



# Artikel 7

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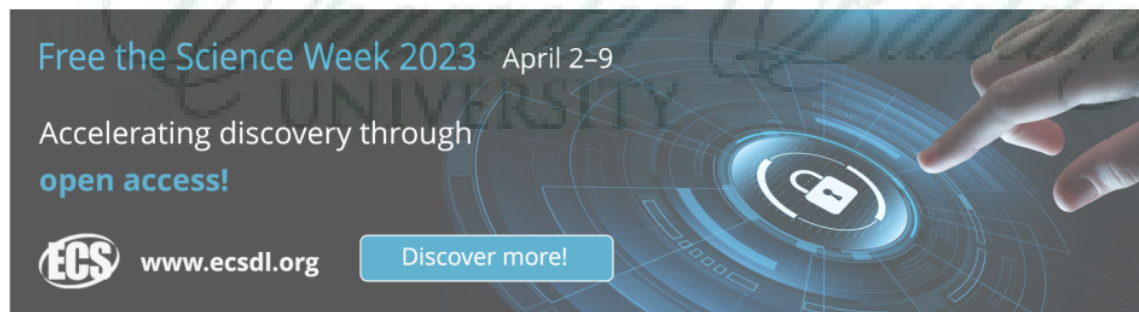
## Development of CNC machining II textbooks to increase the effectiveness of student learning in the mechanical engineering education study program

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## Development of CNC machining II textbooks to increase the effectiveness of student learning in the mechanical engineering education study program

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**Abstract**, This research is research development. The research model used in this research is the development of 4D (Four-D Model) which consists of four stages: the defining stage, the design stage, and the development phase. While the dissemination phase was not carried out because this research was only limited to the feasibility test and the effectiveness of learning media in the form of books. In this study, the respondents were 3 book experts, 3 lecturers who had CNC machine expertise competence in the Department of Mechanical Engineering Education, Faculty of Engineering, State University of Medan. The research instrument used to collect data in the form of questionnaire sheets and observation sheets. Data analysis was performed to determine the feasibility and effectiveness of the resulting CNC II / advanced book. From the results of this development research, it was shown that the developed CNC II / advanced book was suitable for use in learning advanced CNC courses. The results of book validation by book experts amounted to 86.67%, CNC exports amounted to 95.80.% Included in the very feasible criteria. The effectiveness of the advanced CNC learning book that was developed already meets the requirements of learning media with a percentage of positive student responses to the book of 96.11% of the criterion score, as well as an increase in student learning activities expressed in percentag

### 1. Introduction

KeywEducation is a planned effort to create an atmosphere of learning and learning process so that students effectively develop their potential to have the spiritual power, personality, and skills possessed by themselves, the nation and state. The success of education depends on changing attitudes or achieving the end result of learning. Etymological education comes from the word "pedagogies" from the Greek language, consisting of the word meaning child and "again" means to guide, so if interpreted, pedagogies means guidance given to children [1]. Based on the Republic of Indonesia government regulation No. 31 of 2013 concerning National Education Standards, Article 19 paragraph 1 which states that: The educational process in the education unit is carried out interactively, inspiration, fun, challenging, motivating students to participate actively and provide sufficient space for initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of students (Government Regulation, 2013) [2].

The process of implementing teaching and learning activities for Advanced CNC Machining Courses has still used conventional learning methods. Student conventional learning is placed as a learning object that acts as a passive recipient of information. So, in general, the delivery of lessons using the lecture method, questions and answers and assignments [3]. With learning media in the form



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of handouts and delivery of material directly on the blackboard which the majority focuses on practical activities, the result is an imbalance in the level of mastery of student material, given the heterogeneous educational background of students, namely the background of Vocational High School (SMK) and Middle School graduates Above (high school and MA). This advanced CNC course is also a continuation of the previous course which is basic CNC, so it is necessary to learn from the beginning, especially regarding the theory of CNC machine introduction so that the level of student competence can be balanced and maximized.ords: Book, computer numerical control (CNC) II, Effectiveness.

Based on the students' final semester score (DPNA), the Department of Mechanical Engineering Education, Faculty of Engineering Unimed, it can be seen that the learning outcomes of the CNC II course in the even semester of the academic year 2015/2016 varied by 57.33% of students who programmed the CNC II course grade (A) with a total of 14 students. The second-largest percentage is 42.67% of students who get grades (B) with a total of 10 students. Final grades for students who program advanced CNC courses in the even semester of the 2016/2017 academic year are more varied than the 2015/2016 academic year. The smallest percentage, namely 5.55% of students got grades (B) and (C) with the number of each grid of scores of 1 student. While students get grades (A), (D) and none get grades (E).

Based on the data above, it can be concluded that the student learning outcomes of the Mechanical Engineering Education Study Program, Faculty of Engineering, State University of Medan who took advanced CNC courses during the last two academic years, namely the academic year even semester 2016/2017 and 2017/2018, showed learning outcomes that have not been optimal and are less effective because it has decreased. Learning outcomes are certain competencies or abilities, both cognitive, affective and psychomotor achieved or mastered by students after participating in the teaching and learning process [4].

Learning is said to be a system because learning is a purposeful activity, which is learning students. The learning process is a series of activities that involve various components that interact with each other and interact with each other, where the teacher must utilize these components in the activity process to achieve the objectives to be planned [4]. Learning objectives are a very important starting point in learning, so both the meaning and type need to be understood correctly by every teacher and prospective teacher. Learning objectives are the main components that must be formulated by the teacher in learning because they are the target of the learning process. Want to be taken to where students, what must be owned by students, it all depends on the goals to be achieved. Therefore, the goal is the first and main component [5].

The conclusion from the results of the reflection group of lecturers in the field of expertise (KDBK) CNC subjects, indicators of not achieving the learning objectives are caused by several factors, such as limited resources available, learning models that are still dominated by lecture models, interaction between teachers and students are still lacking, unfavorable classroom conditions and lack of learning tools, such as the unavailability of written learning media both in the form of textbooks and books. McIsaac and Gunawardena explained that learning resources that can be utilized for learning needs are very diverse in types and shapes. Learning resources are not only in the form of printed materials such as textbooks, but students can take advantage of other learning resources such as radio education, television, computers, e-mail, interactive video, satellite communication, and multimedia computer technology to increase interaction and the occurrence of feeds. back with students [6].

This fact is a challenge for the lecturer team and all parties involved, especially in advanced CNC courses in the Department of Mechanical Engineering Education, Faculty of Engineering, State University of Medan / UNIMED, to make maximum efforts to improve the quality of learning. Several ways can be done to improve the quality of the process and learning outcomes, including the application of certain learning methods and approaches, the provision of instructional media such as improving tools and practice equipment, the provision of textbooks, interactive learning media and others. The use of instructional media in the teaching and learning process can arouse new interests and desires, arouse motivation and stimulation of learning activities, and even bring psychological

influences on students. The use of instructional media at the stage of teaching orientation will greatly assist the effectiveness of the learning process and the delivery of messages and lesson content at the time [7].

In line with this (Aritonang, 2008: 14) states that learning motivation is influenced by several factors including student ideals, student learning abilities, student conditions, environmental conditions, dynamic elements in learning, and efforts of teachers to teach students. In this case, the use of pocketbook media is related to students' learning abilities and the efforts of teachers to teach students. Student learning ability is related to the function of the pocketbook itself which can make students learn independently, creatively, effectively, and efficiently [8]. Teaching materials are materials or subject matter arranged systematically, which are used by instructors and students in the learning process (Andi, 2011: 16). Furthermore, Ahmad (2012: 102) explains that teaching material is material that will be taught to selected students, or teaching material is material (messages) that must be learned and understood by students. So it can be concluded teaching materials are materials or subject matter that are arranged systematically, which are used by teachers and students in the learning process [9].

Factors that influence students' results of scientific literacy are the selection of textbooks and the low level of scientific literacy of students (Rusilowati, Susilowati & Nugroho, 2015). Textbooks are learning resources that are directly connected to students. A science textbook based on scientific literacy must have several basic categories (Chiapetta, Filman & Sethna, 1991). The basic categories are body science knowledge, science as natural investigation, science as a way of thinking, and the interaction of science, technology, and society. Rusilowati, Susilowati & Nugroho (2015) added in the category of interaction with the environment [10].

Learning by using books is basically an independent learning approach that focuses on mastering the competencies of the study material that students learn with a certain time in accordance with their potential and conditions. An independent learning system is a way of learning that focuses more on the role of student learning autonomy. Independent learning is a process in which individuals take the initiative to diagnose their own learning needs, formulate and determine their own learning goals, identify learning resources, choose and implement their learning strategies and evaluate their own learning outcomes.

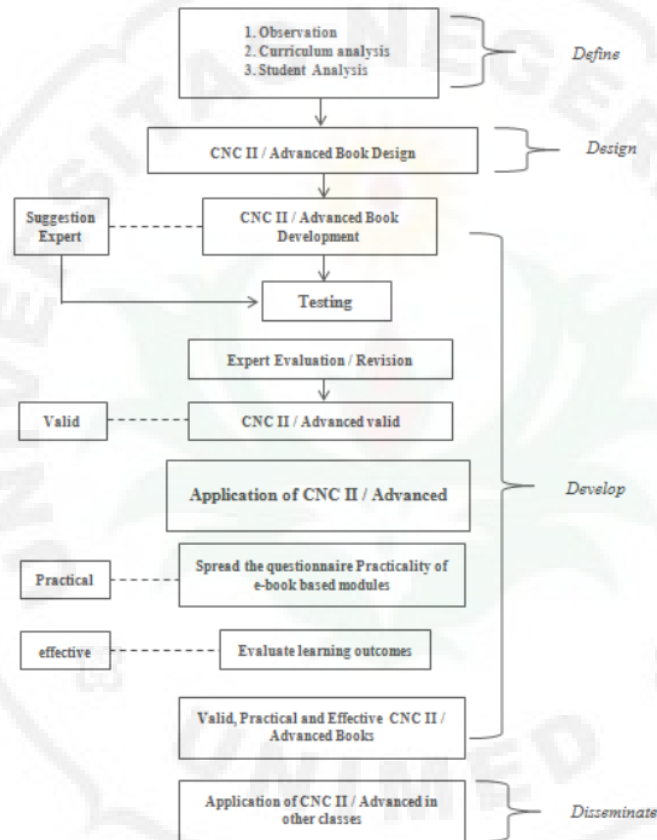
This book is very suitable for prospective educators because in this book there is very complete material about advanced CNC. This book is also recommended for Educators because this book can be used as a guide by educators who want more knowledge for reference in teaching. This book can be used as a reference to find out more about CNC Machining. Some of the advantages of books, including the following: (1) Books make learning goals clearer, specific and can be achieved by students more directed to achieve competencies or abilities that are taught easily and directly; (2) The book gives a lot of feedback (feedback) a lot and directly, so students can know the level of mastery of learning outcomes; (3). Books can be used as differences in students' abilities, including the speed of learning, ways of learning and lecture material. Books can foster student motivation, so learning activities and effectiveness will increase. For lecturers, the discovery of a teaching method using CNC books can increase the effectiveness of learning in advanced CNC courses.

## 2. Method

This development research design uses the development model of the 4-D learning model (Four-D Model) developed by Sivasailam Thiagarajan, Dorothy S. Semmel and Melvyn I. Semmel (1974). The use of the 4-D model is because the development model of the device is easy to understand and has systematic steps or stages. The development model of the 4-D learning device (Four-D Model) consists of 4 stages, namely defining, design, developing and disseminating.

The development research in question is research conducted to produce a CNC II / advanced coursebook. The development research is continued with the feasibility test of the developed book. The feasibility test aims to determine the level of eligibility of books developed from respondents. After the CNC II / advanced coursebook has been developed and carried out a feasibility test, the next

step is to carry out a limited trial to examine the effectiveness of the use of CNC II / advanced courses in the Department of Mechanical Engineering Education, Faculty of Engineering, State University of Medan. More details about the stages of the procedure of this research, it can be observed in the block diagram as well as the explanation as follows:



**Picture 2.1.** The book development procedure is modified from the 4-D model  
Source: Thiagrajan et al in Trinato (2009: 19)

### 2.1. Research Objectives and Objectives

The target of this research is in the form of a CNC II / advanced coursebook, in which there is a description of the material on the competence of the CNC TU-2A lathe machine programming method. In each case, the material is equipped with question exercises and evaluations at the end of each learning activity. In this study, the respondent was 3 book experts, 3 lecturers of CNC machine competence in the Department of Mechanical Engineering Education, State University of Medan, and 19 students majoring in Mechanical Engineering Education, FT UNIMED.

### 2.2. Data Collection Instruments and Techniques

(1) The questionnaire study sheet is hit by a book expert; (2) Book validation questionnaire sheet by lecturer/instructor (3 people); (3) Student response questionnaire sheet (18 students); (4) Observation sheet (19 students).

### 2.3. Data analysis technique

The data analyzed were questionnaire data and observation data.

#### 2.3.1. Questionnaire Data Analysis

Questionnaire data analysis included analysis of the results of questionnaire I (book review sheets by book experts), questionnaire II (book validation sheets by lecturers/instructors competency in CNC II / advanced machine expertise), and questionnaire III (student response sheets). The following data analysis techniques for each questionnaire:

- a) The questionnaire I, book review sheet by a book expert Data from the results of the questionnaire I from book experts, will be analyzed in a descriptive qualitative manner, namely by providing an overview and exposure to the quality of the book based on the input and suggestions that have been given.
- b) Questionnaire II, book validation sheet by lecturer/instructor Questionnaire II for lecturers of CNC machine expertise competency is given at the validation stage, then the questionnaire results will be analyzed descriptively quantitatively, using a percentage in the form of an overview and exposure to the CNC II book / advanced developed. The percentage of questionnaire data is obtained based on the overall score calculation. The score provisions used as a scale of book validation by lecturers of CNC II / advanced machine expertise competency can be seen in Table 2.1. the following :

**Table 1.** Provisions for validation scores

Criteria	Value / Score
No good	1
Pretty good	2
Good	3
Very Good	4

Source: (Laksono, 2005)

To calculate the percentage of eligibility for each indicator, the calculation formula used is as follows:

$$K = \frac{F}{N \times I \times R} \times 100\% \quad (1)$$

Information :

K = Percentage of eligibility criteria

F = Total number of respondents' answers

N = Highest score in a questionnaire

I = Number of questions in the questionnaire

R = Number of assessors

- c) Questionnaire III, student response sheet. Questionnaire III for the response of students given during the limited trial took place, the results will be analyzed descriptively quantitatively as in the questionnaire analysis II for lecturers of CNC II / advanced machine expertise competence, but the percentage of questionnaire data obtained was calculated based on the Guttman scale in Table 2. Following this:

**Table 2.** Guttman scale assessment

The answer	Value / Score
Ya (Y)	1
Tidak (T)	0

(Source : Riduwan, 2009)

To calculate the percentage of eligibility from the narrator, the formula used is the same as in the questionnaire analysis II for lecturers of CNC II / advanced machine expertise competency, which is the same as formula (1) above. The results of the calculation of the percentage of questionnaire data II (book validation sheets by lecturers of CNC machine skill competencies) at the book validation stage, as well as questionnaire III (student response sheets) on the implementation of limited trials, were interpreted into the eligibility criteria of instructional media according to Table 3. The following:

**Table 3.** Percentage value of the book's eligibility level

Interval	Criteria
0% - 20%	Very improper
21% - 40%	Not feasible
41% - 60%	Decent enough
61% - 80%	Worthy
81%- 100%	Very decent

(Source : Riduwan, 2009:15)

Based on Table 2.3. That, the CNC II course book produced in this learning media development research, can be declared feasible if the average percentage reaches  $\geq 62\%$  of the criterion score.

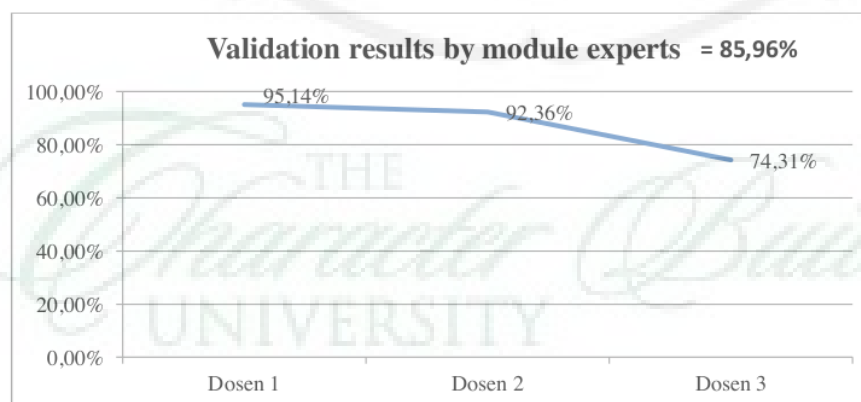
#### 2.4. Data Analysis Observation Sheet

Data obtained from observation sheets were analyzed descriptively qualitatively and used as input to get a better book. The descriptive approach is very appropriate because it can describe systematically, and accurately about the facts that occur during the implementation of a limited trial of the book being developed. In this observation sheet, students learn independently because there is already a book used. The psychomotor domain will also be measured in the observation sheet on point 6, namely students carrying out practical work. The data obtained later will be one of the indicators for evaluating the effectiveness of the developed CNC II / advanced learning books.

### 3. Results

#### 3.1. Book Validation by Book Experts

The results of the book expert validation are presented as follows:

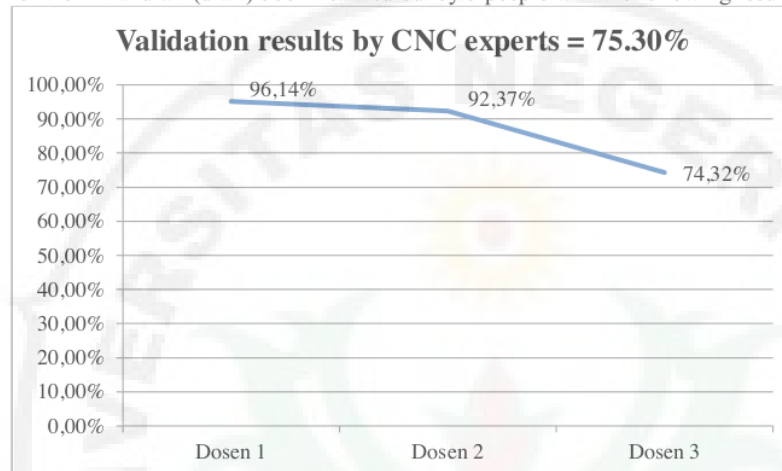


**Figure 1.** results of book expert validation



### 3.2. Book Validation by CNC Experts

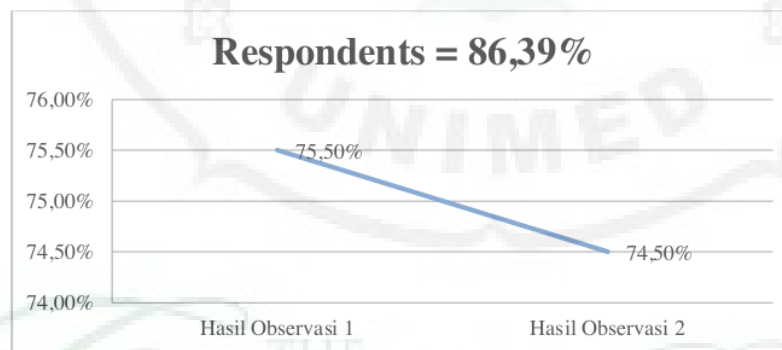
The validation of the CNC expert book is carried out in conjunction with the book expert validator. Validation of the initial draft (draft) book I carried out by 3 people with the following results:



**Figure 2** results of the validation of CNC experts

### 3.3. First Stage Limited Trial Class

The first phase of a limited trial was carried out with technical implementation, namely by observing / observing learning activities with 10 students and given a student response sheet to determine the feasibility of the book before being tested for a limited trial class (actual class).



**Figure 3.** Limited trial results

### 3.4. Second and third Phase Limited Trial Trials

A limited trial was conducted with the technical implementation, namely by observing sample learning activities (students) in the Advanced CNC learning activities, using the developed CNC II / Advanced learning book. The second and third stages of the limited trial involved 4 observers, namely 1 observer as an extraordinary lecturer in advanced CNC courses and 3 observers as S1 students of Mechanical Engineering Education, Faculty of Engineering, State University of Medan. The number of observers in the second phase of the trial was deliberately expanded so that the observation process ran optimally

and got more valid and objective observations. You can see the results of observations and student questionnaires from the second and third stages as follows:

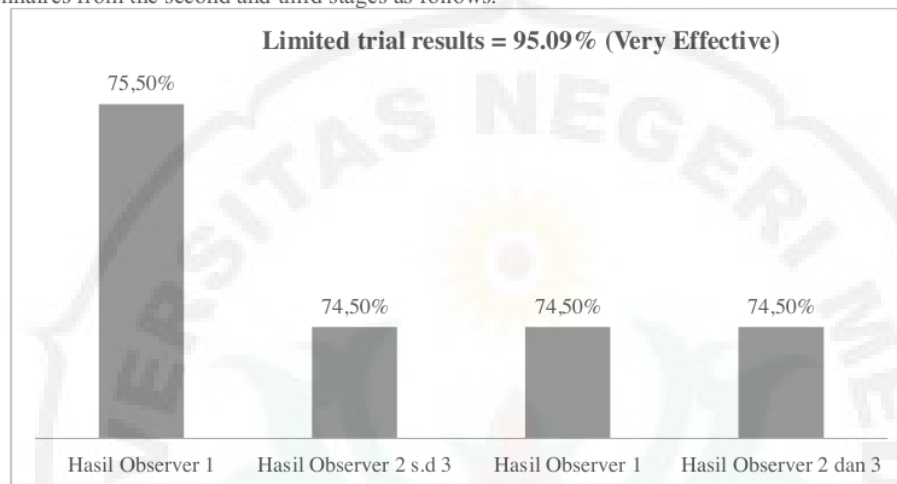


Figure 4. Limited trial results

#### 4. Discussion

In the following discussion section, an explanation of the feasibility and effectiveness of the book produced in this study will be explained, as well as an explanation of the limitations of the study.

##### 4.1. Achievement of Book Feasibility and Effectiveness

From the results of this development research, it was shown that the developed CNC II / advanced book was suitable for use in learning advanced CNC courses. The results of book validation by book experts amounted to 86.67%, CNC experts amounted to 95.80.% Included in the very feasible criteria. The effectiveness of the advanced CNC learning book that was developed already meets the requirements of learning media with a percentage of positive student responses to the book of 96.11% of the criterion score, as well as an increase in student learning activities expressed in percentages of 85.53% and 91.48% and an increase in student learning outcomes without using books obtained a value of 69.43% and after using books increased to 81.15%.

##### 4.2. Research Limitations

The research carried out adopts the development model of 4-D learning tools (Four-D Models), which consists of 4 stages, namely the stages of defining, design, developing and disseminating. But in conducting research, only three stages are adopted and carried out, namely the stages of definition (define), design (design) and development (develop). The fourth stage, namely the dissemination stage, which is the stage of using advanced CNC learning books developed on a broader scale at other agencies, and aims to test the effectiveness of the use of books in real teaching and learning activities in a relatively long period of time, not adopted at the same time not implemented. This is related to research that is limited to the development and due diligence and effectiveness test of the book, besides that it is also due to the limited time, cost and manpower to distribute advanced CNC learning books that have been developed, to other agencies.

Besides this research also has limitations at the time of observation on point 6, namely students carrying out practical work with sub points as follows: (1) Initial preparation; (2) Start the engine; (3) Entering the program; (4) Checking the correctness of the program; (5) Checking the correctness of

the blade trajectory; (6) Installing knives and workpieces; (7) Placing the blade in the starting position; (8) Running a CNC program / machine.

## 5. Conclusion

From the results of the learning research that has been carried out and based on all the analysis and understanding that has been done it can be concluded that by learning to use advanced CNC books in the Mechanical Engineering Department of UNIMED in 2019/2020, the following conclusions are obtained:

An advanced CNC learning book has been prepared which has been validated by a book expert lecturer with a final grade of 85.77%. and validation by CNC experts with a final value of 87.51%. So from these results, advanced CNC learning books are very appropriate to be used to improve the effectiveness of advanced CNC courses in the Mechanical Engineering Education Study Program, Faculty of Engineering, State University of Medan.

The effectiveness of student learning using books is good enough, this is evidenced by the value of the student questionnaire responses from 86.39% to 95.09%. And observations of student learning activities from 83.53% to 91.47%. As well as student learning outcomes when using books increased from 78.53 to 81.76.

Books that have been made can increase the effectiveness of advanced CNC learning. This is evidenced by the results of the assessment of the validator which includes the following criteria:

### 5.1. Validation by book experts

Judging from several points, among others, the book cover obtained value 73.61%, preliminary 87.5%, learning objectives 96.66%, initial ability tests 87.5%, material 87.88%, evaluation questions 86.67% and learning resources 80.55%.

### 5.2. Validation by CNC experts

Judging from several points, among others, the contents obtained value of 86.11%, 87.50% presentation technique, language 89.29%, illustration 88.54%, format 83.33%, cover (83.33%) and layout manners & copyrights at 94.45%.

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