JURNAL PENDIDIKAN TEKNOLOGI INFORMASI DAN VOKASIONAL
http://jurnal.fkip.unila.ac.id/index.php/JPVTI
Vol.3 , No.1 , 2021, 77-86 | e-ISSN 2715-9647 | p-ISSN 2720-9091

DEVELOPMENT OF LEARNING MEDIA *PROGRAMMABLE LOGIC CONTROL* ON ELECTRIC MOTOR INSTALLATION COURSES IN SMKN 2 CITY OF SERANG

Gilang Perdana, Endi Permata, Mohammad Fatkhurrokhman
Fakultas Keguruan dan Ilmu Pendidikan, Universitas Sultan Ageng Tirtayasa, Serang-Banten
Jl. Ciwaru Raya No. 25, Cipare, Kec. Serang, Serang City, Banten 42117
e-mail: Gilangperdanana@gmail.com

Received: June 15, 2021 *Accepted: June 25, 2021* *Published: June 30, 2021*

ABSTRACT

The focus of this research is to find out the process of making PLC learning media, measuring the feasibility level of PLC media, measuring the feasibility level of learning jobsheets, and measuring the effectiveness of learning media and jobsheets at SMKN 2 Serang City. The research method used in this study is Research and Development (R&D) with the ADDIE model developed by Robert Branch and reduced according to the needs of the researcher, which includes: (1) Analyze, (2) Design, (3) Develop, (4) Implement, (5) Evaluate.Tahap got problems not already own analysis of instructional media for subjects PLC Installation Motor Listrik.Tahap Design is a step for designing learning mediaPLC and jobsheet learningPLC.TahapDevelopment is a stage further learning media making media created rated by experts media andexperts worksheet. The implementation phase was carried out in class XI TL 1 SMKN 2 Serang City starting with a pretest to determine the extent of students' knowledge about PLC and then applying the learning media that had been developed. The last stage of evaluation is done by post test to determine the effectiveness of the media that has been made. Based on the results of the study, the results obtained: (1) PLC learning media and PLC learning worksheets were developed based on themethod Research and Development with the ADDIE development model, (2) The feasibility of the media based on the assessment of media experts got a score of 114 "very feasible", (3) The feasibility of the jobsheet based on theexpert's jobsheetassessment got a score of 78.3 "very decent", (4) The level of effectiveness of the use of the developed media reached 0.88 "very effective" as measured by N-gain. SMK students are required to be able to keep up with technological developments in the industry, for example, being able to operate PLC (Programmable Logic Control). In PLC learning, students are advised to have their respectiveworksheets PLC learning, because it makes it easier for students to study independently both at school and at home. On the media used, routine maintenance needs to be done so that this PLC learning media can work optimally.

Keywords*: Electric Motor Installation, ADDIE, PLC.*

INTRODUCTION

Upper secondary education in Indonesia is divided into 2, namely, senior secondary education (SMA) and vocational secondary education (SMK). Vocational High Schools (SMK) prioritize the preparation of students to enter the workforce. In accordance with their form, Vocational High Schools organize educational programs that are tailored to the types of employment (Government Regulation No. 29 of 1990). Jobs that can be filled by vocational students are also very broad and diverse, one of which is by working in the industry. At this time the control system used in industry is based on automatic control, for example the use of PLC *(Programmable Logic Control)*. PLC is an electronic circuit that can perform various control functions at *levels*complex. One of the PLC operations in industry is used as a controller in running an electric motor.

Competency in operating the PLC control system is a mandatory competency that must be mastered by SMK students. The competencies possessed are in the form of knowledge, work attitudes, and skills related to the use of PLC as a control tool in industry. (Sujatmiko, 2016) reported from krjogja.com stated that the tight competition in the quality of employment in the field of engineering has made the academic world have to get closer to the industrial world to understand the needs of the field, especially in the field of PLC. Asep Amrulloh ST M, Pd as a teacher of Motor Installation subjects Electricity stated that the importance of certification of expertise so that after graduation the abilities possessed are not in doubt and have a higher selling value. Based on the results of research that has been carried out by (Arifidin & Budyo, Yogyakarta) the development of learning media in the form of an Electric Motor Installation Trainer-Kit that can attract attention and facilitate students' understanding, to operate an electric motor using this automatic control technology requires both theoretical and practical skills so that technical errors did not occur, therefore SMK provides a lesson that is considered appropriate to print quality Human Resources (HR) in the field of automatic electric motors who will later work in Industry, the name of the lesson is Electrical Motor Installation (IML).

Based on the results of observations at SMKN 2 Serang City, it is known that there are problems that hinder the teaching and learning process in schools, namely, the lack of media used causes them to be unfamiliar with how to operate PLC, time consuming and the material presented is not optimal. In addition to media, the use of *jobsheets* basicwill also be made starting from the introduction of PLC to how to operate it which aims as a guide to help students who are still new to PLC.

From the description of the background of the problem above, a study was compiled with the title "Development ofLearning Media*Programmable Logic Control* (PLC)in Electric Motor Installation Subjects at SMKN 2 Serang City**".** Based on the existing problems, the research problem formulation can be formulated as follows: (1) How is the process of making this PLC learning media for the subject of Electrical Motor Installation at SMKN 2 Serang City? (2) How is the feasibility level of this PLC learning media to help learning activities at SMKN 2 Serang City? (3) How is the level of feasibility *jobsheet* of this PLC learning mediato help learning activities at SMKN 2 Serang City? (4) How is the level of effectiveness of learning media and *worksheets* learningto help learning activities at SMKN 2 Serang City?. From the problem formulation, it can be explained that the research objectives to be achieved in the study are: (1) Creating PLC learning media for the subject of Electrical Motor Installation at SMKN 2 Serang City, (2) Testing the feasibility level of PLC learning media to help PLC learning activities at SMKN 2 Serang City, (3) Testing the feasibility level of *jobsheets* PLCto help PLC learning activities at SMKN 2 Serang City, (4) Testing the effectiveness of media and *jobsheets* to help PLC learning activities at SMKN 2 Serang City. This research is limited to the PLC used is the

Zelio SR2B201BD type and the operation of the PLC learning media is only on *jobForward-Reverse*.

METHOD

type of research is the *Research and Development* (R&D). According to (Sukmadinata, 2015) research and development is a process or steps to develop a new product or improve an existing product, which can be accounted for. The development model used in this study is ADDIE (*Analyze, Design, Develop, Implement&Evaluate*) proposed by Branch and reduced according to the needs of researchers. ADDIE is a product development concept and stands for analyzing, designing, implementing and evaluating. applied here to build performance-based learning. The educational philosophy for implementing ADDIE is that intentional learning must be student-centered, innovative, authentic, and inspirational (Branch, 2009).

The research and development currently being carried out is focused on developing the Zelio PLC learning media and *worksheets*learningto assist learning activities at SMKN 2 Serang City majoring in Electrical Engineering in the subject of Electrical Motor Installation.

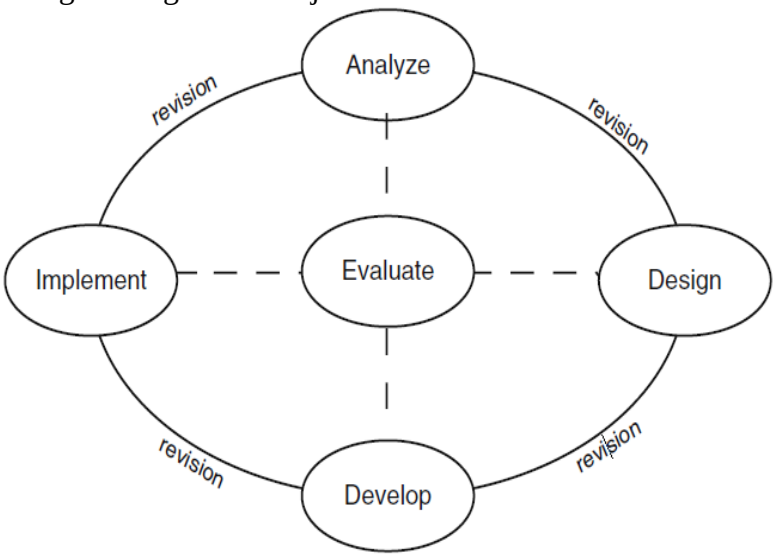

Figure 1. Figure ADDIE The

data analysis technique used is descriptive quantitative analysis and to measure the feasibility data in the research instrument, thescale rule is used *Likert*.Scale *Likert* used to measure attitudes, opinions and perception of a person or a group of social phenomenon. In measuring student learning outcomes,held *pre-test* and *post-test were*. *The pre-test was* carried out before the use of the media in learning and the *post-test was* held after the students used the media in learning. Before the instrument is used in conducting the research, the instrument validation test/process is first carried out to determine whether the instrument used is valid or not. Valid or not the instrument can be measured with the validity and reliability of the instrument. Valid means that the instrument can be used to measure what should be measured (Sugiyono, 2014). A reliable instrument is an instrument which, when used several times to measure the same object, will produce the same data (Sugiyono, 2014).

RESULTS AND DISCUSSION

The initial stage in this research is *analyze* . The analysis phase in the implementation of research serves to analyze the problems and needs needed to be right on target. The problem obtained at SMKN2 Serang City is that in SMKN 2 Serang City, especially class XI in the subject of Electrical Motor Installation, students lack PLC learning media that they can use. And they do not understand PLC because there are no guidelines or guidelines that they can use. After the analysis stage, the next step is *design*. In the design stage, it is divided into 3 steps, namely the design of the PLC learning media to be made, the design *jobsheet* of the PLC learning, and needs analysis. For the initial stages in the design, according to the considerations and needs at SMKN 2 Serang City, the media design is made in the form of a table. The second step is the design of the *worksheet* which serves as a guide for students in carrying out the practice. In *jobsheet* thisthere are 4 work orders, namely *direct on line, forward-reverse*, sequential, and *star-delta.* Each worksheet is equipped with power diagrams, control diagrams, wiring diagrams, and *ladder diagrams* , each of which has a different command for each *job* . The third step is to calculate the costs for the needs that will be incurred in completing the research. After thestage is *design* fulfilled, the next stage is *develop* . Stages *develop* divided into two parts, namely the manufacture of instructional media and manufacturePLC *jobsheet* PLC learning. In making the media there are steps taken, namely (1) installation of components on thepanel *acrylic*, (2) making the frame or *body of* the learning media, (3) merging thepanel *acrylic* with the *body of* the learning media. After the process of making the media, the next step is the testing phase of the tool which is intended for the experimental phase before this media is tested on the test subject so that it can be repaired if there are still deficiencies. The final step in making media is conducting a feasibility test by an expert.

Figure 2. PLC Learning Media

The fourth stage in this research is *implement* . After the PLC learning media and *jobsheet* itshave been made and declared feasible by media experts andexperts *jobsheet* for later use. Before the implementation, the teacher and students were given an explanation about the PLC media used so that this research ran smoothly and avoided unwanted things. The last stage in this research is

evaluate (evaluation). In the evaluation stage based on the ADDIE development model proposed by Branch, there are three steps that must be taken by researchers, namely determining evaluation criteria, selecting tools for evaluation, and conducting evaluations. There are three kinds of evaluation criteria according to (Branch, 2009) namely (1) perception evaluation, (2) learning evaluation, (3) ability evaluation.

At the validation stage of the research instrument, it is divided into 2 parts, namely the stage of instrument validation and instrument reliability. The test questions were carried out by taking 26 samples, the questions tested were multiple choice with 35 questions and 5 answer choices. Of the 35 questions tested, only 23 questions were valid. So the researchers reduced the questions that would be used as *pretest* and *posttest questions* into 20 items. In calculating the reliability of the questions, the researcher uses the KR 21 formula. The results of the reliability calculations show that the instrument is stated in the "very high" category with a value of 0.82. The value of 0.82 is in the interval 0.800 to 1,000 or is in the Very High category. So it can be concluded that the instrument questions made have a very high level of reliability. Before being used, the media and jobsheets must first be tested or validated by experts so that the media developed is suitable for use. The assessment is carried out using ascale *Likert* with a range of 1-5 which is then searched for the average value, then the data that has been obtained is analyzed and converted according to the rules proposed by Mardapi (2017).

Table 1. Conversion of Media Validation

No	ScoreScore	RangeScore	Eligibility Category
1	x x+1.SBx	x 95.3	Very Eligible
2	x+SBx>xx	95.3>x78	Eligible
3	x>xx-1.SBx	78>x60.7	Not Eligible
4	x<x-1.SBx	x<60.7Inappropriate	Very

From the results of the test data for the validity of the PLC learning media which was assessed by 3 media experts, it was found that the average results of the assessments of the three learning media experts were 114 with details: *hardware* and *design* 43.3, technical 31, usefulness 39.7.

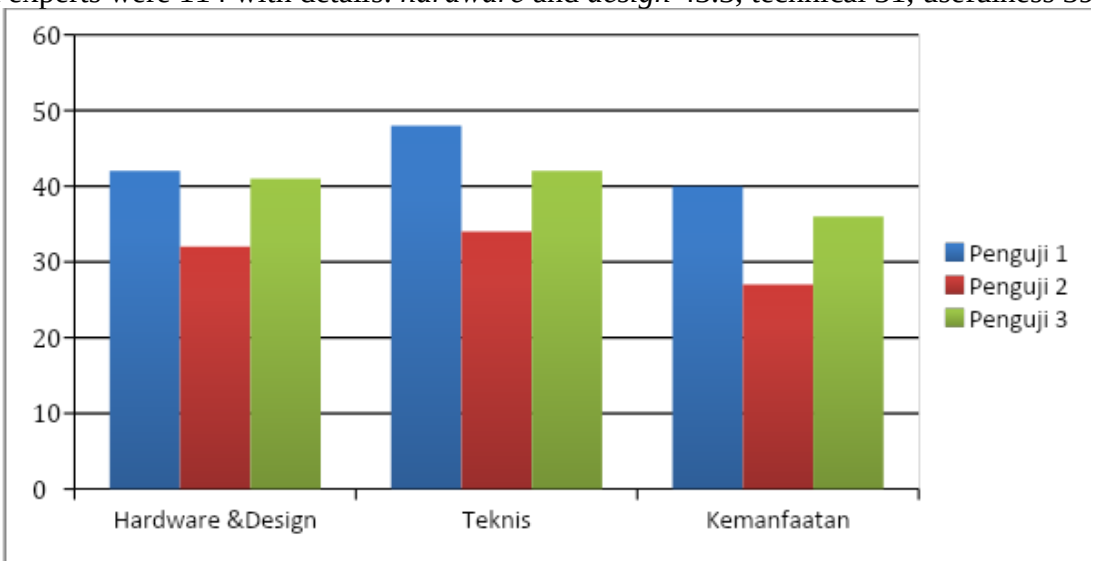

Figure 3. Media Validation Test Results A

score of 114 is in theinterval x 95.3 or is in category 1. If we look at the overall value of theaspects *hardware* and design, technical, and usability, it can be concluded that this PLC learning media is very suitable to be used for student learning. From the results of thevalidation test data *jobsheet* assessed by 3experts *jobsheet* , the results showed that the average assessment of the threeexperts *worksheet* learningwas 78.3.

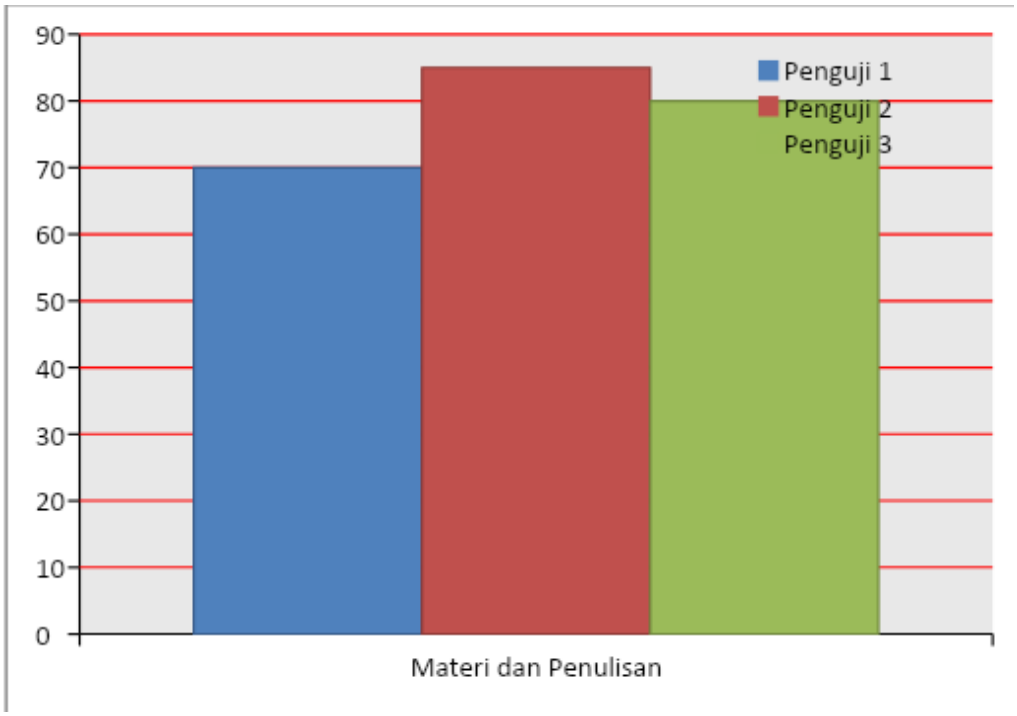

Figure 4. Jobsheet Validation Test Results

Table 2. Jobsheet Validation Score Conversion

No	Score	RangeScore	Feasibility Category
1	x x+1.SBx	x 62.3	Very Eligible
2	x+SBx>xx	62.3>x51	Eligible
3	x>xx-1.SBx	51>x39.7	Not Eligible
4	x<x-1.SBx	x<39.7	Very Inappropriate

So we can see that the value of 78.3 is in the interval x 62.3 or is in category 1. If we look at the overall value of the material and writing aspects, it can be concluded that *worksheet* this PLC learningis very suitable for learning students.

From the results of media validation tests and worksheets by experts, the results obtained state that the two media developed have been declared suitable for research with thecategory **"very feasible"**. Based on the results of student responses to the use of PLC learning media and jobsheets, the average results obtained from respondents who use learning media are 78.3. So that we can see that the value of 78.3 is in the interval x 62.3 or is in category 1. If we look at the overall value of the material, learning and technical aspects, it can be concluded that the learning media and *worksheet* thisreceived a very decent response from students. To measure the

effectiveness of using PLC learning media on students,conducted *pre-test* and *post-test were* to measure student learning outcomes before and after using the media. The subjects studied were 25 people with an average *pre-test* score of 37.8 and a post-test score of 88.8.

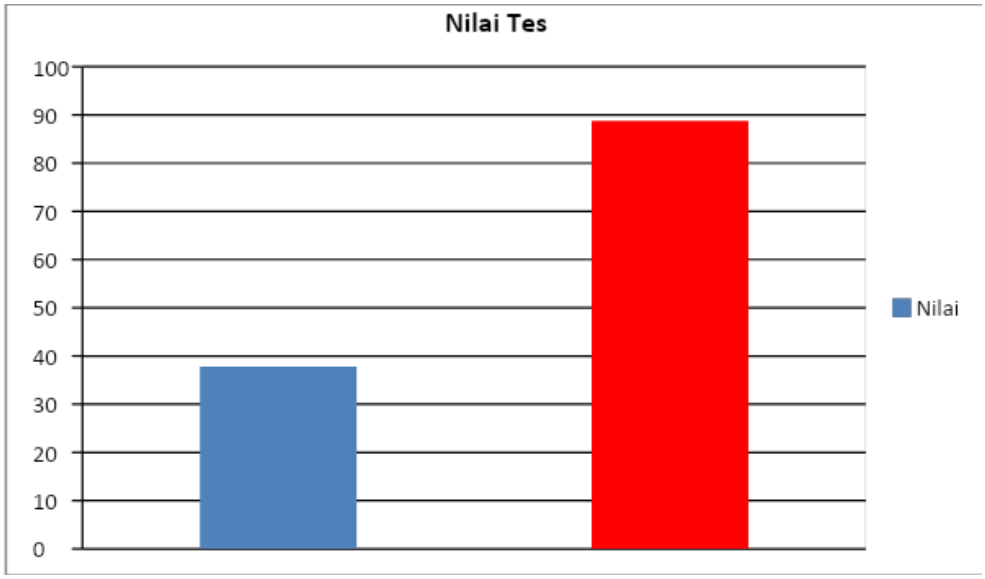

Figure 5. Comparison of Pre-Test and Post-Test Values The
data obtained from the *pre-test* and *post-test results are* then processed using the n-gain formula according to Hake (1999) with the formula:

n-gain =(posttest-scorepretest score)(maximum score-pretest score)

After using PLC media, the value of student learning outcomes increased by 51. The n-*gain* value obtained from the calculation resulted in a value of 0.81.

Table 3. Criteria for Product Effectiveness LevelEffectiveness

No	Criteria for Achievement Value	level
1	n-*gain* 0.7	High effectiveness
2	0.3 < n-*gain*< 0.7	Medium effectiveness
3	n-*gain* 0.3	Low effectiveness

So that we can see the value of 0.81 is in theinterval n-gainof 0.7 or is in category 1. If we look at the n-value*gain* that has been obtained, it can be concluded that the PLC learning media is very effective for student learning. Based on the results of research conducted by PLC media, it is stated that it can improve student learning outcomes and is very effective as evidenced by the results of the *pre-test* and *post-test of* students who experienced an increase of 50 and the *gain score* reached 0.81.

The development of this PLC made of media has advantages and disadvantages. The advantages of this media are: (1) this media is equipped with a *manual book* that is used as a guide

by students in carrying out practice so they can find out for themselves what to do and avoid in maintaining and caring for this media, (2) PLC media it is equipped with a TDR /*Time Delay Relay* which is used to set the time so that the practice of installing electric motors carried out on this media does not only use PLC but can be used in conventional electric motor installations, (3) PLC used in this media is a *smart relay* which has 20 I/O which is useful so that students can develop existing *outputs* and *inputs* so that in learning the use of inputs and outputs is more varied, (4) PLC media are made with sturdy and strong materials to be able to withstand the load of electric motors and are not easily damaged , (5) the *jobsheet is* made to assist students in carrying out the practice, students only need to follow the steps the stages contained in the *jobsheet* and understand it, (6) *jobsheet* the createdis printed with a neat cover and an attractive design so that students are more interested in reading the *jobsheet*.

In addition to its advantages, this PLC media also has its drawbacks, namely: (1) the media made is considered too large, making it difficult for students to move the media and takes up a lot of space, (2) the PLC media made does not have a drawer to put the media in. cables used so that the media and cables used must be placed separately, (3) the electric motor used in this media is only 1, (4) in the panels made there are air bubbles which can reduce the neatness value of this PLC media.

CONCLUSION

Based on the research conducted, it can be concluded that the PLC learning media and the PLC learning *worksheet* were developed based on themethod *Research and Development* with the ADDIE development model (*Analyze, Design, Develop, Implement, Evaluate*). The manufacturing process is divided into several stages including: (a) determining the design (b) installing components onpanels *acrylic*, (c) making frames or *bodies* learning media, (d) mergingpanels *acrylic* with *bodies* learning media(e)development *jobsheet*. The feasibility level of the PLC learning media according to the media expert's assessment, in terms ofaspects *hardware* and design, technical, and usability, this PLC learning media got a score of 114 with the "Very Eligible" category. The feasibility level of the *jobsheet* PLC learningaccording to theexpert's *jobsheetassessment*, in terms of the material and writing aspects, *worksheet* this PLC learninggot a score of 78.3 with the "Very Eligible" category. The achievement of the average score of students before using learning media was 37.8 and then increased to 88.8 after using learning media. The N-*gain* obtained is 0.81 with the "Very Effective" category.

REFERENCES

Alphonsus , R. E., & Abdulloh , O. M. (2016). A Review On The Aplications Of Programmable Logic Controllers. *Renewable and Sustainable Energy Reviews*, 1185-1205.

Arifidin, A. A., & Budyo , D. L. (Yogyakarta). Pengembangan Trainer-Kit Untuk Mata Pelajaran Instalasi Motor Listrik Kelas XII di SMK Muhamadiyah 3. *E-Journal Universitas Negri Yogyakarta*, 66-74.

Branch, R. M. (2009). *Instructional Design ADDIE Approach.* London: Springer Science.

Hake, R. R. (1999). Analyzing change/gain Scores.

Handayani, P., & Putro , T. Y. (2008). *Teknik Pemeliharaan dan Perbaikan Sistem Elektronika.* Jakarta: Direktorat Pembinaan Sekolah Menengah Kejuruan.

Levenson, R. M., Nelson, Z. E., & Adegbege, A. A. (2017). Programmable Logic Controller for Embedded Implementation of Input Constrained System. *IFAC PappersOnLine*, 14412-14417.

Mardapi, D. (2017). *Pengukuran Penilaian dan Evaluasi Pendidikan.* Yogyakarta: Parama Publishing.

Peraturan Pemerintah Nomor 29 Tahun 1990.

Sanjaya, W. (2008). *Perencanaan dan desain sistem pembelajaran.* Bandung: Kencana Prenada Media Group.

Sugiyono. (2014). *Metode Penelitian Pendidikan Kuantitatif, Kualitatif, dan R & D.* Bandung: Alfabeta.

Sujatmiko, T. (2016, Agustus 25). *Pendidikan: Krjogja*. Retrieved Maret 1, 2018, from Krjogja: www.krjogja.com

Sukmadinata, N. S. (2015). *Metode Penelitian Pendidikan.* Bandung: Remaja Rosdakarya.

Trianto. (2009). *Mendesain Model Pembelajaran Inovatif-Progresif.* Jakarta: Prenada Media Group.