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VALIDATION OF ELEMETARY ELECTRONICS MODULES INTEGRATING CREATIVE THINKING IN PASSIVE COMPONENT MATERIALS AND ITS APPLICATIONS

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ABSTRACT

The purpose of this study is to cultivate students' creative thinking. Students' thinking can have an impact on human development. This was achieved through the Human Development Index survey results, which showed that the level of human resource development in Indonesia is still low due to poor student abilities. One of the drivers of increasing students' ability to think creatively is the learning tools used. We need educational tools that can help students improve their thinking skills. One of the most popular learning tools is critical thinking in it. This research was conducted to develop an elementary electronics module that integrates creative thinking in passive component material and its application for physics students. The kind of study is R&D. The development in this study uses the ADDIE development model which consists of five stages, namely analysis, design, development, implementation and evaluation. The development of this research only reached the development stage due to the limited time and cost for this research. The data obtained from this study came from the validity test through validity sheet. The worksheet is divided into five sections, which are assessed by our qualified trainers. The average improvement in students' creative thinking is 86.5%. This value states that the development of basic electronics modules integrates creative thinking in passive component materials and the application is declared feasible in terms of product validity tests.

Keywords : Creative Thinking; Elementary Electronics.

I. INTRODUCTION

It is necessary to improve the quality of human resources in order to acquire human resources who have the character and personality to be active in the fields of internationally competitive science, technology and industry. Especially in the era of industrial development 4.0, the quality of human resources will affect the development of the country. To do this, they need a good, proper and fair education[1].

The main purpose about education this century to help students develop skills and support the development of students' independence when facing the times. Students will be able to solve problems effectively and creatively. The National Education System as stated in Law Number 20 of 2003 in the fourth paragraph explains that the purpose of national education is, among other things, to develop the creativity and independence of students as well as to make students human beings who are pious as well as have faith in God Almighty.

However, based on data from the HDI (Human Development Index) survey by UNDP (United Nation Development Program) conducted in 2017, it is clear that of 188 countries in the world, Indonesia is ranked 113 [2]. This is because the thinking ability of Indonesian students is still low. Based on his research, Amtiningsih says that students' average creative thinking is about 25.5%, including the least creative category[3]. Poor thinking ability of students is a common problem, especially in education.

Neumann explained that the ability to think creatively is a solution for generating new ideas and obtaining the final result in the form of unique and one-of-a-kind products [4].The ability to think creatively requires solving a number of problems with various alternative solutions according to pre-existing data/information. The resulting

solution idea demonstrates originality, flexibility, fluency, and elaboration. The ability to think creatively can be realized through learning activities that provide opportunities for students to think openly and flexibly in solving a problem.

Moma explained that the characteristics of creative thinking are described in Table 1.

Table 1. The Characteristics of Creative Thinking Skills

Skills	Percentange
Fluency	• Generating many ideas in problems. • Provide multiple responses to a query. • Work it more than others and work it faster.
Flexibility	• Generate multiple troubleshooting responses from a query • Could notice the matter from a different perspective
Originality	• Provide the possibility of new thoughts when complete questions • Designing uncommonl combinations of components
Elaboration	• Evolve or increase the treasury the thoughts of others. • Adding, organizing or detailing in thoughts so as to increase the quality of the thought.

(Source: Ref [5])

The learning process must facilitate students in conveying many concepts in every condition that students face, whether in the form of query or responses. So that when students are faced with a problem, they can come up with different ideas from other students so that each student gives a different response. With this, it is hoped that students are able to provide unique thoughts according to the ideas developed and can complete a matter so that creative thinking skills are formed

The ability to think creatively is a skill that must be possessed by students in implying an understanding of a problem and producing various kinds of ideas in solving it. These ideas produce creative ideas to develop students' thinking and create new things. Therefore, the creative thinking process can develop students' creative thinking. Students gain confidence in the development of their skills, especially creative thinking.

The student will find a new idea from the pattern of thinking, so they can develop new information according to the student's thoughts and views. Students will look for alternative ways to solve a problem. So that access to appropriate learning materials determines the success of the student learning process.

In the physics department, students are required to take courses in the field of expertise, namely Elementary Electronics. In this course, students are expected to have an understanding of basic electronic components and electronic circuits and their application in everyday life. Hufri has conducted analytical research on two basic electronics books that are used as a means of supporting lectures in basic electronics courses, Department of Physics, FMIPA UNP stated that the percentage in facilitating students' creative thinking skills in these books is, of 36% fluency, 21% flexibility, 12% originality, and 32% improvement [6]. See Table 2 for the results of the analysis of the two books.

Table 2. Results of Basic Electronics Book 2 Analysis

Book	Aspects of Creative Thinking			
	Fluency	Flexibility	Originality	Elaboration
A	38%	21%	11%	30%
B	34%	20%	13%	33%
Averge	36%	21%	12%	32%

(Source: Ref [6])

From the analysis of the teaching materials the elementary electronics course used as the electronics elementary course of the the Department of Physics Universitas Negeri Padang, it can be concluded that the teaching materials were not maximized in the development of students' creative thinking abilities during the learning process. . Therefore, it is necessary to develop learning tools, specifically in order to improve aspects of creative thinking. The availability of learning modules that integrate creative thinking can improve students' creative thinking skills in elementary electronics courses, specifically in passive component materials and its applications.

Passive component material and its application are elementary materials that use passive components in elementary electronic circuits, where by studying this material, students can analyze the characteristics of each passive component contained and used in a circuit in accordance with the application of students' creative thinking skills. passive and its application students acquire the concept of the characteristics of each passive component

through exploration and experimentation, and apply this knowledge to creatively solve problems encountered in everyday life.

Experiencing the development of the 4.0 industrial revolution era, creative thinking skills are one of the supporting factors that need to be developed by students. Creative thinking skills train students in developing information to solve problems and produce unique new works. In this era, besides being able to receive knowledge, students are also required to have the ability to explore knowledge without limits. This can happen if students experience an increase in creative thinking skills during or after learning.

Improving students' creative thinking skills in learning activities will have an impact on their learning outcomes. This statement is in accordance with Nuriadin's opinion that students' creative thinking skills are related to their learning outcomes, creative thinking skills have a positive impact on students' learning outcomes [7]. Supardi also stated that student learning achievement is positively influenced by students' creative thinking skills [8]. Furthermore, Blegur stated that students' creative thinking skills have a positive correlation with student learning outcomes [9]. Mutsaqofah revealed in his research that the results of the correlation between creative thinking skills and student learning outcomes showed a significant relationship[10]. [11][12][13]14] have also conducted research related to teaching materials integrating creative thinking in physics learning materials with similar research, namely the development of teaching materials integrate creative thinking. In this study, the object and research material will be different from previous research.

Based on the results of the research above, to overcome the problem of the low creative thinking ability of students, one of them is the development of teaching materials that integrate creative thinking. Students' creative thinking ability affects their academic achievement. Students with high creative thinking skills have good learning achievements. In order for students' creative thinking skills to develop, students need to be facilitated with devices that support learning. One of them is the existence of teaching materials which integrate creative thinking. Therefore, researchers will develop teaching materials that integrate creative thinking, namely "Development of Elementary Electronics Modules Integrating Creative Thinking in Passive Component Materials and Its Applications".

II. METHOD

Research and development (R and D) is the research method used in this study. The object to be studied is teaching materials in the form of elementary electronics learning modules on passive component materials and their applications to integrate students' creative thinking. This module consists of 5 chapters and 13 LA. This elementary electronics module is validated by the lecturer as an expert.

The design model used is ADDIE, with the following steps:

1. Analysis

At the analysis stage, needs assessment and task analysis were carried out. At the end of this analysis stage, an evaluation of the analysis results obtained. Evaluation is needed to determine the feasibility of the developed module if it is applied as a learning tool.

2. Design

At this stage, the design of the concepts and contents of the textbooks that will be developed is carried out. This textbook is prepared in accordance with the guidelines for developing teaching materials by integrating aspects of creative thinking abilities. As stage above, also here an evaluation also applied, to determine feasibility of design’s produtc.

3. Development

At this stage, the previously made design is transformed an electronics elementary. Evaluation at this stage is a test of feasibility and product quality through a validity test conducted by the validator.

4. Implementation

Implementation is the application of elementary electronics learning modules by integrating creative thinking. Evaluation at this stage is a practical test of product validity.

5. Evaluation

At this stage, it will be known whether the electronics’ elementary textbook by applying how to think creatively that was developed is successful and in line with expectations. Evaluation on the ADDIE model aims to improve product results is referred to as formative evaluation.

The control variable in this study is the passive component material and its application. The instrument of data collection in this research is the validity test questionnaire sheet by the lecturer. Pay attention to Table 3 for the assessment categories used in determining the validity of teaching materials.

Table 3. Product Validity Criteria

No.	Percentange	Criteria
1.	0-20	Invalid
2.	21-40	Less Valid
3.	41-60	Quite Valid
4.	61-80	Valid
5.	81-100	Very Valid

(Source: Ref [15])

This study lies in the range of values from 61-100 with valid and very accurate criteria for classification of the validity's value of the module used. To analyze the data obtained from this study, descriptive data analysis techniques were used which described the accurasy of electronics' elementary module applying to think creatively. The validity of the basic electronics module integrates creative thinking using questionnaires that have been made which are assessed by FMIPA UNP lecturers as product validators. Descriptive analysis is a statistical assessment used in this study, by representing the results of the assessment in the type of a graph with a Likert scale as a weighting for the assessment. According to Riduwan, the use of a Likert scale will help in finding the indicators to be measured by describing the variables used [15]. Then made a question with the weight of the assessment:

a. 5 points for a very good rating,
b. Point 4 for good rating,
c. Point 3 for enough rating,
d. Point 2 for less rating, and
e. Point 1 for the rating is very less.

Some respondents will make an assessment and then the assessments are added up to find out the score. Then, the score is divided by the highest number of weights to get the results of the assessment on each statement for each questionnaire criteria, then multiplied by 100. Mathematically it can be written as the following equation.

$$Nilai = \frac{bobot\ total}{bobot\ maksimum} x100 \quad (1)$$

The determination of the value of the product validity feasibility test is adjusted to the score category obtained. The categoriz ation of level of validity in this work lies in the values' range from 61 to 100, namely accurate and very accurate.

III. RESULT AND DISCUSSION

A. Result

The outcome of the study are the validation of the elementary electronics learning module that applies thinking creatively in passive component material and its application for physics students majoring in FMIPA UNP with the ADDIE model as the development model used. The ADDIE model includes five main stages, with no sequence namely the design stage, the analysis stage, the implementation stage, the development stage, and the evaluation stage. Each stage in the ADDIE model is equipped with an evaluation step. In this study, the researcher limited the module development stage to the development stage due to time and cost limitations.

Experts who work as lecturers conduct validity tests for products that have been developed by researchers. The tool used to test the feasibility of the learning module and the accuracy of its constituent components as well as a guide for revising the learning module is to use a validation instrument. The validation instrument which is prepared based on indicators of learning module development which will be filled by experts produces an analysis of five assessment components.

The assessment components used in the validation instrument consist of content feasibility, construction feasibility, language feasibility, module display feasibility and creative thinking feasibility in learning modules. Based on the analysis of the outcome of the validation instruments that filled in by experts, the accurasy results for the five components that make up the developed learning module are obtained. First, the results of the validity test are viewed from the content component of feasibility which containt of five indicators, pay attention to Figure 1.

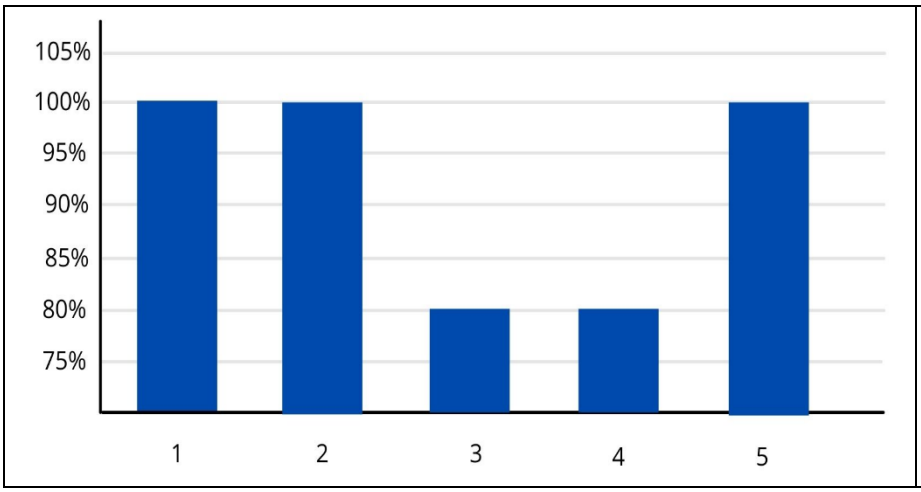

Figure 1. Module Content Eligibility Validation Value

The graph in Figure 1 is a graphical representation of the validation data on the content feasibility component. Based on the graph in type 1, we may see that the results of the validation of the feasibility components of the contents of each indicator can be seen. The first indicator shows that the module that used in learning learning is in accordance with the Semester Learning Plan (SLP) with a 100% score presentation. For the indicator of the substance of the material in the learning module with a presentation value of 100%, it can be said to be correct. Judging from the relationship with the latest issues, the learning module with a presentation value of 80% can be declared appropriate. In the fact indicators, the concepts/materials presented in the learning module are correct with a presentation value of 80%. As for the last indicator with a presentation value of 100%, it states that the learning module created can add insight to knowledge. The value of the presentation of the feasibility component of the content of the learning module ranges from 80%-100%, with very accurate criteria.

According to on the scores of the five indicators of the feasibility component, the content of the learning module consists of two indicators with a value of 80% categorized as valid and three indicators with a value of 100% categorized as very accurate. The medium value of the five substance feasibility component indicators is 92%. So that the feasibility component of the content of the learning module developed is categorized as very valid.

The two results of the validity test are viewed from the feasibility component of the module construction consisting of six indicators. The graphical representation of the data from the validation results on the construction feasibility component, pay attention to Figure 2.

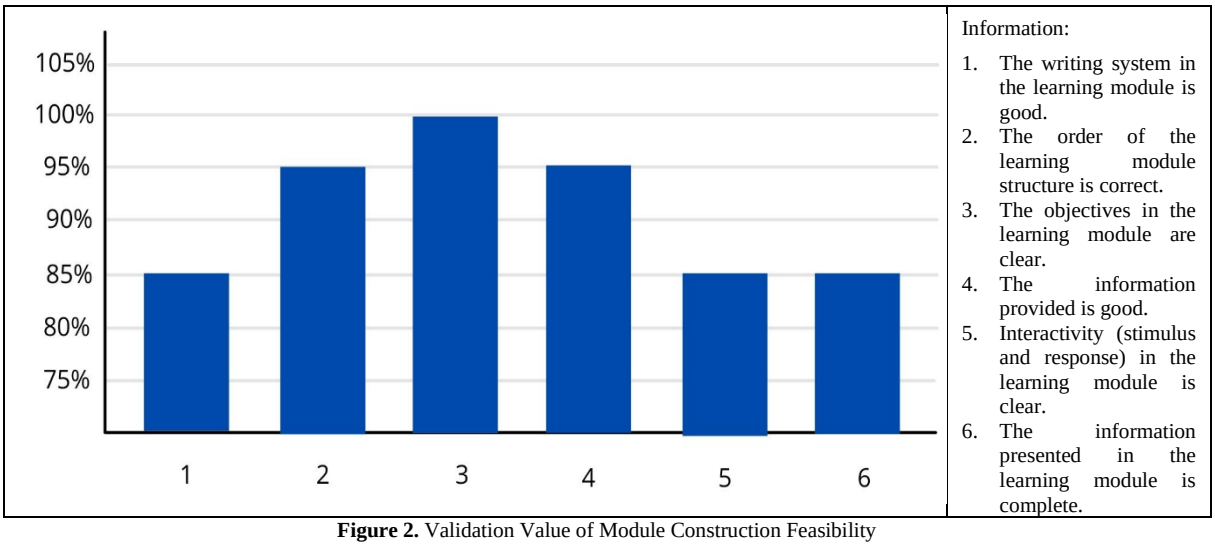

Figure 2. Validation Value of Module Construction Feasibility

Type 2 shows the validation outcome of each indicator of the construction feasibility component. The presentation value of the construction feasibility component which consists of six indicators ranges from 73%-100%. The average value of the presentation of the six content feasibility component indicators, which is 88%, is

categorized as very valid. So that the feasibility component of the construction of the learning module developed is declared to be very valid.

The three results of the analysis of the validity of the language feasibility item consist of five measures. The outcome of the graphical representation of the validity test analysis data pay attention to Figure 3.

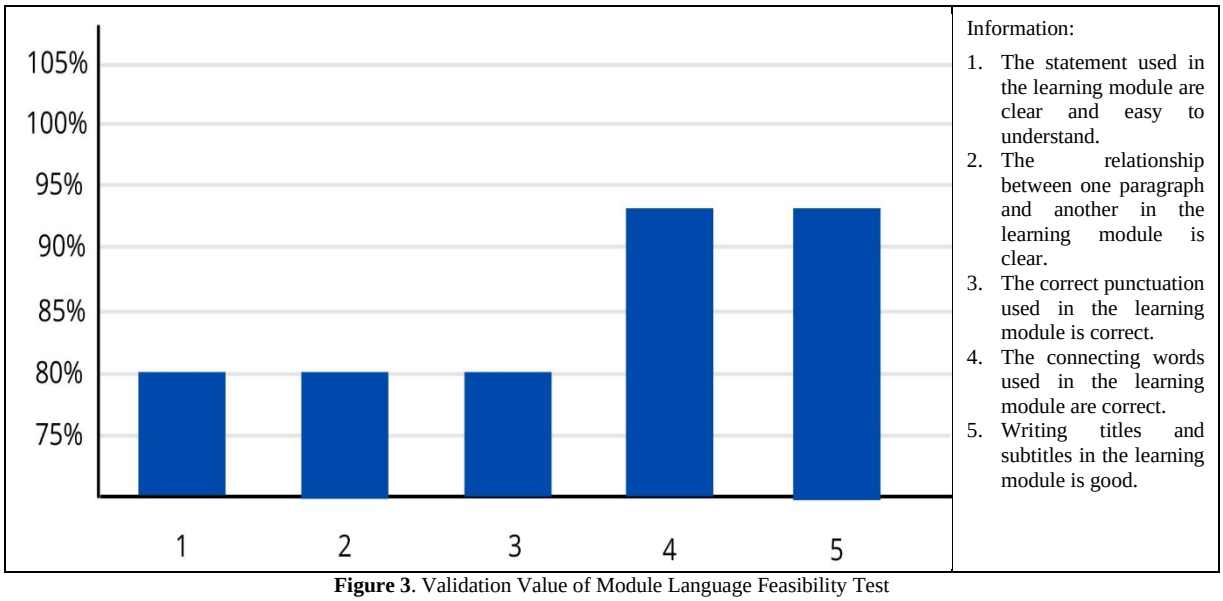

Figure 3. Validation Value of Module Language Feasibility Test

In Figure 3, the outcome of the validation of each indicator of the language feasibility component are explained. The graph states that three indicators are categorized as valid with a presentation value of 80%, and two indicators are categorized as very valid with a presentation value of 93%. The average value of the five indicators is 85.2%. So that the language feasibility component of the learning module developed is categorized as very valid. The four outcome of the analysis of the validity of the module display feasibility component consisting of five indicators. The results of the graphical representation of the validity test analysis data pay attention to Figure 4.

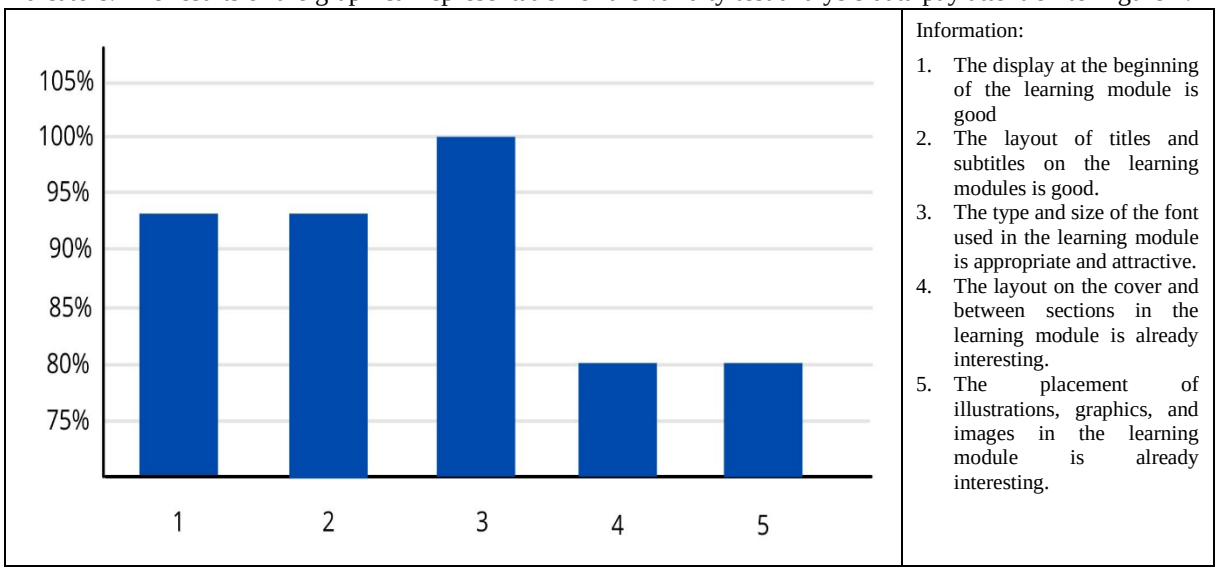

Figure 4. Validation Value of Module Display Feasibility Test

Figure 4 describes the value of the accuracy test of those components indicator of the feasibility of the module. From the picture it can be seen that, two indicators are categorized as valid with a percentage value of 80% and three indicators are categorized as very valid with indicator values ranging from 81%-100%. The average value of the five indicators is 89.2%. So that the accuracy test of the feasibility item of the display of the learning module applies to think creatively on the passive component material and its implication is categorized as very valid.

The five results of the analysis of the validity of the feasibility component of think creatively in the learning module consist of four indicators. The outcome of the graphical representation of the validity test analysis data pay attention to Figure 5.

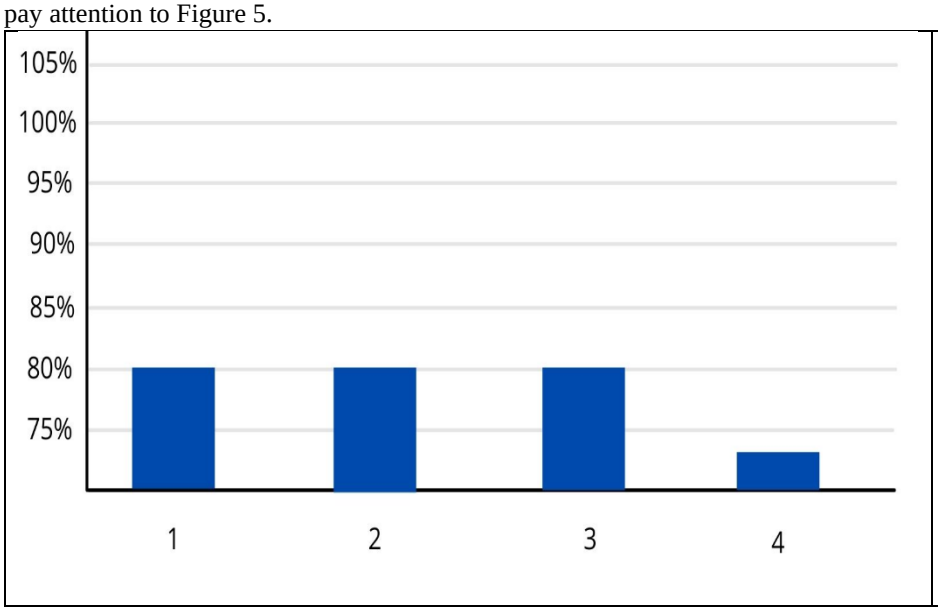

Figure 5. Validation Value of Creative Thinking Feasibility Test in Module

According to figure 5, we can see the outcome of the analysis of the accuracy test scores of each indicator on the feasibility component of think creatively in module of learning. The four indicators are categorized as valid with a presentation value range of 61% -80%. The middle value of the validity test of the four indicators is 78.25%. So that the value of the validity test of the feasibility component of creative thinking in the developed learning module is categorized as valid.

According to the average value of the analysis of the accuracy of each component, the value of the validity test of the learning module is obtained as a whole. The middle value of the accuracy of each component has been represented in the graph Figure 6.

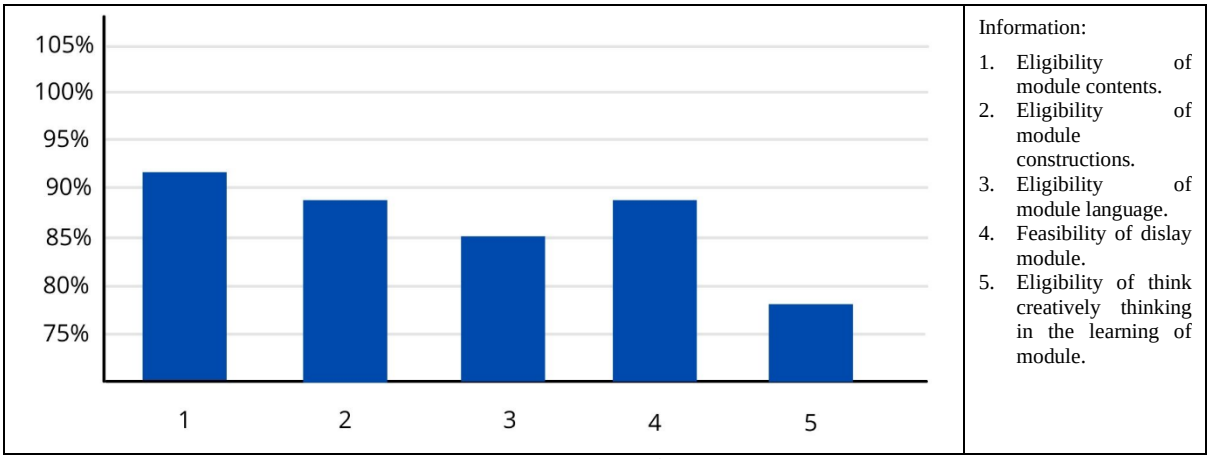

Figure 6. Average Validation Value of each Module Component

In **Figure 6** we can see the outcome of the analysis of the accuracy test scores of each indicator of the study module item. The average value of the validation of the learning module consists of one component categorized as valid with a value of 78% and four components classyfied as so accurate with a value range of 85%-92%. The middle value of the accuracy test of the five average values of each component is 86.5%. From the average value of the validity test of all components, the overall ground electronics module of learning applying think creatively is categorized as very valid.

B. Discussion

Research on the development of elementary electronics learning modules applying think creatively for physics students has previously been carried out by Frima and Filda, but the difference lies in the materials

developed. In previous studies there were shortcomings, one of which was the inconsistency of the symbols used in the module. The previous research module showed different chapters of the material discussed, so the symbols used in the material were different for the same consonant. So in this study the use of symbols is carried out more carefully so that students can understand the relationship between one chapter and another.

After the learning module product is developed, a product feasibility test is carried out on the validity aspect. The accuracy test was carried out by three physics subjects. The assessment is obtained using an assessment instrument consisting of indicators that are translated into several statements to make it easier to analyze the ease and weakness of product designs that are filled out by the validator. Experts test the validity of each component of the validation assessment of the development of basic electronics learning modules applying think creatively, namely the items of content feasibility, construction feasibility, language feasibility, module display feasibility and creative thinking feasibility in learning modules. The outcome of the analysis of the validation assessment of each items of the assessment resulted in an average value of the overall validity test, which was 86.5%. In this study, the eligibility criteria obtained were in the 81%-100% interval with a very accurate category. The analysis of the validation results states that the learning module that has been made by the researcher is categorized as very valid to be used as a learning tool to integrate creative thinking in passive component material and its application for students majoring in physics. This research related to teaching materials integrating creative thinking in physics learning materials with similar research, namely the development of teaching materials integrate creative thinking [11][12][13]14].

Overall, the learning module developed by the researcher is said to be still not perfect. Based on the assessment of the validity test sheet by experts, there are some constructive comments and suggestions for improving the basic electronics learning module to integrate think creatively in passive component material and its application for physics students. According to the advice of experts, the resulting module still needs to be improved on the feasibility of the language, the feasibility of the module display and the feasibility of think creatively in the module of study. To get more perfect results than the previous product, a product revision was made according to the suggestions from the validator.

IV. CONCLUSION

The summary of the learning said that the elementary electronics learning module applies think creatively in passive component material and its application to improve the creative thinking competence of students in the Physics Department, Universitas Negeri Padang, has a high level of validity with an middle validity value of 86.5% with a so high level stated very valid. So the elementary electronics learning module applies think creatively in passive component material and its application has met the valid criteria

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