# The Development of Introduction for Basic Mathematics Based Structured Tasks Textbook to Improve the Ability of Logical Thinking

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# The Development of Introduction for Basic Mathematics Based Structured Tasks Textbook to Improve the Ability of Logical Thinking

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**Abstract.** The aims of this research are to produce textbooks of introduction for basic Mathematics based structured tasks to improve the ability of logical thinking. Textbooks are expected to create students' structured learning. The researcher uses research and development approach by Gall & Borg which consists of eight steps. However, the researcher limits the steps into six steps. This research is done in mathematics education program of IKIP PGRI Madiun. The instrument and data collection methods used in this study are test, questionnaire, and observation sheets. Development result indicates that textbook included into valid category. The response of students to the textbook is very positive. Therefore, the textbook is categorized as praktical. The use of textbook meets the criteria of mastery learning, thus effectively categorized textbook. Textbook can improve the ability of logical thinking. Based on the result of research and development that have been implemented, it can be concluded that the textbook developed were fit to be used, because the textbook meets the validity criteria, practical, and effective to improve the students ability of logical thinking.

## 1. Introduction

The visions and objectives of Mathematics study in school are developing the mastery of Mathematics concept as well as its implementation, giving a chance for developing logical, systematics, critical, accurate and creative thinking. To achieve the objectives, it depends on the implementation and responsibilities of every institutions.

Logical individual sees problem as challenge and tries to find and decides the strategy through a wide perspective. A logical person will be able to draw a legal conclusion based on the logical rules and able to prove the truth and validity of the conclusion according to the prior knowledge. Logical thinking is a straight and organized toward everything that is believed from a certain object or phenomenon in the form of problem which is investigated to in order to differentiate its truth or false [5].

A study done in America found that two third of Americans between 16 to 25 years old are not provided with useful skills to face challenge in their real life. Some of those skills are logical, critical, and creative thinking as well as problem solving skill [4].

The Mathematics learning in Indonesia are similar to those found by Mc Gregor in his study. Generally, the learning done in Indonesia are not directed to form the logical thinking ability. Mathematics learning in Indonesia are still done through algorithmic approach [8].

Aside from Mathematics learning condition, the fact is that students find difficulty in learning Mathematics due to the characteristics of the concept taught. Based on the field finding, there are some mistakes done by students of Mathematics Teaching Department in IKIP PGRI Madiun. These constrains are found in the third semesters students who study Basic Mathematics. These happened when students create models and solve mathematics problem related to Mathematics set and logic, arranged in disorder problem.

Related to the learning process which enable the development of higher order thinking skills, the role of lecturer in teaching learning process is critical. The lecturer's role are helping students to

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develop knowledge and give the chance to the students to think independently. Therefore, students need to master the skills of creative thinking to solve problems faced in learning Basic Mathematics subject.

Basic mathematics is a subject which discusses function substance, sets and logical Mathematics. Students need to learn these materials as these materials play a very important role in various branch of science as well as in real daily life.

Basic mathematics are still spread in various learning source such as text book, internet, and other source of learning. Even though those source are supporting one another, a single student is unlikely to complete all those source of materials on his own. This situation cause student to depend solely on lecturer to provide the materials for them and this cause the passive teaching learning process. Lecturer became the main source of materials and students are passively listening. Therefore, the time allocated to study this materials will be wasted in explaining the materials and less time will be spent to guide students to master the process.

Therefore, lecturer needs to compile all those materials into one single book. The purpose is to provide students with a guidance text book to enable them to learn independently while other source of materials are used as complementary.

Based on the above explanation, the researcher is motivated to study this under the title of "The Development of Introduction for Basic Mathematics Based Structured Tasks Textbook to Improve the Ability of Logical Thinking".

The research questions of this study are:1) How is the development and the result of Development of Basic Mathematics Structured Based Text Book to Improve Students' Ability of Critical Thinking?, 2) How is the students' response toward the Basic mathematics Structured Based Text Book?, 3) How is Students' Logical Thinking Ability using Basic Mathematics Structured Based text Book?.

The objectives of this research are: 1) to know the development and its result of Basic Mathematics Structured Task Based Text Book, 2) to Know Students' response toward Basic Mathematics Structured Task based Text Book, and 3) to know the Students' Logical Thinking Ability using Basic Mathematics Structured Task Based text book.

## 2. Pertubed Heat Flow Model

The method used in this research is research and development model (R&D). R&D is a method used to produce a certain product and test the product effectiveness [6]. The development of basic mathematics structured task based is the development of product to optimize teaching learning process in education. The validity of the product must be tested in order to achieve the learning objectives. Reference [6] said that to produce a certain product, a need analysis research is needed and to test its validity, effectiveness test is needed. The subject of the research are third semester students of mathematics Teaching Department of IKIP PGRI Madiun, engaged in the experiment of Basic mathematics Structured task Based Text Book.

This study uses Gall & Borg developmental research approach. Reference [2] said that the cycle of R&D consist of ten steps namely: 1) Research and information collection, 2) planning, 3) develop preliminary form of product, 4) preliminary field testing, 5) main product revision, 6) main field testing, 7) operational product revision, 8) operating field testing, 9) final product revision, and 10) dissemination and distribution.

Based on the research steps and development developed by Borg and Gall, the researcher done some consideration of time and cost. Therefore, this research only uses six steps for developing the Basic Mathematics Structured Task Based Text Book as shown in the flow chart below:

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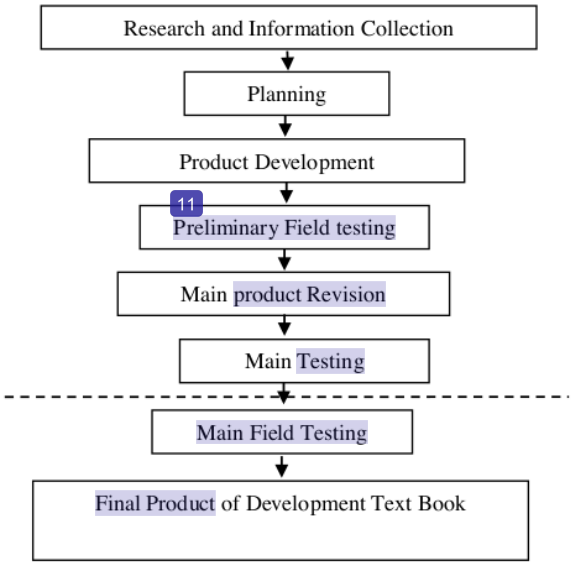


**Skema 1** Flowchart Desain Penelitian

The chart above can be explained as follow:

a. Research and Information Collection, needs selection which is done by selecting the materials and methods included in the text book, analyzing competency standard, basic competence and indicators which should be achieved by students after the learning process.
b. Planning, correlates all aspects to develop the text book, arrange the plan to develop the text book which is meant to develop the whole materials in it.
c. Product development, creating the text book and compile the materials in an interesting form.
d. Preliminary Testing, this test is meant to obtain text book experts feedback and material expert related to the text book developed. This step is started by the used of text book by expert and giving feedback afterward. This process is done through observation by both experts while the book is being used in the teaching learning process to see its implementation ability. This is done to obtain appraisal of the text book, feedback and suggestions from both experts to improve and complete the book.
e. Main Product Revision, review and edit the text book by developer, by evaluating the whole design, adjust the text book review by experts.
f. Main testing, this process is done to obtain the evaluation of the product use impact by students. Students' response toward the main product can be seen through questionnaire of students' response given to the students who join the test. This evaluation is done to obtain appraisal of the main product developed as well as to know the students' logical thinking ability in using the main product.

*2.1. Data Collection Instrument*

The data analysis technique used in this research is analysis result of text book validation to know the quality of the text book developed, analysis the students' response questionnaire to know the level of practicality of the book developed, and analysis the data of observation result of students' logical thinking ability to know the effectiveness level of the book in improving the students' level of logical thinking ability.

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*2.2. Data Analysis*

The data analyzed in this research are the text book evaluation result to understand the text book validity, students' response questionnaire to know its practicality and the observation result of students' logical thinking ability in order to know the text book's effectiveness in improving students' logical thinking ability.

*2.3. Text Book Validity Analysis*

Reference [3], valid means this instrument can be used to measure what is meant to be measured. An evaluation technique can be called as having a high validity level when the evaluation technique or test is able to measure what is meant to be measured. Every aspect of teaching equipment will be validated by validator with score range between1to 4. Validator will give score1 when the validity level is bad, 2 when it is not quite good, 3 when it is quite good and 4 when it is very good. To understand better about the scoring system of teaching equipment, the criteria can be seen in the table 2.1 below:

**Table 1.** Validation Criteria

| Percentage answer (%) | Meaning |
|---|---|
| 85,01 – 100,00 | Valid, can be used without revision |
| 70,01 – 85,00 | Quite Valid, can be used with small revision |
| 50,01 – 70,00 | Not quite valid, need a lot of revision |
| 01,00 – 50,00 | Not valid, can't be used at all. |

[7]

A teaching equipment can be called as valid after being validated by two validators. If the result of scoring categorized the teaching equipment developed as good enough, then the next process of teaching equipment development can be continued. Otherwise, when the scoring result has not fulfill the criteria, then revision must be done in order to get its validity.

2.1.1. Text Book Practicability Analysis

The next data to be analyzed in order to obtain the practicability of the Text Book is students' response questionnaires data. The text book can be called as practical when it is able to fulfill the positive response from the students up to $\geq 70\%$ [6]. The formulae used in measure the students' response is as follow:

$$RS_{students} = \frac{A}{B} \times 100\%$$

Note :

$RS_{students}$ = students' response percentage/students' response mean

$A$ = the number of studnets' response

$B$ = the number of students who give the response

[7]

2.1.2. Text Book Affectivity Analysis

The data used to analyze the text book affectivity is the students' logical thinking ability score. The text book can be called as effective if students pass the test with passing grade around medium (effective enough) and high (very effective). To understand better about the scoring criteria, can be seen in the table below:

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**Table 2.** Affectivity Crieteria

| No | Affectivity Criteria | Affectivity Level |
|---|---|---|
| 1. | 85,01% - 100,00% | Very valid or very effective, can be used without any revision. |
| 2. | 70,01% - 85,00% | Quite valid, quite effective, can be used with minor revision. |
| 3. | 50,01% - 70,00% | Not quite valid, not quite effective, need major revision. |
| 4. | 01,00% - 50,00% | Not valid, not effective, can't be used. |

[1]

Students' worksheet (LKS) can be called as effective when the number of students who pass the test are ≥ 75% classically [9]. The classical passing grade can be count by using formulae as follow [9].

$$\text{Passing score percentage} = \frac{\text{the number of passing stundents}}{\text{the total number of students}} \times 100\%$$

The text book can be called as acceptable when it fulfill the criteria of validity, affectivity, and practicality.

## 3. Main Result

### *3.1. Result Of Observation*

The development of Basic Mathematics text book Logical Thinking Ability based uses the development model developed by Borg and Gall. There are ten steps used in this research namely: 1) Research and information collection, 2) planning, 3) develop preliminary form of product, 4) preliminary field testing, 5) main product revision, 6) main field testing, 7) operational product revision, 8) operating field testing, 9) final product revision, and 10) dissemination and distribution. However, the researcher used only six steps in this research due to limited time of research.

The development process done in this research are: 1) research and information collection through class observation, 2) planning where researcher took note of problems faced in the basic mathematics classroom, 3) developing preliminary form of product where researcher created basic mathematics text book based on the development of logical thinking, 4) Preliminary testing of the draft resulted in the observation data and questionnaire collected from the observation. The preliminary testing was done to 6 of third semester students, 5) product revision which is done based on the firs preliminary test. As the result of the first preliminary testing, the researcher obtained some qualitative information of the text book developed.

Below are the result of the development from every step of the research:

#### *3.1.1. Preliminary research and information collection*

The first preliminary information collection is done through needs analysis by implementing front-end analysis principle. This step is started by doing collages interview, analyzing basic mathematics syllabus, analyzing basic mathematics text book, reviewing basic mathematics text book literature, studying the characteristics and development level of students' logical thinking ability.

a. Doing collages interview

Collages interview (subject lecturer) is done to understand the problems, obstacles and phenomena faced by the students related to basic mathematics learning. Based on the interview, can be concluded that students lack of understanding of the materials. In addition, students also lack of motivation to find additional references and information related to the subject.

b. Analyzing the basic mathematics syllabus

From the analysis of basic mathematics subject in the Department of Mathematics Teaching of IKIP PGRI Madiun, can be seen that learning performance has not been fully achieved. This is due to the lack of students' understanding of basic requirement of the subject. Moreover, teaching activity done in the class is more of teacher center than students center learning. Teaching and learning activities

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should be designed to maximize students' activity and develop active and independent learning. This can be solved by giving students basic mathematics structured task based text book.

c. Analyzing and Reviewing Basic Mathematics Text Book References

The analysis of basic mathematics text book is done to see the content of the materials, how it is presented, example or non-example in exercise as well as suitable tasks based on the syllabus. After analyzing, the researcher then review the book and compile them into a book according to the syllabus.

d. Analyzing the Students' Needs

Students' need analysis need to be done in order to develop suitable basic mathematics structured task based text book. This analysis is done through giving students questionnaire to the third semester students of Mathematics Teaching Department of IKIP PGRI Madiun. These questionnaire are then used as references to determine the students' need. The purpose is to gain the clear picture of students' need in the learning process. These questionnaire contain 8 questions with descriptive answer that should be completed by the students.

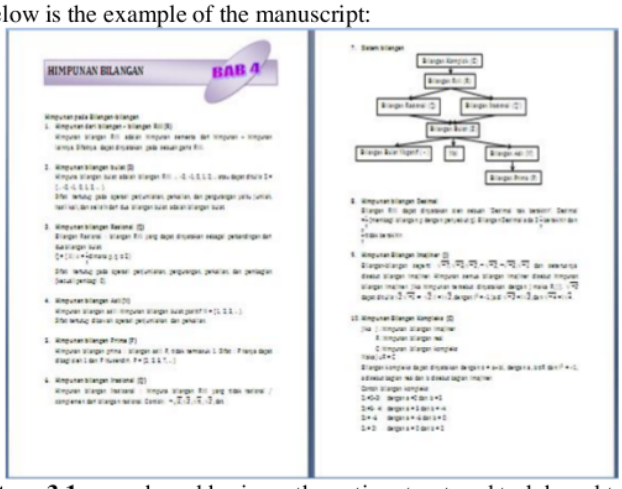
The questionnaire result shows that there are many students who still couldn't master the required materials in the basic mathematics namely logical mathematics, and mathematics sets. Therefore, students need basic mathematics structured task based text book in order to improve students' logical thinking skills.

*3.1.2. Planning*

This is the step when the researcher collect the field data obtained from the preliminary information collection. The data shows the lack of students' understanding of logical mathematics and mathematics set in basic mathematics subject. Students still find difficulty in proving the validity of the argument as well as operational theory of mathematics sets. The development of basic mathematics based on logical thinking is hoped to be able to give explanation related to the basic mathematics subject as students are trained to develop their logical thinking through problem solving of the task given.

*3.1.3. Developing Preliminary Product Draft*

The researcher create initial prototype of the basic mathematics structured task based text book. The book contain materials, example as well as non-question, exercises, task and evaluation. The book is created in paper based, in the form of manuscript of the materials to make the preliminary validity process easier. Below is the example of the manuscript:




**Picture 3.1** paper-based basic mathematics structured task based text book

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*3.1.4. Preliminary testing*

Validation test by expert is done after the prototype of the book is made. Validation test to see the lack of the draft from the point of content, which contain basic competence, material, example of the questions, exercises, and evaluation. Below is the result of validity test by experts:

**Table 3.** Validator Name of Basic Mathematics Text Book preliminary draft

| No | Name | Occupation /Focus | Suggestions |
|---|---|---|---|
| 1. | Drs. Sanusi, M.Pd. | Lecturer of Mathematics Teaching Department/Basic mathematics text book validator | The book cover should represent the theme of the subject, the inaccurate system of writing should be revised |
| 2. | Edy Suprapto, S.Si., M.Pd. | Lecturer of Mathematics Teaching Department/Basic mathematics text book validator | The format for symbol should be consistent, the double interpretation of the definition should be revised. |

a. Textbook validation for text book experts

This test is meant to get appraisal of the text book in the form of suggestions and input for improvement and perfection of the book seen from all aspects related to its quality. This step is started by the use of the text book by expert, then give appraisal of the book in the form of validation questionnaire. The validator are Drs, Sanusi, M.Pd. the validation result can be seen in the table below:

**Table 4.** Total Score Validation Questionnaire and Total Appraisal Validator of text Book Expert

| Score | Score Alternative | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| The number of aspect | 0 | 4 | 29 | 5 |
| Total | 0 | 8 | 87 | 20 |

Draft of validation analysis data I (text book validator expert)

$$P = \frac{\text{appraisal total score}}{\text{total highes score}} \text{ x } 100\%$$

$$P = \frac{115}{152} \text{ x } 100\% = 75{,}65\%$$

Based on table 3.2 can be seen that the validation data analysis percentage from the text book expert validator is 75,65 %.

b. Material Evaluation for Material Expert

This is done to obtain appraisal of the materials, in the form of input and suggestion for the improvement and perfection of the materials seen from all aspects related to learning and determine its suitability. This process is done through direct observation by text book and material experts to see whether the book can be implemented in the teaching process. The investigation is done to obtain appraisal of the book, input, and suggestion for improvement and perfection of the book. Material validation expert, Mr Edy Suprapto, S.Si.,M.Pd given his appraisal as follow:

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**Tabel 5.** Jumlah Skor Validasi dan Jumlah Aspek Penilaian Validator Ahli Materi

| Skor | Alternatif Skor | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Jumlah Aspek yang Dinilai | 0 | 4 | 27 | 7 |
| Total | 0 | 8 | 81 | 28 |

Draft of Validation Data Analysis I (Material expert validator)

$$P = \frac{\text{total appraisal score}}{\text{total highes sore}} \text{x } 100\%$$

$$P = \frac{117}{152} \text{x } 100\% \quad = 76{,}97\%$$

Based on the table 5 can be seen that the validation data analysis percentage by material expert is 76,97%.

The summary of basic mathematics logical thinking based text book is shown in the table below:

**Table 6.** Text Book Validation Analysis Data

| Text Book expert | Material expert |
|---|---|
| 75,65 % | 76,97% |

Based on table 6 above, can be seen that the preliminary draft development validation score of the basic mathematics logical thinking based text book based from both validator experts are include into three main categorized as valid and acceptable to be tested. In order to obtain the book perfection, the revision will be done based on the suggestion and comment from each validator. After the revision step, the book then can be tested in the preliminary test.

c. Text Book Evaluation Questionnaire For Lecturer

This questionnaire is meant to understand lecturer appraisal of the basic mathematics text book. This questionnaire contain 38 questions. The researcher used scale questionnaire with 1 to 4 score.

**Table 7.** Total Validation Score and total appraisal aspect by lecturer

| Score | Alternate Score | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Total aspect being scored | 0 | 3 | 28 | 7 |
| Total | 0 | 6 | 84 | 28 |

Draft of Validation Analysis Data I (lecturer)

$$P = \frac{\text{total appraisal score}}{\text{total highest score}} \text{x } 100\%$$

$$P = \frac{118}{152} \text{x } 100\% = 77{,}63\%$$

Based on table 7 above can be seen the validation data percentage by expert is 77,63%, therefore, this book can be categorized as quite valid and acceptable for test.

*3.1.5. Main product Revision*

The result of validity test shows that the basic mathematics logical thinking based text book developed has fulfilled the acceptable criteria. However, there are some minor revision according to the expert, namely the use of language which potentially lead to students' misunderstanding and misinterpretation, some symbols used in the book are not quite suitable and need to be revised. Those minor problem became the consideration for the researcher to revise the draft. The revision is done through edit and review process by developer. The developer then done evaluation of the whole design based on the experts' input and suggestions.

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*3.1.6. Main Product Test*

This process is done to obtain data of impact of the book for the students. The main test of the product is done through giving the text book to 6 of the third semester students of Mathematics Teaching Department. This process is done to obtain the data from the questionnaire given to the students related to the affectivity of the basic mathematics logical thinking based text book toward the students. Moreover, through this process, the researcher can obtain the data of students' logical thinking ability through observation sheets of students' logical thinking.

The product test was done in two meeting with the duration approximately 150 minutes for each meeting. Some aspects put in the students' questionnaire are how is the students' response toward the book, how is the components of the book, response of the use of the book, is the content, exercises and evaluation can be understood easily by students. In this process, students have to read the book, then they have to full up the questionnaire given to see the affectivity of the basic mathematic logical thinking based text book and whether or not the book has fulfilled the basic competence, language and content.

a. Students Response Of The Text Book

Table 8 below shows students' response of the book:

**Table 8.** Data of Students' Respose

| No. | Nama | Kriteria |
|---|---|---|
| 1. | Ria Nopida | High |
| 2. | Uci Novianti | High |
| 3. | Ayu Apriliya C | Mediun |
| 4. | Arisma Noviana P | Medium |
| 5. | Novi Eka Rahayu | Low |
| 6. | Veronika Yustika A | Low |

**Table 9.** Result Of The Students' Questionnaire

| No. | Responded Aspects | Appraisal | | | |
|---|---|---|---|---|---|
| | | Total | (%) | Total | (%) |
| 1 | Can you understand the language of the book easily and clearly? | Clear | | Not clear | |
| | Total | 4 | 66,67 % | 2 | 33,33 % |
| 2 | Are you interested with the appearance (writing, symbols, illustration/picture and placement of the picture) of the book? | Interested | | Not interested | |
| | Total | 5 | 83,33 % | 1 | 16,67 % |
| 3 | Is the content of the book interesting? | Interesting | | Not interesting | |
| | Total | 5 | 83,33 % | 1 | 16,67 % |
| 4 | Is the text book can be understood easily? | Easy | | Difficult | |
| | Total | 4 | 66,67 % | 2 | 33,33 % |
| 5 | Are you interested with the presentation of the materials in the book? | Interested | | Not interested | |
| | Total | 5 | 83,33 % | 1 | 16,67 % |

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| | | | | | |
|---|---|---|---|---|---|
| 6 | Will you be interested when the lecturer use the same book for the next teaching learning process? | Interested | | Not interested | |
| | Total | 6 | 100 % | 0 | 0 % |

Based on the data presented in the table 3.7 the positive response given by students reached up to 80,56%, while the negative response only 19,44%. Therefore, can be concluded that the respond of the students toward the book is very good where the percentage of positive response reached more that $\geq 70\%$.

b. Observation Of Students' Logical Thinking Ability

Below is the result of students' logical thinking ability observation:

**Table 10.** Hasil observation result of students' logical thinking ability

| Appraisal Aspect | Alternate score | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 0 | 0 | 3 | 3 |
| 2 | 0 | 1 | 3 | 2 |
| 3 | 1 | 2 | 2 | 1 |
| 4 | 1 | 1 | 1 | 3 |
| 5 | 1 | 1 | 2 | 2 |
| 6 | 1 | 1 | 1 | 3 |
| 7 | 0 | 1 | 3 | 2 |
| 8 | 1 | 2 | 1 | 2 |
| Number | 5 | 9 | 16 | 18 |
| Total | 5 | 18 | 48 | 72 |

Result of students' logical thinking ability data analysis

$$P = \frac{\text{total appraisal score}}{\text{total highest score}} \text{x } 100\%$$

$$P = \frac{143}{192} \text{x } 100 \ \% = 74{,}48 \ \%$$

Table 10 above shows that the students' logical thinking ability reached up to 74,48 %, therefore, can be concluded that the students' logical thinking ability can be categorized good and the book can be categorized as effective.

*3.2. Discussion*

From the analysis result of the book done by text book and material experts, the validity level of the book reached up to 75,65% and 76,97%. Therefore, this text book can be categorized as quite valid and can be implemented. Based on the students' questionnaire result analysis, 80,56% of the students give positive response toward the book. Therefore, this text book can be categorized as practical. The result of students' logical thinking ability observation, 74,48% of students show high ability of logical thinking. Therefore, this text book can be categorized as effective in improving students' logical thinking ability.

## 4. Conclusion

There are three points of conclusions obtained from the research, namely:

*4.1. The basic mathematics structured task based text book is valid and can be implemented*

*4.2. The basic mathematics structured task based can be categorized as practical as it seen from the positive response from the students.*

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*4.3. The basic mathematics structured task based can be categorized as effective in improving students' logical thinking ability.*

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# The Development of Introduction for Basic Mathematics Based Structured Tasks Textbook to Improve the Ability of Logical Thinking

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