

Desenvolvimento de e-learning baseado em Moodle para melhorar a eficácia da tecnologia de sistema de controle e automação fundamental de aprendizagem

Development of Moodle based e-learning to improve the effectiveness of learning fundamental automation and control system technology¹

Desarrollo de e-learning basado en Moodle para mejorar la eficacia de la tecnología del sistema de control y automatización fundamental del aprendizaje

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Resumo

O objetivo deste estudo é examinar a influência do aprendizado por e-learning baseado em Moodle para melhorar os resultados de aprendizagem dos cadetes no material básico dos sistemas pneumáticos. O método usado neste estudo é o design de pesquisa e desenvolvimento. O assunto da pesquisa foram os cadetes do quarto semestre que se especializaram em eletronavegação na Surabaya Merchant Marine Polytechnic, determinada por amostragem por conveniência. Os dados foram extraídos da viabilidade em termos de material e mídia através de questionários, resultados de aprendizagem através de pré-teste e pós-teste, bem como respostas de alunos e professores através de questionários. Respostas de especialistas mostram que o e-learning baseado no Moodle é viável em termos de mídia e viável em termos de material. Os resultados da aprendizagem em ensaios em larga escala indicam que os resultados das respostas dos questionários dos alunos a ensaios em pequena e grande escala indicam que a maioria dos estudantes dá respostas positivas às atividades de aprendizado usando mídia de e-learning baseada no Moodle. As respostas dos professores com base nos resultados do questionário mostraram que os professores estavam interessados em aprender usando os meios de aprendizagem de e-learning baseados no Moodle que foram aplicados. Com base nos resultados da análise e discussão, pode-se concluir que o e-learning

¹ Presented on 3rd ICMET.

baseado no Moodle é viável e efetivamente aplicado ao material básico dos sistemas pneumáticos. A aprendizagem por e-learning tem um impacto significativo na melhoria dos resultados de aprendizagem dos cadetes.

Palavras-chave: E-learning baseado em Moodle; Resultados de aprendizagem; Mídia de aprendizagem.

Abstract

The aim of this study is examine the influence of Moodle-based e-learning learning to improve learning outcomes of cadets on the basic material of pneumatic systems. Method used in this study is research and development design. Subject of research was the fourth semester cadets majoring in electro navigation at Surabaya Merchant Marine Polytechnic which was determined by convenience sampling. The data taken from the feasibility in terms of material and media through questionnaires, learning outcomes through pre-test and post-test, as well as students and teacher responses through questionnaires. Expert responses show that Moodle-based e-learning is feasible in terms of media and feasible in terms of material. Learning outcomes in large-scale trials indicate that the results of student questionnaire responses to small-scale and large-scale trials indicate that the majority of students give positive responses to learning activities using Moodle-based e-learning media. Lecturer responses based on the results of the questionnaire showed that lecturers were interested in learning using Moodle-based e-learning learning media that had been applied. Based on the results of the analysis and discussion it can be concluded that Moodle-based e-learning is feasible and effectively applied to the basic material of pneumatic systems. Learning by e-learning has a significant impact on improving the learning outcomes of cadets.

Keywords: Moodle-based e-learning; Learning outcomes; Learning media.

Resumen

El objetivo de este estudio es examinar la influencia del aprendizaje en línea basado en Moodle para mejorar los resultados de aprendizaje de los cadetes en el material básico de los sistemas neumáticos. El método utilizado en este estudio es el diseño de investigación y desarrollo. El tema de la investigación fueron los cadetes del cuarto semestre con especialización en electro navegación en el Politécnico de la Marina Mercante de Surabaya, que se determinó mediante muestreo por conveniencia. Los datos tomados de la viabilidad en términos de material y medios de comunicación a través de cuestionarios, resultados de aprendizaje a través de la prueba previa y posterior a la prueba, así como las respuestas de

estudiantes y docentes a través de cuestionarios. Las respuestas de expertos muestran que el aprendizaje electrónico basado en Moodle es factible en términos de medios y factible en términos de material. Los resultados del aprendizaje en ensayos a gran escala indican que los resultados de las respuestas de los cuestionarios de los estudiantes a los ensayos a pequeña y gran escala indican que la mayoría de los estudiantes dan respuestas positivas a las actividades de aprendizaje utilizando medios de aprendizaje electrónico basados en Moodle. Las respuestas de los docentes basadas en los resultados del cuestionario mostraron que los docentes estaban interesados en aprender utilizando los medios de aprendizaje de aprendizaje electrónico basados en Moodle que se habían aplicado. Con base en los resultados del análisis y la discusión, se puede concluir que el e-learning basado en Moodle es factible y se aplica efectivamente al material básico de los sistemas neumáticos. El aprendizaje mediante e-learning tiene un impacto significativo en la mejora de los resultados de aprendizaje de los cadetes.

Palabras clave: Aprendizaje electrónico basado en Moodle; Resultados de aprendizaje; Medios de aprendizaje.

1. Introduction

Education sector has a positive impact from the development of information technology, thus sparking the birth of the idea of electronic learning. Now and in the future, e-learning technology can be an alternative solution and technology to be used in learning methods (Lukman & Dinarin, 2012).

The field of education has a positive impact from the development of information technology, thus sparking the birth of the idea of electronic learning nowadays and in the future e-learning technology can be a solution and alternative technology to be used in learning methods.

E-learning is a network that is able to quickly repair, store or reproduce, distribute, share learning and information using Compact Disk-Read Only Memory (CDROM), internet and intranet technology to achieve distance learning goals or broad-based (Amiroh, 2012).

Since 2013 Surabaya Shipping Polytechnic has opened an electro study program, in conducting lectures problems have been found, one of which is lectures on the basic courses of automation and system control technology, where learning outcomes from cadets can be categorized as still needing improvement, due to the percentage of cadets who follow these courses is 40% have to take the improvement test because the scores are still below the

graduation standard. From the results of discussions with the instructors of the course, problems were found that there was a lack of time allocation for learning while the material load referred to the IMO 9 International Maritime Organization) course model 7.08 for the Electro Technical Officer (ETO) competency program on the topic was quite extensive, so the time allocation allocated there is not enough. One solution that can be done is to increase the allocation of learning time (supplements) through e learning.

Application of e-learning in marine education is also a recommendation from the 1978 STCW (Standard of Training Certification Watch keeping of Seafarer) which was amended in 2010 in section B / I-6 which regulates learning and testing through e learning. Based on the background description, the objective of this study will be regarding to design Moodle-based e-learning products that are suitable for the basic material of pneumatic systems, the feasibility and effectiveness of Moodle-based e-learning in learning the basic material for pneumatic systems and the influence of moodle-based e-learning learning to improve learning outcomes of cadets on the basic material of pneumatic systems.

2. Literature Review

E-learning is a learning method that functions as a complement to face-to-face learning methods in class. The essence of e learning is a method in which students are positioned as the top priority by putting all sources of teaching materials so that they are easily accessible to students.

The difference between conventional learning and e learning is that in conventional learning, instructors are considered as the center of knowledge, while in e learning the main focus is on students. Learners are independent at certain times and are responsible for their learning.

Differences between e-learning and conventional learning method is as below:

A. E-learning has the academic characteristics:

- (1). Depending on the student's self-motivation;
- (2) Tests and examinations are carried out in accordance with the speed of catching students;
- (3) Innovative methods are needed to conduct tests and practice experiments;
- (4) The duration of the course / course is determined by students and,

(5) More success in the number of students participating in online learning.

B. The conventional learning method has the following characteristics (Borstorff, 2007):

- (1) The teacher ensures the role in motivating and guiding students;
- (2) Tests and examinations are carried out according to a predetermined schedule in general;
- (3) Laboratory is available for conducting test activities and practical experiments;
- (4) Institutions have fixed calendars and duration for each course / subject and,
- (5) Learning activities are limited to those who attend an institution.

E-learning philosophy is as follows (Arkorful & Abaidoo, 2015):

- (1) E-learning is the delivery of information on communication, education, training online;
- (2) E-learning provides a set of tools that can enrich the value of conventional learning, so that it can answer the challenges of globalization;
- (3) E-learning does not mean replacing conventional learning models in the classroom, but it strengthens the learning model through enriching the content and development of educational technology and,
- (4) The capacity of students can vary depending on the form, content and manner of delivery.

Model in e-learning is viewed in terms of the interaction between humans and the system, but there are 3 basic categories of e learning, i.e. (Borstorff, 2007):

- A) In synchronous learning the conditions are similar to conventional learning, only the learning process is not marked by the physical presence of students. In this synchronous instructor, students and colleagues meet online on the internet. Doing the learning process as if he were in the same physical space.

- B) Self-directed learning in this learning students learn independently by accessing various teaching materials provided. There are no instructors or special time to discuss with fellow students. Each student does the learning process according to their needs.
- C) Asynchronous (Collaborative) Learning. This category combines from the two previous categories. Students learn independently but still communicate with other students and with educators, although not necessarily at a special time.

3. Methodology

This research used qualitative-quantitative method with research and development design. Based on observations through identification of potential problems and data collection, the data obtained are then analyzed. The results of the analysis are then used as a reference for the initial design of the contents of the Moodle e-learning that will be developed.

The initial design is left to the expert to be assessed. The design is assessed by media experts and material experts. To assess this design the learning media feasibility criteria are used. The assessment of media experts includes 2 aspects, namely software engineering and audio visual communication (Azhar, 2008). The software engineering aspects consist of maintainability, reusability, compatibility, documentation, and reusability. Audio visual communication aspects consist of communicative, creative in the following ideas pouring ideas, simple and attractive, interactivity, providing motivation to learn, assessment of the material experts include aspects of learning design consisting of clarity of learning objectives (formulation, realistic), relevance of learning objectives with the syllabus courses and curriculum, the suitability of the material with the learning objectives, contextually and topicality, completeness and quality of Moodle-based e-learning, depth of material, ease of understanding, systematic and clear logic flow, clarity of discussion and examples. The feasibility of Moodle-based e-learning learning media was assessed by experts in the material and media fields as well as responses from cadets and lecturers through the instruments they made (Cole & Foster, 2008). Moodle-based e-learning products are said to be feasible if the instrument being validated by experts states that Moodle-based is in the feasible category and the responses of cadets and lecturers are at least good (Nuriyanti, 2013).

After the design was validated by material experts and media experts, a revision was made. The revised part is the part that is still considered lacking by media experts and material experts. Validator suggestions on the questionnaire can be used as a reference for improvement.

This trial was conducted twice, and the first trial was carried out on a small scale, namely on 7 people of the cruise electro cadets. The small-scale pilot functioned to find out the responses of several cruise electro cadets and lecturers about the lack of Moodle e-learning as a medium for learning digital engineering materials.

A small-scale trial was given to 3 cadets who were classified as smart and 3 people who were classified as having achievements. The technique used for sampling is convenience sampling technique. The testing procedure is done by asking cadets to watch and download material (whether in writing, pictures or videos) from Moodle, do quizzes or assignments given, and communicate with lecturers through chat menus and forums.

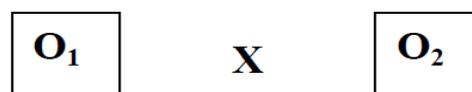
After using learning media in the form of e-learning Moodle, cadets and lecturers are asked to fill out questionnaire responses to the assessment of e-learning Moodle digital engineering material. The purpose of this questionnaire is to find out the responses of cadets and lecturers about the Moodle e-learning that was developed.

At this stage, Moodle e-learning was revised by considering the results of small-scale trials that have been carried out. The weaknesses that exist in Moodle e-learning can be corrected first before being used as a medium in learning during large scale trials.

Large scale trial, this trial was conducted in the Even Semester of the Academic Year 2017/2018 at the cruise electro study program in Surabaya Polytechnic, after Moodle's e-learning had improved. The research design used for experiments is to compare conditions before and after using a new system (before-after).

In this study no comparison class was used and pre-test and post-test were held.

Figure 1 - Experimental design (before-after).



Source: Sugiyono (2016).

Based on the figure above, there is a difference of value after getting a treatment. O_1 is value before treatment, O_2 is value after treatment and X is treatment.

Such research designs are also called Pre-test and post-test one group designs. The difference between O_1 and O_2 is $O_2 - O_1$ is assumed to be the effect of treatment or experimentation. The effectiveness of the treatment is calculated using the formula N-gain

pre-test and post-test, then statistical tests using the t test. Furthermore, the scores obtained by cadets are compared with the graduation reference score at Surabaya Shipping Polytechnic, which are 70. Large-scale trials in the implementation of using sample sizes use a reference from (Azwar, 2004) which limits the sample size taken for research at least 10% of the population. After the material is finished, students are asked to do post test questions. After working on the post-test questions, the cadets were asked to fill in the questionnaire sheets on responses to learning using Moodle e-learning media as the basis for digital engineering. In addition, the assessment is also given by the lecturer through a questionnaire.

Data Sources and Data Collection

Methods

1. Data sources: students / cadets, lecturers, media experts, and material experts
2. Data type: a. Qualitative data: the effectiveness of Moodle e-learning by students and teachers and the validity of Moodle e-learning from material experts and media experts. b. Quantitative data: student learning outcomes.
3. How to retrieve data: a. the data validity of Moodle e-learning was obtained from the Moodle e-learning assessment / validation questionnaire by material experts and media experts. b. Moodle e-learning effectiveness data in the form of student learning outcomes were obtained from tests and
4. Responses to the effectiveness of Moodle e-learning are obtained from the results of the questionnaire.

Data Analysis Methods

The items in the form of multiple choices are given to the cadets before learning to pre-test in order to measure the early ability of the cadets, and at the end of the study a post test is conducted to measure the learning outcomes of the cadets.

Data Validity of Moodle e-learning

Data validity of Moodle e-learning by material experts and media experts was analyzed quantitatively. The results of the assessment instrument scores from material experts are converted into the following criteria:

Score 10-13 = Not worth it

Score 14-17 = Inadequate

Score of 18-21 = Decent enough

Score 22-25 = Eligible

Score 26-30 = Very decent

The results of the assessment instrument scores from media experts are converted into the following criteria:

Score 13-17 = Not feasible

Score 18-22 = Inadequate

Score 23-27 = Decent enough

Score 28-32 = Eligible

Score 33-39 = Very decent

Data effectiveness of Moodle e-learning

Moodle e-learning effectiveness data from cadets and obtained through questionnaires and analyzed with a descriptive percentage analysis formula, while from the teacher using descriptive qualitative. Yes answer gets a score of 1 and the answer is not a score of 0. Furthermore, the scores obtained are added. The score data from the student response questionnaire was converted into the following criteria:

Score 0-2 = Not good

Score 3-5 = Not good

Score 6-8 = Good enough

Score 9-11 = Good

Score 12-15 = Very good

Data on student learning outcomes

Student learning outcomes data obtained from pre-test and post-test and calculated with the following formula. The level of score acquisition is categorized into three categories (Hake 1998) Height

(High): $g > 0.7$ Medium

(Medium): $0.3 < g < 0.7$

Low (g): $g < 0.3$

Paired sample t test

Paired sample t test was used to test the research hypotheses: Ho: there is an influence in the use of e-learning learning on learning outcomes.

H1: there is no influence in the use of e-learning learning on Learning Outcomes Provisions in hypothesis testing: 1. If the probability value sig (2-tailed) < 0.05 , with a significance level $\alpha = 5\%$, then there is a significant difference between learning outcomes before and after the use of e learning learning, which means Ho is accepted, H1 is rejected 2. If the probability value sig (2-tailed) > 0.05 , with a significance level $\alpha = 5\%$, then there is no significant difference between learning outcomes before and after the use of e learning learning, which means Ho is rejected, H1 is accepted.

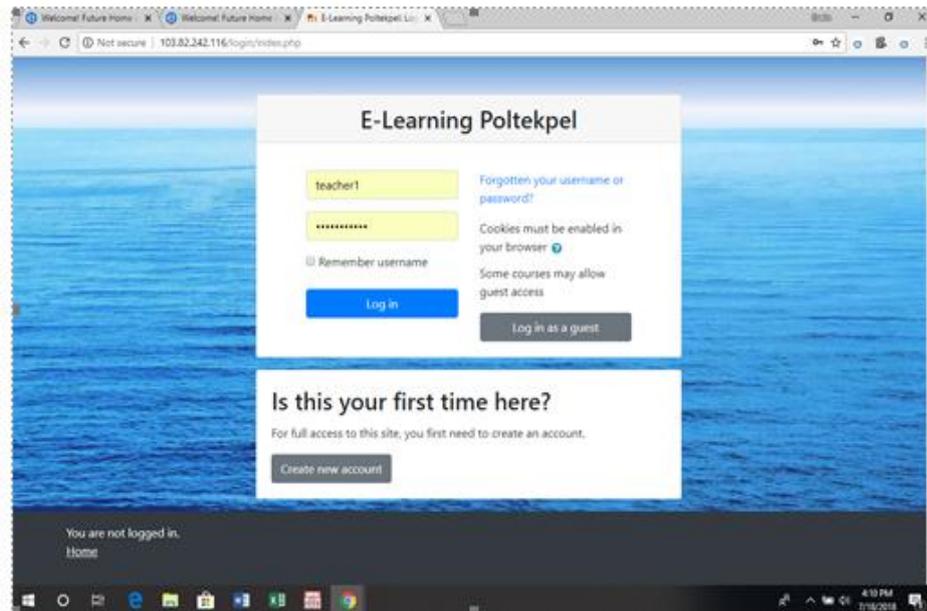
4. Result

Based on the research objective, which is to show that Moodle-based e-learning product design is appropriate and feasible to be developed for the basic material of pneumatic systems, the following is explained about the results of the research according to that purpose. The results of the development of Moodle-based e-learning as the basic learning media for pneumatic systems in the electro-shipping department of Surabaya Shipping Polytechnic.

Moodle-based E-learning Product Design

Results E-learning was developed based on moodle version 3.5, and the following is a display of the results of the development of moodle e-learning for learning on the basic material of pneumatic systems in the Department of electro-shipping at Surabaya.

Figure 2 - Initial display of e-learning.



Source: Authors.

That is the main display of e-learning system in Surabaya Merchant Marine Polytechnic system.

Design Validation Results

Product design is validated by media experts and material experts. The selected media expert is an Electrical Engineering lecturer. Before validation, improvements are made which cover various aspects, including appearance, readability, and writing. The content of e-learning in terms of material is validated by material experts, hydraulic pneumatic lecturers.

1) Media Expert Validation

Based on Table 1, it can be seen the results of the assessment of media experts, there are 3 aspects that get a minimal assessment, namely the audio aspect, where the e learning display that exists, especially in teaching material still looks rigid, without any audio effects, such as back sound, sound effect, narrative. Furthermore, the one who gets a minimum rating is the moving media, in this case the video that is displayed gets notes so that the narrative is also included in the Indonesian language and the third aspect that gets minimal value is the

visual aspect (layout design, typography, color). Some aspects that are being assessed include: reusability, compatibility, complete documentation, and reusable, creative simple and able to motivate learning. Overall based on the assessment of moodle e-learning, media experts consider as quite feasible for learning.

Table 1 - Media Expert Validation.

No.	Rated aspect	Score
1	Maintainable (can be maintained / managed easily	3
2	Usability (easy to use and simple to operate	2
3	Compatibility (learning media can be installed / run available hardware with or without downloading material	2
4	Complete media documentation	2
5	Reusable	2
6	Communicative	3
7	Creative in the following ideas pouring ideas	2
8	Simple and alluring	2
9	Interactivity	3
10	Providing learning motivation	2
11	Audio (narration, back sound, and sound effect)	1
12	Visual (layout design, typography, color)	1
13	Mobile media (video)	1
	Σ score	26
	Criteria : Decent	

Source: own study.

According to the table above which contain of various variable and it score of each variable, all the criteria include as decent criteria.

2) Material Expert Validation

Based on Table 2 it can be seen that the results of the material expert assessment of the contents of the Moodle-based e-learning developed are there are 8 aspects that get a moderate assessment and 2 aspects get a good assessment that is the aspect of clarity of learning objectives (formulation, realistic) and the depth of the material. Thus, the overall assessment of the material experts in the category is feasible.

Table 2 - Material Expert Validation.

No.	Rated aspect	Score
1	Clarity of learning objectives (formulation, realistic)	3
2	Relevance of learning objectives with SK / KD, Curriculum	2
3	The suitability of the material with the learning objectives	2
4	contextually and actuality	2
5	Completeness and quality of e-learning	2
6	Material depth	3
7	Ease to understand	2
8	Systematic, coherent, and clear logic flow	2
9	Clarity of description, discussion and example	3
10	Influence in process skills	2
	Σ score	22
	Criteria : Decent	

Source: own study.

According to the table above which contain of various variable and it score of each variable, all the criteria include as decent criteria.

Results of large-scale trials

After improvements at the product revision stage, e-learning is ready to be tested on a larger scale. In large-scale trials used Electron Semester IV with a total of 27 cadets. This trial was designed by making Moodle-based e-learning developed as one of the basic learning media for pneumatic systems (Chen, Lin, & Nien, 2014).

The trial begins with the cadets are first asked to do pre-test questions. Followed by doing a post test after completing the learning process with the aim to get data about the impact of the application of e learning, especially on the effectiveness of learning to improve learning outcomes of cadets. Large scale trials are conducted to obtain learning outcomes, cadet response data, and lecturer response data.

- a. Learning outcomes.

Table 3 - Recapitulation of the learning outcomes of the fourth semester electro cruise cadets on the basic material of the pneumatic system at Surabaya Shipping Polytechnic.

No.	Class	Average	classical class completeness	Minimum passing grade criteria
	Electro IV	89,03	100%	70

Source: own study.

The learning outcomes of cadets in this study were subsequently measured using normality gain (N-gain) to determine the effectiveness of the treatment given to the Electro-Sailing Class IV semester by using e learning learning. The recapitulation of N-gain measurement results is presented in Table 4.

Table 4 - Gain calculation results.

Category	Criteria	Total	Percentages (%)
$g > 0.7$	High	16	59
$0.3 < g < 0.7$	Medium	11	41
$g < 0.3$	Low	0	0

Source: own study.

Based on the calculation result above, it showed that High Criteria has higher percentages with 59% and medium is 41% and there is none of low criteria.

Hypothesis Testing

In testing the research hypothesis there are stages that are carried out, namely: a. Test normality of learning outcomes data pre test and post test, as a requirement before the paired t test b. Paired t test to test the hypothesis.

Data Normality Test

Based on the calculation data using SPSS to test the normality of the data obtained the following results:

Table 5 - Data Normality Test Results.

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Selisih	.187	27	.016	.961	27	.380

. Lilliefors Significance Correction

Source: own study.

The significance value (p) in the Shapiro-Wilk test was 0.853 ($p > 0.05$), so based on the Shapiro-Wilk normality test the data was normally distributed. This is also shown in the portion of the data shown in the following graphic image (Figure 2).

Paired t test

Paired sample t test was used to test the research hypotheses: Ho: there is an influence in the use of e-learning learning on learning outcomes H1: there is no influence in the use of e-learning learning on Learning Outcomes Provisions in hypothesis testing:1. If the probability value sig (2-tailed) < 0.05 , with a significance level $\alpha = 5\%$, then there is a significant difference between learning outcomes before and after the use of e learning learning, which means Ho is accepted, H1 is rejected2. If the probability value sig (2-tailed) > 0.05 , with a significance level $\alpha = 5\%$, then there is no significant difference between learning outcomes before and after the use of e learning learning, which means Ho is rejected, H1 is accepted. From the results of calculations using SPSS as in attachment 7, the following results are obtained.

Table 6 - Paired Sample Statistic.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	56.8148	27	8.26967	1.59150
	Posttest	89.0370	27	3.77727	.72694

Source: own study.

Based on the paired sample statistic, there is a difference on Pretest and Posttest result of Mean and Deviation

Table 7 - Paired Sample Test.

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	Pretest- Posttest	-3.222E1	8.04475	1.54821	-35.40462	-29.03983	-20.813	26	.000

Source: own study.

Interpretation of the output calculation results from SPSS is: a. The mean value of the pre test = 56.81 and the average value of the post test = 98.03b. The probability value of sig (2-tailed) is 0.001 < 0.05, with a significance level $\alpha = 5\%$, then there is a significant difference between learning outcomes before and after the use of e learning learning, which means H_0 is accepted, H_1 is rejected. paired t test can be concluded that learning e learning has a significant effect on improving learning outcomes of cadets in pneumatic system basic learning.

5. Final Considerations

Based on the results of the development and research results described in Chapter IV, it can be summarized the following research:

1. The results of the final product design have been adjusted with advice from material experts, media experts, lecturers and cadets.
2. The final product of Moodle e-learning based on the pneumatic system basic material has been validated by experts with proper criteria in terms of material and quite feasible in terms of media. The application of learning using Moodle-based e-learning media received positive responses from cadets and lecturers.
3. It is proven that learning using Moodle-based e-learning media is effective in increasing learning outcomes based on the results of the significance of N-gain, namely $g > 0.7$ is high as much as 515% cadets and n gain is $0.3 < g < 0.7$ is moderate as much as 41% cadets.
4. Based on the results of the paired t test to test the hypothesis it is proven that e-learning learning has a significant effect on improving the learning outcomes of cadets in pneumatic system basic learning.

Thus, based on the result of validation Moodle e-learning that received positive responses from cadets and lecturers and it has significant effect on improving the learning outcomes, the objective of this study was reached.

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Percentage contribution of each author in the manuscript

Hariyono - 100%