligence can be described as the ability of the people to understand oneself, such as feelings, thinking processes, self-reflection, intuition, and spiritual.

7. Naturalistic Intelligence

Naturalist intelligence is mostly owned by environmentalists. A countryside resident can recognize the signs of the environmental change by looking at natural phenomena.

8. Spiritualist Intelligence

Spiritual intelligence is mostly belonged to the clergy. This intelligence related to the relationship between humans and their God.

9. Existentialist Intelligence

Existential intelligence is often found in philosophers. They are able to realize and aware about the existence of himself in this world and what the purpose of his life.

Using multiple intelligences, a lecturer can give the opportunities for students to learn the material based on their needs, interests, and talents. Students will be able to show their ability to build the characteristic and motivation in learning discrete mathematics.

3 DEVELOPMENT OF LEARNING SYSTEM

The development model that will be used to develop learning tools in this study is the model of Thiagarajan et al. (1974: 5-9) known as Four-D Models (4D Model). The 4D model was chosen because it was more systematic and suitable for developing learning tools, but in this study,

researchers made modifications to the 4D model. This is done because the 4D model is designed for learning for exceptional pupils while the subject of this research is normal / normal students. The modifications made in this study will be explained as follows.

Steps for Developing Textbooks

The following illustrates the flowchart of the module development steps (figure 1).

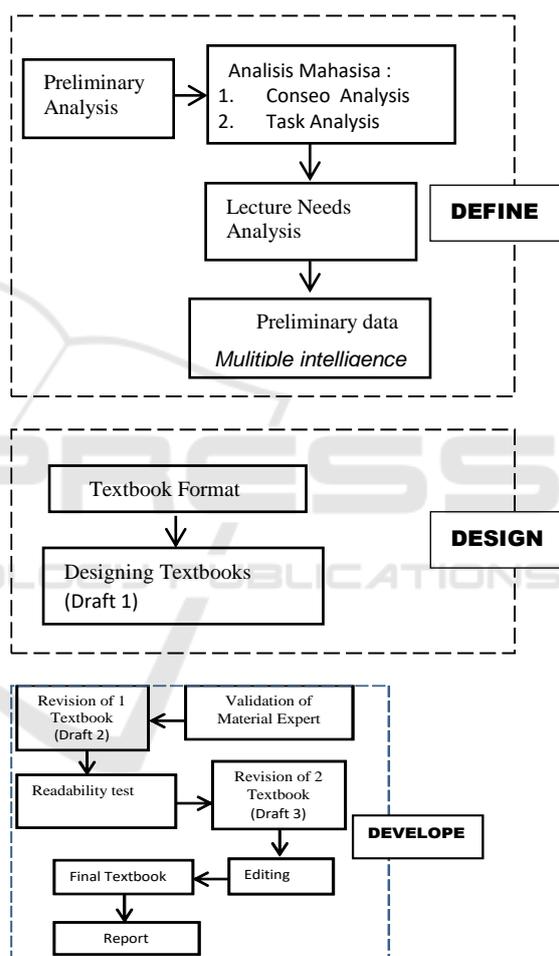


Figure 1: 4-D Models.

4 RESEARCH METHOD

Research Location

The location where this research took place is PGRI University Adi Buana Surabaya Campus 1

which is located at Jl. Ngagel Dadi III-B No. 37 Surabaya.

Research Variables

The population of this research were all seventh semester Mathematics students who programmed the Discrete Mathematics subject of the University of PGRI Adi Buana Surabaya. The subjects of this study were 37 students in Class A.

Data Collecting Technique

In this study, the data obtained are relating to multiple intelligences. The data was obtained from students who took Discrete Mathematics courses. Multiple intelligence data is obtained by the test sheet.

Analysis Data Technique

The collected data were analyzed descriptively using the average answers. The results of the Multiple Intelligence Test sheet are obtained from the number of values of the three intelligences possessed

$$P = \frac{X_2 - X_1}{X_1} \times 100\%, \tag{1}$$

where P is percentage of increasing student achievement of each intelligence, X_1 is data of the respondent's initial value / score for each intelligence question, X_2 is data of the final score / score of each respondent on intelligence, and N is the number of respondents.

5 RESULTS AND DISCUSSION

Examination (UAS) the subject is given a problem-solving problem regarding the Discrete Mathematics course. The questions given before and after the use of textbooks are the same, consisting of 6 (six) items with details of 2 (two) questions for linguistic intelligence, 2 (two) questions for spatial visual intelligence, and 2 (two) questions for logical intelligence mathematics.

From the table 1, it can be calculated the percentage of increase in linguistic intelligence values as follows:

$$P = \frac{38.78378}{49.37838} \times 100\%$$

$$P = 78.54406 \%$$

$$P \approx 78.54\%.$$

So, the percentage increase value for linguistic intelligence is 78.54%.

Table 1: Multiple Intelligences student test results for Linguistic intelligence

No	Subject Name	X_1	X_2	$X_1 - X_2$
1	Shilvia Putri Pradana	49	90	41
2	Ike Yuniarsih	46	88	42
3	Ruri Dwi Suciyantri	46	90	44
4	Jiwanti Mahmudah	47	92	45
5	Alifah Nur Aini	60	90	30
6	Afrian Kurniawan	61	92	31
7	Dwi Mardiana	47	92	45
8	Lidia Concita	61	86	25
9	Winda Paramita	47	94	47
10	Wahyu Ningtias	48	89	41
11	Wahyudi Edo Awanda	61	88	27
12	Ina Triana	46	86	40
13	Paskalia Mediyana	62	88	26
14	Maria G Jehabut	46	85	39
15	Mira Dewi Damayanti	47	90	43
16	Febry Fitria Pratiwi	48	86	38
17	Nurul Laili Karimah	60	86	26
18	Rosita Dewi	45	90	45
19	Erma Adiningsih	61	86	25
20	Emmanuel Mahardhika	47	84	37
21	Yulin Pratiwi Suwarno	46	85	39
22	Dinik Nofiah Ningrum	42	85	43
23	Shinta Dewi Suparno	47	90	43
24	Sulimah	46	88	42
25	Apriliani Ayuningtyas	44	88	44
26	Siti Nur Azizah	58	92	34
27	Nur Azizatun Ni`Ma	20	85	65
28	Dina Mustafidah	40	86	46
29	Hana' Fairuz Mufidah	45	85	40
30	Annisa Zuhrotul	45	87	42
31	Siti Asmaul Azizah	62	88	26
32	Mega Rahayu	47	94	47
33	Santi Dwi Lestari	59	88	29
34	Miftakhul Hidayah	43	85	42
35	Vida Ayu Amaliya	43	90	47
36	Lulu Eka Oktaviani	42	80	38
37	Deny Triyanto	63	94	31
Average		49.3	88.1	38.7

From the table 2, it can be calculated the percentage of increase in logis mathematic intelligence values as follows:

$$P = \frac{33,67568}{42,02703} \times 100\%$$

$$P = 80.12862 \%$$

$$P \approx 80.13\%$$

So, the percentage increase value for logis mathematic intelligence is 80.13%.

Table 2: Multiple Intelligences student test results for Logis Mathematic intelligence.

No	Subject Name	X ₁	X ₂	X ₁ - X ₂
1	Shilvia Putri Pradana	34	82	48
2	Ike Yuniarsih	47	72	25
3	Ruri Dwi Suciyaniti	37	70	33
4	Jiwanti Mahmudah	30	72	42
5	Alifah NurAini	42	76	34
6	Afrian Kurniawan	46	80	34
7	Dwi Mardiana	40	76	36
8	Lidia Concita	43	76	33
9	Winda Paramita	39	74	35
10	Wahyu Ningtias	54	72	18
11	Wahyudi Edo Awanda	49	74	25
12	Ina Triana	46	78	32
13	Paskalia Mediyana	47	72	25
14	Maria G Jehabut	36	70	34
15	Mira Dewi Damayanti	40	78	38
16	Febry Fitria Pratiwi	49	68	19
17	Nurul Laili Karimah	54	82	28
18	Rosita Dewi	47	80	33
19	Erma Adiningsih	18	76	58
20	Emmanuel Mahardhika	55	74	19
21	Yulin Pratiwi Suwarno	41	78	37
22	Dinik Nofiah Ningrum	40	75	35
23	Shinta Dewi Suparno	43	74	31
24	Sulimah	44	70	26
25	Apriliani Ayuningtyas	39	68	29
26	Siti Nur Azizah	56	75	19
27	Nur Azizatun Ni`Ma	17	64	47
28	Dina Mustafidah	35	82	47
29	Hana' Fairuz Mufidah	38	80	42
30	Annisa Zuhrotul	43	82	39
31	Siti Asmaul Azizah	54	75	21
32	Mega Rahayu	40	82	42
33	Santi Dwi Lestari	51	80	29
34	Miftakhul Hidayah	36	78	42
35	Vida Ayu Amaliya	40	74	34
36	Lulu Eka Oktaviani	39	80	41
37	Deny Triyanto	46	82	36
Average		42.0	75.7	3.36

From the table 3, it can be calculated the percentage of increase in visual-spasial intelligence values as follows:

$$P = \frac{30,83784}{45,7027} \times 100\%$$

$$P = 67.47487\%$$

$$P \approx 67.47\%$$

So, the percentage increase value visual-spasial intelligence is 67.47%.

Table 3: Multiple Intelligences student test results for visual-spasial intelligence.

No	Subject Name	X ₁	X ₂	X ₁ - X ₂
1	Shilvia Putri Pradana	46	92	46
2	Ike Yuniarsih	61	80	19
3	Ruri Dwi Suciyaniti	36	87	51
4	Jiwanti Mahmudah	44	74	30
5	Alifah Nur Aini	45	70	25
6	Afrian Kurniawan	60	82	22
7	Dwi Mardiana	39	84	45
8	Lidia Concita	46	82	36
9	Winda Paramita	35	72	37
10	Wahyu Ningtias	55	72	17
11	Wahyudi Edo Awanda	63	75	12
12	Ina Triana	48	72	24
13	Paskalia Mediyana	61	72	11
14	Maria G Jehabut	39	70	31
15	Mira Dewi Damayanti	44	72	28
16	Febry Fitria Pratiwi	45	80	35
17	Nurul Laili Karimah	55	72	17
18	Rosita Dewi	60	82	22
19	Erma Adiningsih	17	70	53
20	Emmanuel Mahardhika	43	60	17
21	Yulin Pratiwi Suwarno	45	74	29
22	Dinik Nofiah Ningrum	39	75	36
23	Shinta Dewi Suparno	44	74	30
24	Sulimah	63	80	17
25	Apriliani Ayuningtyas	39	64	25
26	Siti Nur Azizah	63	72	9
27	Nur Azizatun Ni`Ma	22	74	52
28	Dina Mustafidah	36	80	44
29	Hana' Fairuz Mufidah	40	82	42
30	Annisa Zuhrotul	47	80	33
31	Siti Asmaul Azizah	53	80	27
32	Mega Rahayu	38	80	42
33	Santi Dwi Lestari	54	78	24
34	Miftakhul Hidayah	36	83	47
35	Vida Ayu Amaliya	48	74	26
36	Lulu Eka Oktaviani	36	80	44
37	Deny Triyanto	46	82	36
Average		45.7	76.5	30.8

Discussion

Multiple intelligence theory suggests that everyone has several levels of intelligence and has their own intelligence profile, Mahmot et al., 2014, in Maharani (2015). This intelligence profile is in the form of 8 intelligences that have been initiated by Gardner (2003), namely linguistics, logic-

mathematical, visual-spatial, kinesthetic, music, interpersonal, intrapersonal, and naturalist. The intelligence discussed in this study is only three intelligences, namely linguistic intelligence, mathematical logic intelligence, and spatial visual intelligence. Linguistic intelligence is the ability to think in the form of words, use language to express, and appreciate complex meanings. Logic-mathematical intelligence is the ability to count, measure, and consider a proposition and hypothesis, and complete the operations of numbers. Visual-spatial intelligence is a way of looking at certain projections and the capacity to think in three dimensions. This intelligence allows one to explore imagination, for example modifying the shadow of an object by performing a simple experiment.

The application of the third theory of intelligence is one of which can be fulfilled through textbooks. In a learning that uses certain instructional materials must pay attention to the specifications or qualifications of changes in attitudes and behaviors so as to be expected. The textbooks used must also be right on the target. Educators should also know the purpose of the learning so that the objectives of learning must be formulated so clearly. Because teaching that has no direction and purpose will be difficult to be processed and understood by students.

The implementation of textbooks that apply Multiple Intelligence can be observed through learning outcomes tests. In this study teaching materials were prepared based on Multiple Intelligence and based on Thiagarajan's theory (Thiagarajan, 1974) that applies step 4D in product development, namely define, design, and development, this research was carried out and obtained results. Based on the test results before and after using textbooks as a learning guide, the results obtained from the percentage increase in linguistic intelligence was 78.54%, for mathematical logic intelligence was 80.13%, and for mathematical logic intelligence was 67.47%.

6 CONCLUSIONS

The results of this study are textbooks on Discrete Mathematics courses based on Multiple Intelligence. Test results before and after using textbooks as a learning guide showed that the percentage increase for linguistic intelligence was 78.54%, for mathematical logic intelligence was 80.13%, and for visual-spatial intelligence was 67.47%.

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