

# Validity of Math Comic Design Using Computational Thinking to Stimulate the Special Needs Student's Critical Thinking Ability

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## ABSTRACT:

Critical thinking is an act reasonable thinking in choosing a problem-solving strategy for proper decision making. If students have high critical thinking skills, students can solve math issues easily. Comics can be used as form of variation in the provision of interactive, fun, and reinforcing student critical thinking skills. The study aimed to analyze and design Math Comic by Computational Thinking methods to stimulate students' critical thinking skills. This type of research is descriptive research method. The research result in several findings. First, teachers need a medium of learning. Second, the special needs student's critical thinking ability needs to be improved. Third the researcher designs Math Comic consisting of covers, prefaces, tables of contents, usage instructions, basic competence, core competence, achievement indicators, comic story development, and matters of evaluation. Fourth, Math Comic was designed according to computational thinking methods to stimulate students' critical thinking skills. The results of this study can be used as a guide for mathematics teachers in developing Math comic that make students understand mathematics and have critical thinking skills simultaneously. The contribution of this research is to stimulate critical thinking skills into Math comic. In addition, Math comic is designed according to the computational thinking.

## Keywords

Computational Thinking, Critical Thinking, Math Comic Design, Special Needs.

Article Received: 18 October 2020, Revised: 3 November 2020, Accepted: 24 December 2020

## Introduction

Critical thinking is an act of reasonable thinking in choosing a problem-solving strategy to realize proper decision making (Agus & Fitriani, 2019). Whereas, Chukwuyenum in (Chukwuyenum, 2013) states that critical thinking is a process of thinking about realizing a decision by collecting, interpreting, analyzing, and evaluating information with data and or assumptions, as well as implementing decision according to what it believes. Therefore, critical thinking is a process of thinking in choosing a problem-solving strategy by collecting, interpreting, analyzing, and evaluating information with data and or assumptions, as well as implementing decision according to what it believes to realize the right decision making (Suparman & Wijayanti, 2019;

Bello & Steyn, 2019; Dnga & Mafini, 2019; Isabirye & Moloji, 2019).

One of the abilities that became the goal of 21st-century mathematics learning and capability was the critical ability (Agus & Fitriani, 2019; Hidayat et al., 2017; Widana et al., 2018). Additionally, critical thinking ability cans self-efficacy or belief inability on the self. The higher is one's self-efficacy than the higher the level of his critical thinking ability (Misbahudin, 2019). Therefore, critical thinking ability is important to develop because it increases belief in the ability shared by students and becomes one of the goals from 21st-century capability.

The development of mathematics critical thinking ability for students can make it easier for students to solve mathematical matters (Palinussa, 2013). Besides, research conducted by Aikovitsh and Amit in (Aizikovitsh & Amit, 2010) showed that students acquire conceptual thinking skills by realizing a learning environment that builds critical thinking skills, thus encouraging students to investigate problems as critical thinkers (Tajudin, Ali & Idris, 2015). Therefore, students need to familiarize being critical thinkers because it can make it easier for students to solve the mathematical matter.

In reality, some students have not had critical thinking skills. In Indonesia generally still emphasizes mathematical concepts, rather than leading to reasoning, analysis, or problem-solving capabilities (Widana et al., 2018). This also occurs in the SLB Bhakti Kencana 1 Yogyakarta, students' ability to analyze questions, and formulate answers still need to be improved. Besides, students' asking skills also need to be improved.

Computational thinking (CT) is one method of learning that can improve critical thinking on 21st-century learning (Ambrasio et al., 2014; Siong & Osman, 2018). The application of CT can provide instruction of a road map from a large problem, and then be divided up until the problem becomes scaled down in the student thinking process so that the solution is obtained (Weintrop et al., 2015). Therefore, the implementation of CT needs to be done to make it easier for students in the critical thinking process to seek mathematical problem solutions by dividing the problems into small parts first.

The use of language within the math comic can strengthen the student's critical thinking ability (Anugerahwati, 2017). In line with that, research Rasiman and Pramasdyahsari in (Rasiman & Pramasdyahsari, 2014) conducted showed that the

use of effective flipbook maker-based e-math comic learning media was observed from junior high school students' critical thinking skills and could foster student characters such as discipline, cooperation, honesty, confidence, and perseverance. So, media math comic can stimulate students' mathematical critical thinking skills.

Comics can be used as a form of variation in the provision of interactive and fun learning media (Indaryati & Jailani, 2015). Furthermore, media math comic represents the delivery of messages in the form of a series of images containing stories and problems of mathematical calculations in them so that even difficult math lessons will feel easy and fun (Manalu et al., 2017; Florayu et al., 2017). This is in line with the statement (Indaryati & Jailani, 2015) stating that the medium of mathematical comics is potentially favored by students as it is underlain by a row of images that can animate the contents of the story. Therefore, comics constitute that one of the mediums of learning mathematics that is easy and fun for students.

Based on background, research result, observations on students, and interviews with math teacher at SLB Bhakti Kencana 1 Yogyakarta, critical thinking ability still needs to be improved. Proper selection of methods and learning media is necessary for helping students understand the materials taught and is also expected to stimulate students' critical thinking skills. However, schools with information technology that is still require the medium of learning in the form of print media for use by students on the learning process in the class (Pardimin & Widodo, 2017).

One of the usable print media is comics. Therefore, researchers are interested in developing Math Comic by Computational Thinking methods to stimulate students' critical thinking skills. The purpose of the study was to analyze and produce

Math Comic designs by Computational Thinking methods for stimulating students' critical thinking skills (Felicia et al., 2016).

### Method

The methodology used in this work relied on a qualitative approach through a series of interviews, observations and document analysis. Since the interviews could give a deeper insight into the Math comic, interviewees were carefully chosen from among those who had the knowledge and experience of the Math comic. However, the data collected needed to be interpreted and coded in a valid and reliable manner for analysis. The method sought to classify the findings of discussions into an effective number of categories by coding that represented similar meaning. Coding is a way to link the data with information, topics, concepts and factors. In this study, researchers designed learning media in the form of Math Comic using the Computational Thinking method on Smallest Fellowship Multiple materials and the Greatest Fellowship Factor for the VIII class of SMPLB.

The subject of trials in the study is a VIII grader and math teacher at special needs school located in SLB Bhakti Kencana 1 Yogyakarta. Data capture is done using non-tests. Interviews are conducted on 2 teachers and 2 students to find out data about students' need for Math Comic. Observations are conducted to know the characteristics of students and learning methods in the learning process. Whereas document analysis is done to analyze the curriculum, learning materials, and teaching materials used. The data analysis technique used is content analysis.

### Results and Discussion

Results and discussions contain descriptions of the need analysis and the math design stages, and the validity of math comic design.

#### Need Analysis

Based on the results of interviews with curriculum-related teachers, researchers get information saying that SMPLB Bhakti Kencana 1 Yogyakarta further excavates ability in the student skill field. The application of the 2013 curriculum still needs to be optimized. The source of learning used by teachers for VIII graders is the thematic book according to 2013 curriculum. Teachers use the medium of learning in the form of objects around, abacus, pictures, and domino cards. The available learning media is less helpful to students in stimulating critical thinking skills. Students have difficulty in studying materials as abstracts, such as seeking the Multiple of the Smallest Fellowship, the Greatest Fellowship Factor, and the factor numbers.

Based on observations, researchers found that the SMPLB Bhakti Disaster 1 Yogyakarta uses conventional methods. Conventional learning methods also lack help to students in understanding the concept of Least Guild multiples and the Greatest Fellowship Factor because it is less specific in honing or stimulating students' critical thinking skills. Based on the analysis of learning methods, researchers get the idea that Computational Thinking learning methods can be used to make it easier for students in Understanding the concept of Smallest Fellowship Multiples and Greatest Fellowship Factors.

Teachers state that students also have happy characteristics if given a question continuously and cross the picture world. Deaf students are more minutely mindful of vision skills in receiving learning. There are 2 students who often win the painting race. Therefore, the math comic learning medium is chosen because it fits these characteristics.

Based on observation results, 2 students have not been able to analyze questions and formulate answers so that teachers need to review the

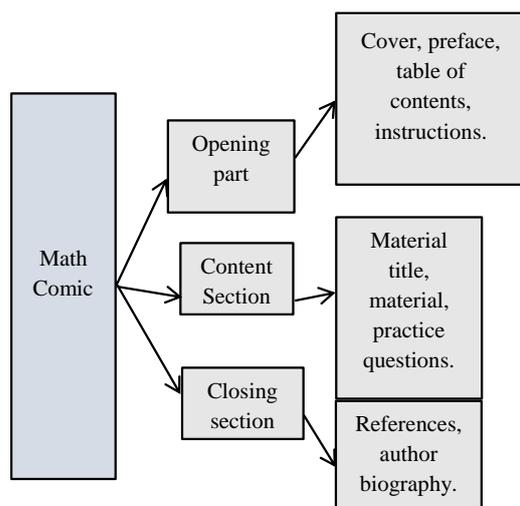
materials taught in the classroom. When working on the matter, the majority of students use measures similar to those in the examples of the teacher. Some students did not ask at all but when asked it turned out that it still did not understand. This suggests that the ability to think critically of students still needs to be improved.

From some of the above analysis results, researchers get information that the critical thinking ability of most students still needs to be improved. The development of a learning source that can help students to improve students' critical thinking skills is necessary. Students have difficulty in studying the materials of the Smallest

Fellowship Multiple and Greatest Fellowship Factor. Students are also happy in the world of pictures. Therefore, researchers concluded that the development of math comics to stimulate students' critical thinking skills is necessary (Suparman & Aini, 2019).

### Math Comic Design

At this stage, researchers created a Comic Math design based on the Computational Thinking method. Math Comic manufacturing is divided into three parts, namely: opening part, content section, and closing section (Harisna & Suparman, 2019). The development of Math Comic is shown in Figure 1.



**Figure 1.** An arrangement of the Math Comic section

This math comic design uses images as one of the unique features for the math comic to be able to attract students in the process of learning mathematics. Student activity in understanding the concept of material can be shaped and trained using comics. The BBC website proposes some activity to use comics, as follows: 1) telling complex stories, 2) providing commentary and provoking thoughts, 3) providing examples of vocabulary dealing with current topics in

discussion, 4) providing identifiable characters, and 5) including cultural teaching (Anugerahwati, 2017).

The opening part of the comic math book contains covers, content list, introductions, and usage instructions. This section is structured based on results obtained from interviews and observations made to students. The opening part, especially the cover section, is composed as interestingly as

possible the cover section feels interested in Math Comic and feel happy in the learning done. The

cover Math Comic is shown in Figure 2



Figure 2. Cover

The cover is designed against a brownish-pink background and with a dizzy human image of the KPK and FPB material. The hammer image shows that there is pressure on the material inside his head. There is writing that this Math Comic uses

the Computational Thinking method to be more easily understood by readers related to this learning method. The UAD logo identifies the author's institution. The preface section can be seen in Figure 3.

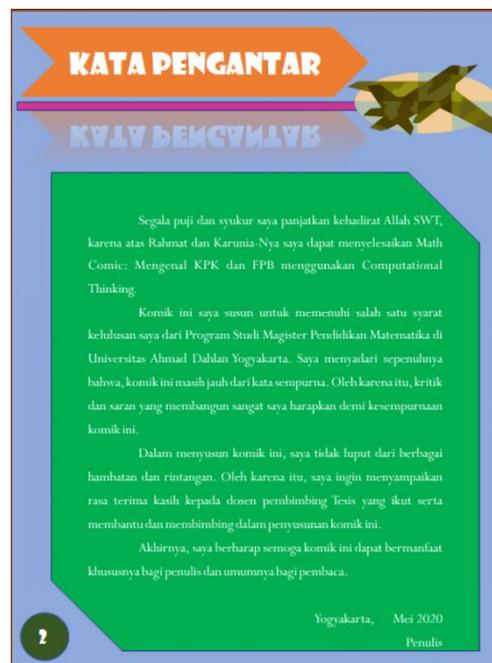


Figure 3. Preface

The color used for the preface is green. While the color used for the background color of the writing

is blue. The table of contents can be seen in Figure 4.

DAFTAR ISI	
Sampul .....	1
Kata Pengantar .....	2
Daftar Isi .....	3
Supriadi mendapat giliran ronda .....	4
(Mengetahui dan berhitung KPK)	
Buku Novel dan Komik Tamrina .....	10
(Mengetahui dan berhitung FPB)	
Ayo Berlatih .....	17

Figure 4. Table of Contents

In the table of contents, there are lists in Math Comic, including a list of comic story sections in the material of the Smallest Multiples Alliance and the Biggest Communion Factor. The table of contents for the evaluation questions is named by Let's Go Practicing.

The contents section of the math comic is the chapter title, basic competencies, core

competencies, achievement indicators, and the steps of learning activities. This section is based on the results of interviews and observations of students. Researchers create math comic designs following the material requirements that are considered difficult by students, namely: the least common multiple materials and the greatest communal factor. The concept of math comics can be seen in Figure 5 (Ciayo, 2020).



Figure 5. Concept

Math comic displays the story through 2 pictures in 1 page as shown in Figure 6. Math comic is designed by showing the faces of students of SLB Bhakti Kencana 1 Yogyakarta as human figures in

comics. The picture above is an illustration of the design. Researchers have not taken pictures of the students' faces yet to be turned into comic characters. Besides, the content on math comics

also presents stories related to the Indonesian culture. For example, the characters are drawn from different tribes, the language is adapted to

the tribes of the figures, the activities of the figures are also related to the Indonesian culture. The evaluation questions can be seen in Figure 6.

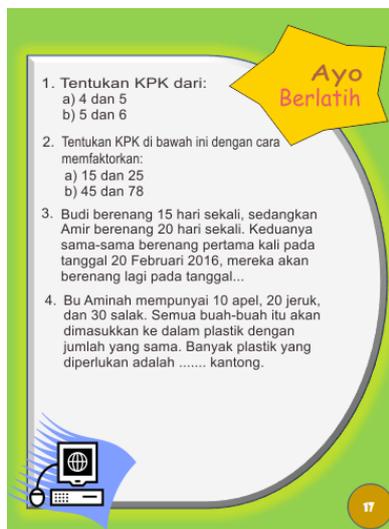


Figure 6. Evaluation Questions

Evaluation questions are used to train students' level of conceptual understanding in the material of Multiple Smallest Fellows and Biggest Communion Factors learned through math comics. Students can construct mathematical problems through their minds by using evaluation questions in the form of words. The concluding part of Math Comic consists of a glossary and bibliography.

**Validity of Math Comic Design**

Math Comic Design uses Computational Thinking as a learning medium that has been further validated by Firda Yani Yulindra, S.Pd, and Elsi Monica, S.Pd. The second validator is a teacher at SLB Negeri 2 Pangkalan Bun. Comments and suggestions can be seen in Table 1.

Table 1. Comments and Suggestions

Validator	Comments	Suggestions
<b>Respondent 1</b>	Questions and story content are adjusted to the learning method used.	Add questions and fill in the story by using the CT learning method to match the learning objectives.
<b>Respondent 2</b>	Lack of strengthening the content of stories about Indonesian culture	Add context to the content of the story such as night patrols that are closely related to Indonesian culture

Researchers improve the design according to suggestions and comments. The next step is the feasibility assessment by the validator with

completing the instrument of eligibility for media experts and material experts. The results of the

assessment from media experts and material

experts can be seen in Table 2.

**Table 2.** Feasibility Assessment

No	Validator	Score	Criteria
1	Respondent 1	80	Good
2	Respondent 2	72	Good
Total Score		152	
Average		76	Good

Table 2 shows that the feasibility assessment given by Respondent 1 is 80. While the assessment of Respondent 2 is 72. The average score obtained is 76. This score indicates that the Math Comic design is classified as good criteria. It shows that Math Comic uses Computational

Thinking is a valid instructional media design. As in Faulina & Suparman (2019) and Suprotun & Suparman (2019), this research can be further expanded at the development, implementation, and evaluation stages.

### Conclusion

This research resulted in a Math Comic design. Math Comic Design is designed based on curriculum analysis, learning resources, learning materials, learning methods, and student characteristics. Furthermore, the analysis is summarized in the analysis of students' needs to produce Math Comic designs using the Computational Thinking method. The Math Comic design component consists of a cover, introduction, table of contents, usage instructions, basic competencies, core competencies, achievement indicators, comic story development, and evaluation questions. The results of the Math Comic design are the initial stages to create learning media. To develop Math Comic, researchers will conduct further research in the stages of development, implementation, and evaluation.

### Acknowledgements

The researchers would like to thank the SLB Bhakti Kencana 1 Yogyakarta, Universitas Ahmad Dahlan, Universiti Pendidikan Sultan Idris Malaysia,

Universitas Negeri Gorontalo, Universitas Khairun, and Institut Agama Islam Negeri Ternate for helping and providing opportunities in this research.

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