Development and Application of ATMega 2560 Based Trainer in Supporting the Learning Process in the Faculty of Engineering State University of Makassar

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Abstract. This study aimed to determine the student's response and the application effectiveness of ATMega 2560-based microcontroller trainers in supporting the agricultural robotics learning in the Faculty of Engineering, State University of Makassar. This study was a research and development study using ADDIE (Analysis, Design, Develop, Implement, and Evaluate) approach. The student's response to the application of ATMega 2560-based microcontroller trainers was collected using questionnaires. The samples size of students in this study were 30 students from the Faculty of Engineering, Makassar State University. Information on the application effectiveness of ATMega 2560-based microcontroller trainers was collected from the observations results of learning outcomes, which were conducted through pre-test and post-test. The analysis results on the student's response showed an average result of 3.65, which means that they were in a good category. The average results of the pre-test and post-test obtained for the analysis of effectiveness were 60.55 and 83.50, respectively. This showed an increase in student learning outcomes which were above the minimum standard and were in a good category. The application of ATMega 2560-based microcontroller trainers received a good response from students and was effective in supporting the agricultural robotics learning in Faculty of Engineering, State University of Makassar.

1. Introduction

Education is a process of cultural transformation that aims to educate and inherit the cultural values including cognitive and affective aspects [1,2]. One of the goals of education is to produce students who have skills and mastery of technology in accordance with the needs of the labor market and the world of industry, especially in the field of robotics related to the mastery of microcontrollers. The process of mastering the microcontroller is inseparable from the process of providing theory and practice on an ongoing basis. Continuous practice can be done by providing a trainer that can become a learning media.

Learning media is a teaching aid that is used to channel messages or information from the sender to the recipient of the message. Media can be interpreted as something that can bring information and knowledge in interactions that take place between educators and students [3,4].

The development of microcontrollers has entered various sectors, one of which is the agricultural sector. Microcontrollers play automatic controls that play an important role in modern science and engineering. In addition to special interests such as space-vehicle systems, missile-guidance systems, robotic systems, automatic control have become an important integral part in modern manufacturing

and process industries, as well as integrated with a variety of devices, especially devices in the field of agricultural mechanization. The existence of a microcontroller in the agricultural mechanization sector allows users to explore and express themselves to develop technology, make sophisticated and creative technologies such as agricultural robotics.

Agricultural robotics technology has been studied in the Agricultural Technology Education Study Program, Faculty of Engineering, State University of Makassar. In this study program, there are elective courses in the form of agricultural robotics for the field of agricultural mechanization which discusses the microcontroller. This material is very important for the development of modern agricultural technology as applied in developed countries, but there are still many students who are not interested in taking these courses due to difficulties in understanding various kinds of logic functions. This condition shows that students do not like challenges, so an ATMega 2560 microcontroller trainer was developed with the aim of knowing students responses to the use of a trainer and knowing the effectiveness of using trainers in understanding agricultural robotics material..

2. Methods

This study is Research and Development study. This research was conducted at the Department of Agricultural Technology Education, Faculty of Engineering, State University of Makassar and was conducted for one semester. The object in this study was the class of 2016 students, amounting to 30 people taken by purposive sampling.

2.1. Research Procedure

The development model used in this study was the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The stages of the ADDIE model can be seen in Figure 1.

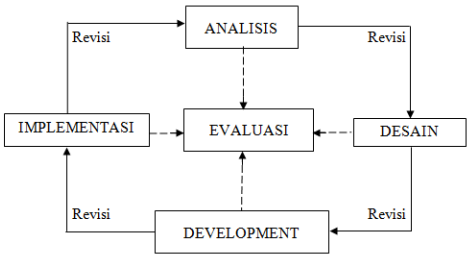

Figure 1. ADDIE Development Model Design [5].

2.2. Research Development Procedure

The procedure for developing an agricultural robotics learning trainer was carried out as follows:

2.2.1. Analysis. This analysis phase is done to determine the problem and the right solution for students.

2.2.2. Design. This stage identifies trainer needs, product design, and revisions. Identification of needs is done to identify the needs that will be used in making the trainer. Product design is done by developing the main menu and sensor input system on the trainer's hardware to be portable. The process of product revision phase I was carried out based on comments, suggestions and input from media experts so that the learning media designed was more interesting and appropriate

2.2.3. Development. The development phase is carried out with the following activities*:*

a. Making ATMega 2560 microcontroller trainer products is carried out by procedures, namely (1) Tools and Materials Planning, (2) I / O Need Analysis, (3) Minimum System Pathway Making, (4) Minimum System Creation, (5) Programming, and (6) Trial.
b. Revision. The stage II product revision process is based on comments, suggestions and input from media experts
c. Expert validation is carried out by media experts and material experts

d. The Small Group Test Phase is carried out for 5 students
e. Phase III revision based on comments, suggestions and input from students.

2.2.4. Implementation. Implementation is carried out in large groups. The large group trial phase involved 30 students with activities as follows:

a. Providing pretest questions to students before starting learning using the developed trainer
b. Students carry out the learning process using the developed trainer.
c. Students follow the learning process as many as 6 meetings
d. The researcher carries out the posttest and distributes the questionnaire to students regarding the application of the developed trainer.
e. Revision stage IV is based on input and suggestions from students on the response questionnaire.

2.2.5. Evaluation. The purpose of this learning media evaluation was to find out whether media products that were being developed could achieve the expected goals. *Data Collection Techniques*

2.3. Data Collection Techniques

The data collection method used in this study was to use a closed questionnaire to assess the validity of trainer learning media. Filling out answers from questionnaires was done using a four-choice Likert scale. The scoring used in the questionnaire can be seen in Table 1. The method of data collection is also done by tests to find out and measure the learning outcomes of students related to the material that has been delivered.

Table 1. Answers and Weighting Scores [6].

Answer	**Score**
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

2.4. Research Instruments

2.4.1. The research instrument used to assess the practicality and validity of learning media is a questionnaire addressed to media experts, material experts and students. Practical and valid assessment of learning media consists of design aspects and media performance, media operations, the benefits of media and material in the media.

2.4.2. The instrument used to assess students' responses to learning media is a questionnaire consisting of three aspects, namely the assessment of aspects of the display, assessment of aspects of content / material and assessment of aspects of learning.

2.4.3. Testing student learning outcomes for learning media developed is done by giving a pretest and posttest to find out the learning outcomes of students.

2.5. Testing on Instruments

This study used a questionnaire instrument that had been tested by construct validity by a team of media experts. The validity category of each aspect or all assessed aspects was determined based on the device quality categorization criteria adapted from according to [7] in Table 2.

Table. 2. Validation of Assessment Aspects [7]

Interval	Category
3,5 ≤ Score ≤4	Very Valid
2,5≤ Score <3,5	Valid
1,5 ≤ Score < 2,5	Less Valid
Score < 1,5	Not Valid

2.6. Data Analysis Techniques

The data analysis technique used in this study was the T-Test. The purpose of using the T test was to find out the significance of the difference in the average learning outcomes of the pre test and post test

3. Result

3.1. Results of Development of ATMega 2560 Based Trainer

Software development was done on the main menu of the trainer. The menu on the trainer had been made by the researcher in the form of program code that was inputted into the microcontroller so that the trainer had a menu that could be selected through the LCD to see the workings and functions of each input or output device. The main menu that had been developed could connect the work of input and output devices so that the work process of an automation process could be seen directly.

Development of the hardware part is carried out on the installation system of sensor devices that have been designed to be easily used by students. The sensor installation system on the trainer already uses a system port resembling the VGA connector model so that the possibility of being mistaken in cabling can be minimized (Figure 2). Errors in sensor cable installation can cause damage to a sensor.

Figure 2. Hardware of ATMega 2560 Based Trainer

3.2. Results of the Validity Analysis of Material Experts and Media Expert

3.2.1. Validity Assessment Analysis of User Guide of Media. Based on the assessment of material experts including the format of teaching materials, language, and content, the validity of teaching materials still requires revision. The results of revision of teaching materials can be seen in Table 3

Table 3. Revision of Teaching Material Instruments

	Before Revision	After Revision
1.	The use of language according to KBBI is still not suitable	Has been repaired
2.	In the user guide, the image must be made simpler so that it is easy to understand	Has been repaired

After the revision, the results of validity assessment can be seen in Table 4. Based on these data, the ATMega 2560 microcontroller trainers obtained an average total value of 3.80 which means very valid.

Table 4. Results of the Validity Assessment of User Guide of Media

	Description of aspects	Average	Status
1	Format	3,66	Very valid
2	Language	3,66	Very valid
3	Content	4,00	Very valid
	Total Average	3,80	Very valid

3.2.2. Validity Assessment Analysis of Media. The results of the validity assessment of the media indicated comments and suggestions for the products developed (Table 5). Description of the revised instrument validity of media was shown in Table 6. Based on the results of the media validation data, the agricultural robotics learning trainer obtained an average total of 3.81 which means very valid.

Table 5 Revision of Media Validity Instrument

	Before Revision	After Revision
1	The addition of several sensors related to agriculture, such as pH Sensor	Sensors have been added

Table 6. Results of Media Validity

	Media Aspects	Average	Category
1.	Display	3,63	Very valid
2.	Technique	3,80	Very valid
3.	Learning	4,00	Very valid
	Total Average	3,81	Very valid

3.3. Results of the Analysis of the Student Responses

Data on the response value of students to the application of ATMega 2560 microcontroller trainers in agricultural robotics learning could be seen in Table 7. Based on the response of students, the use of ATMega 2560 microcontroller trainers was in a very good category. The highest value was at point 15, namely the use of ATMega 2560 microcontroller trainers in agriculture as learning media needs to be maintained and developed with an average value of 3.90. This was because all students assumed that the learning process carried out in the 21st century must always use a more sophisticated products. Technology-based learning process is a form of advancement in education in entering the industrial era 4.0.

Table 7. Results of student responses to the implementation of ATMega 2560 microcontroller trainers in agricultural robotics learning

No	Responded Aspect	Score	Category
1.	The media created encouraged me to learn better	3,85	Very Good
2.	Learning that uses ATMega 2560 microcontroller trainers in agriculture has encouraged me to learn about IT better than usual	3,45	Very Good
3.	I like to take part in learning that is done with the learning media of ATMega 2560 microcontroller trainers in agriculture	3,65	Very Good
4.	The use of microcontroller trainers in agriculture as learning media can help me improve my learning achievement beforehand.	3,65	Very Good

5.	Agricultural robotics learning using media that has been implemented is more interesting to follow	3,65	Very Good
6.	Agricultural robotics learning by using ATMega 2560 microcontroller media trainers in the field of agriculture that has been implemented is more fun to follow	3,55	Very Good
7.	Agricultural robotics learning using the ATMega 2560 microcontroller media trainer in agriculture that has been implemented gives me a better understanding of learning than other learning.	2,90	Good
8.	I understand more about programming and robotics using ATMega 2560 microcontroller trainers in agriculture	3,35	Very Good
9.	I experience a lot of learning experience about the basics of agricultural robotics when using ATMega 2560 microcontroller trainers in agriculture	3,55	Very Good
10.	The stages of learning about the basics of agricultural robotics by using ATMega 2560 microcontroller trainers in agriculture in learning materials greatly helped me in the process of absorption of knowledge and skills	3,65	Very Good
11.	The use of learning media ATMega 2560 microcontroller trainers in agriculture helps a lot in providing an overview of the components used in agricultural robotics technology	3,65	Very Good
12.	The use of learning media by using a microcontroller trainer ATMega 2560 agriculture increase interaction with fellow student communication	3,30	Good
13.	Agricultural robotics learning by using ATMega 2560 microcontroller media trainers in agriculture makes it easy to do assignments that are oriented towards project	3,65	Very Good
14.	The use of ATMega 2560 microcontroller trainers in agriculture as learning media can develop my talents and skills in designing microcontroller-based agricultural tools.	3,65	Very Good
15.	The use of ATMega 2560 microcontroller trainers in agriculture as learning media needs to be maintained and developed.	3,90	Very Good
	Average Score	**3,56**	**Very Good**

3.4. Result of Analysis of the Students Learning Outcomes

The initial ability of students was measured by giving a pre-test. Based on the results of the first pre-test, researchers had not yet gotten an overview of the ability of students as a whole so that at the end of the learning activities, students were given post-test. Table 8 showed the average learning outcomes that have increased with the pre-test value of 16.67% and post-test value of 83.3%. Whereas, Table 9 showed that the obtained sig (2-tailed) value of 0,000 <0,05. According to the basis of decision making in the independent sample T – Test, then it was concluded that H_o was rejected and H_a was accepted which indicated a significant difference between learning outcomes conducted at the pretest and posttest.

Table 8. Results of Descriptive Analysis of Students Learning Outcomes

Statistic	Value	
	Pretest	*Posttest*
Average	60,55 (Medium)	83,50 (High)
Lowest value	40	55
Highest value	80	95
Percentage of completeness	16,67%	83,3%

Table 9. *Output independent sampel T –Test*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Learning outcomes	Equal variances assumed	2.709	.105	-8.464	58	.000
	Equal variances not assumed			-8.464	55.685	.000

4. Conclusion

The response of students to the application of ATMega 2560 microcontroller trainers was very good so that the media could be developed to improve the competence of students in the field of agricultural mechanization, especially in agricultural robotics. In addition, the learning outcomes of students towards the use of ATMega 2560 microcontroller trainers experienced a significant increase with the final score above the standard average and included in the high category so that trainers was effective learning media to use.

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