

# Development of Scientific Writing Guidelines for Project Based Learning in Vocational School

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**Abstract**—This research started from the results of a need analysis that vocational students still have a lot of difficulties in compiling reports on scientific papers from project-based learning outcomes in class. Around 56,25% of students have not systematically compiled scientific papers. In fact, students must have the ability to write scientifically including writing scientific papers. The purpose of this study is to produce a guidebook for preparing valid, practical and effective scientific paper reports for vocational students. This research used the method of Research and Development (R&D). Product design and implementation was carried out using the TIER model (Training Intervention Effectiveness Research). The subjects in this study were 105 grade XI students majoring in Industrial Electronic Engineering at SMK 1 Katapang. The results of this study concluded that students are able to write scientific papers with systematic writing in accordance with the instructions in the guidebook. This study reveals the guidebook is valid, practical and effective. This was indicated by the validation score of the experts that was 4,25 with very good classification, the percentage of mastery learning with growth from 34,3% to 100% in the classification was very good, and the student response score was 4,1 with good classification.

**Keywords**—*project based learning, scientific writing guidelines, vocational school*

## I. INTRODUCTION

Project Based Learning (PjBL) is one of the efforts to improve the quality of the process and learning outcomes, both to master declarative and procedural knowledge that will later be product oriented [1]. In the implementation of project-based learning required communication skills in writing through the preparation of scientific papers with systematic reports in accordance with standards. This is one of the social skills that students need to have as stated in Permendiknas No. 41 of 2007 concerning Process Standards [2]. Communication skills are skills to convey his findings to others both verbally and in writing can be in the form of report preparation, paper making, composition writing, drawing, tables, diagrams, graphs [3]. The assessment of scientific communication skills in the preparation of scientific paper reports includes systematic reporting and completeness, the quality of exposure (citation)

literature review, discussion of results, and writing of literature [4].

One of the written communication skills that needs to be trained in students is the ability to arrange and present research results systematically. This means that the compiled scientific paper reports must meet the components of a good scientific paper report and indicators that must be met in communication skills [5]. Reports of scientific papers generally consist of components, namely introduction, literature review, research methods, results and discussion, as well as a conclusion containing conclusions and suggestions.

Facts in the field many students who have difficulty in making reports of scientific papers on project-based learning. Based on the results of the identification of problems through interviews conducted with the head of the department program who is also a productive subject teacher in the Department of Industrial Electronics Engineering SMKN 1 Katapang, it was found that most students still have low competence in preparing scientific paper reports.

## II. METHODOLOGY

This research is a research and development (R&D). This research and development resulted in a product [6] in the form of guidelines for preparing scientific paper reports on project-based learning at SMK. The guideline development model used in this study adopts the TIER (Training intervention Effectiveness Research) development model [7] which will be implemented during project-based learning in class. The steps in this study consist of a study of the researcher's findings that are adjusted to the product to be developed, develops the product based on the findings and conducts a field trial and revises the results of the field test. Characteristics of development, namely 1) the product is based on problems encountered in learning; 2) developed through development and testing; 3) trials are carried out in three stages, namely expert testing, empirical testing, and field testing; and 4) the resulting product is in the form of guidelines for preparing a scientific paper report.

A. Research Development Steps

The development model in this study refers to the concept of the research model of the effectiveness of training interventions or the TIER (Training intervention Effectiveness Research) model which is implemented during project-based learning in class [7]. The TIER model systematically organizes research into training effectiveness into the four stages described in Figure 1.

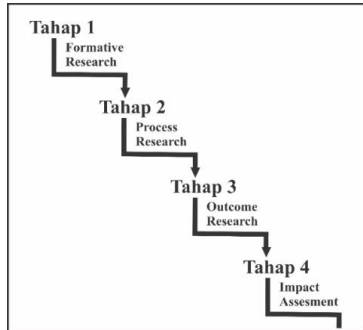


Fig. 1. Steps in the TIER Model.

At this stage, assessment instruments and learning materials are designed. Researchers conduct a needs analysis to find out whether students need guidance in preparing scientific paper reports. Researchers conducted interviews with the head of the Department of Industrial Electronics Industrial Engineering at SMKN 1 Katapang about the difficulties they faced in preparing reports on scientific papers and validating the guidelines with experts. In stage two, the researcher tested the guidelines in the field. In stage three, a controlled evaluation study is carried out on the preparation of scientific paper reports. The results of the learning effort compiling a scientific paper report are documented. In stage four, the researcher will examine the impact of implementing the guidelines related to the preparation of scientific paper reports when applied to project-based learning.

B. Research Instruments

Data collection instruments are tools that are selected and used by researchers in their activities to collect data so that these activities become systematic and made easier by them [8]. Table 1 shows the use of instruments in each phase in this study.

TABLE I. INSTRUMENTS IN EACH PHASE.

No	Step	Focus	Instrument
1	Formative Research	Need analysis	Interview and documentation
2	Process Research	Expert validation	Guidance assessment by experts
3	Outcome Research	Practicality and Effectiveness	User questionnaire and observation sheet
4	Impact Assessment	Formative Evaluation and Summative Evaluation	-

C. Data Analysis Techniques

Data analysis in this study was carried out to obtain guidelines that met valid, practical, and effective criteria. Data analysis in this study was carried out to obtain guidelines that met valid, practical, and effective criteria. Validity data were obtained from assessments by lecturers and expert teachers. In this study, the response questionnaire was used to obtain practicality data on the use of guidelines. The step developed in analysing data from expert assessment sheets on guidelines and response questionnaires starts from changing qualitative data to quantitative data with Likert scale provisions (1-5) calculating average scores, and guidelines are said to be valid if they meet the minimum good guideline rating classification (> 3,4) [9]. While the value of effectiveness is obtained by documenting students' scientific paper reports before and after implementing the guidelines on learning projects carried out by students. The steps taken starting from documenting learning outcomes, assessing the completeness of learning outcomes with a scale of 0-2, counting the number of students who graduated i.e. students who successfully compiled scientific papers with the correct systematic, classifying completeness classically, and converting calculations to the previous step to classically display the student's academic skills category. In this study, the guidelines are said to be effective if the percentage of mastery learning classical test results of student implementation reaches a minimum classification of good (> 60).

III. RESULTS AND DISCUSSION

A. Design and Implementation Results

1) Stage 1. Formative research: At this stage assessment instruments and learning materials in the guidelines for preparing scientific paper reports are designed. Based on the results of the interviews, researchers found the final results of the assessment that most students still have low competence in preparing scientific paper reports. The average percentage of students who have compiled reports of scientific papers with the correct writing systematics is 56.25%. The findings of this study indicate that students at SMK 1 Katapang really need guidelines for preparing scientific paper reports as researchers have developed. The results from the product design stage are explained in Figure 2.

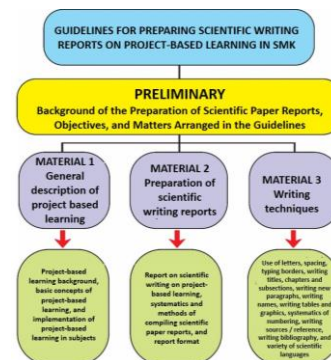


Fig. 2. Guideline framework.

Based on Figure 2 it can be explained that:

- The guideline consists of 4 parts, namely 1) introduction, 2) general explanation of project-based learning, 3) preparation of scientific paper reports, and 4) writing techniques.
- Introduction, consisting of the background of the preparation of the scientific report, the purpose of the preparation of the scientific report, and matters set out in the guidelines for the preparation of the scientific report on project-based learning.
- The general explanation of project-based learning consists of the background of project-based learning, the basic concept of project-based learning, and the implementation of project-based learning in subjects.
- Compilation of scientific paper reports consisting of scientific paper reports on project-based learning, systematic and how to prepare scientific paper reports and report formats.
- Writing techniques consist of using letters; spacing; edge typing; writing titles, chapters and sub-chapters; writing a new paragraph; name writing; writing tables and graphs; numbering systematics; source / reference writing; writing a bibliography; and various scientific languages.

The next stage in this formative stage is validating the guidelines with experts. At this stage, researchers also conduct data analysis of the results of the assessment of guidelines obtained from the validator. This is done to get the validity value of the guideline. Guidelines are said to be valid if they meet the classification of minimum good guideline assessment. Table 2 shows the results of the validator's assessment of the guidelines.

TABLE II. RECAP OF THE GUIDELINE ASSESSMENT RESULTS

No. Validator	Average	Classification
1	4.63	4.25 Very good
2	4.47	
3	4.42	
4	3.95	
5	4.00	
6	4.05	
7	4.26	

Based on the data in Table 2, it is known that the result of the validation guidelines is 4.25 and is included in the very good classification. Then, it can be concluded that the guidelines are declared valid.

2) *Stage 2. Process research:* At this stage, the research instrument was tested at the research site at SMK 1 Katapang. The research phase starts from the preparation to the implementation of learning carried out on March 10 to June 1 2020. At this stage, the researcher makes the XI grade students majoring in Industrial Electronics Engineering as learning

participants. Next the researcher examines the effectiveness and practicality of the guidelines. The validated guidelines were then implemented experimentally on 105 respondents in project-based learning in the Electronic Control System subject with a project that was designing an op-amp application as a temperature controller using an LM35 sensor and displayed on the LCD. All students consisted of 36 students of class XI-E1, 34 students of class XI-E2 and 35 students of class XI-E3.

3) *Stage 3. Outcome research:* At this stage the researcher tests the effectiveness and practicality of the guidelines on a limited sample. Based on the implementation results, the following findings were obtained.

a) *Testing practicality guidelines:* In this study, the user questionnaire was used to obtain practicality data on the use of guidelines with the results of the questionnaire analysis in Table 3.

TABLE III. USER QUESTIONNAIRE AVERAGE SCORE.

No.	Rated aspect	Assessment
1	Material Aspects	
	a. The contents of the sentence in the guidelines I can understand very well	4
	b. The steps in the guidelines easily can be followed	3.9
	c. The material provided is in accordance with the project-based learning practice in the department	4.1
2	Learning Aspects	
	a. The use of report drafting guidelines gave me the opportunity to study more extensive scientific paper reports	4.3
	b. I find it helpful to make reports using guidelines	4.4
	c. The use of guidelines gave me additional motivation to learn about scientific papers	4.1
	d. The use of guidelines adds to my knowledge of the systematic and format of writing scientific papers	4.3
	e. The use of guidelines increases my attention to the procedures for writing good scientific papers	4.2
f. The Scientific Report Preparation Guidelines helped improve my written communication skills	4	

The results of data analysis from the user questionnaire obtained an average score of 4.1 and included in the classification very well, indicating that the guidelines developed were declared practical.

b) *Testing the effectiveness of the guidelines:* To get the value of the effectiveness of the guidelines, a test of learning outcomes is used before and after implementation. Data on learning outcomes are obtained by documenting learning outcomes with completeness criteria based on the rubric of student communication skills assessment scale 0-2. Table 4 shows the results of observations before implementing the guidelines.

TABLE IV. OBSERVATION RESULTS BEFORE IMPLEMENTING THE GUIDELINES

No	Focus	Fulfilled		Partially fulfilled		Not fulfilled	
		F	%	F	%	F	%
1	Cover page / title	35	37.63	55	59.14	3	3.226
2	Ratification page	15	16.13	12	12.9	66	70.97
3	Abstract	13	13.98	3	3.226	77	82.8
4	Preface	64	68.82	22	23.66	7	7.527
5	Table of contents	65	69.89	16	17.2	12	12.9
6	Table of picture	29	31.18	1	1.075	63	67.74
7	List of tables	50	53.76	7	7.527	36	38.71

Table IV. Cont.

No	Focus	Fulfilled		Partially fulfilled		Not fulfilled	
		F	%	F	%	F	%
8	Background	33	35.48	57	61.29	3	3.226
9	Formulation of the problem	34	36.56	58	62.37	1	1.075
10	Research purposes	35	37.63	56	60.22	2	2.151
11	Benefits of research	36	38.71	54	58.06	3	3.226
12	Theoretical review	63	67.74	25	26.88	5	5.376
13	Research methodology	21	22.58	22	23.66	50	53.76
14	Results and discussion	34	36.56	24	25.81	35	37.63
15	Conclusion	61	65.59	19	20.43	13	13.98
16	Suggestion	62	66.67	20	21.51	11	11.83
17	Bibliography	60	64.52	20	21.51	13	13.98
18	Attachment	15	16.13	2	2.151	76	81.72
<b>Average</b>		40.28	43.31	26.28	28.26	26.44	28.43

Based on Table 5, the observation results of 105 students before implementing the guidelines, obtained an average of 28.43% of the learning participants did not work on the sub-points on the systematic preparation of the report, 28.26% of the learning participants were not appropriate in preparing the report as standard, and 43.31 % of participants who were systematically compiled with standardized scientific paper reports. Thus it can be concluded that before learning, most respondents did not graduate with a total of 56.69%. While the results of observation after the implementation of the guidelines showed progress as shown in Table 5.

TABLE V. OBSERVATION RESULTS AFTER IMPLEMENTATION OF THE GUIDELINES.

No	Focus	Fulfilled		Partially fulfilled		Not fulfilled	
		F	%	F	%	F	%
1	Cover page / title	82	88.17	11	11.83	0	0
2	Ratification page	89	95.7	4	4.301	0	0
3	Abstract	64	68.82	29	31.18	0	0
4	Preface	72	77.42	21	22.58	0	0
5	Table of contents	86	92.47	7	7.527	0	0
6	Table of picture	81	87.1	4	4.301	8	8.602
7	List of tables	86	92.47	5	5.376	2	2.151
8	Background	89	95.7	4	4.301	0	0
9	Formulation of the problem	89	95.7	4	4.301	0	0
10	Research purposes	89	95.7	4	4.301	0	0
11	Benefits of research	89	95.7	4	4.301	0	0
12	Theoretical review	88	94.62	5	5.376	0	0
13	Research methodology	64	68.82	29	31.18	0	0
14	Results and discussion	90	96.77	3	3.226	0	0
15	Conclusion	93	100	0	0	0	0
16	Suggestion	93	100	0	0	0	0
17	Bibliography	75	80.65	9	9.677	9	9.677
18	Attachment	25	26.88	3	3.226	65	69.89
<b>Average</b>		80.22	86.26	8.111	8.722	4.667	5.018

Table 5 shows the results of observations after implementing the guidelines designed by researchers of 105 XI grade students majoring in Industrial Electrical Engineering at SMKN 1 Katapang with an average yield of 5.018% of learning participants not working on sub-points on the systematic preparation of the report, 8.722% of the learning participants were not yet suitable in preparing the report as standard, and 86.26% of participants who were in accordance systematically compiled a standard scientific paper report.

*c) Stage 4. Impact assessment:* The last stage after all the development steps have been completed. Improvements to the guidelines at the evaluation stage are based on student suggestions and comments written in the user's questionnaire. In addition, the improvement of guidelines is also based on the

results of observation and evaluation after learning. Evaluation in the learning process is done by researchers to see the suitability of the delivery of the contents of the guidelines with the design made. Evaluation of the results is done by researchers using the implementation of observations to see the level of achievement of respondents from the results of interviews and observations before the implementation of the guidelines for preparing scientific reports. So it can be concluded overall that this guideline is very influential, because there is an increase in the value of respondents from before implementation and after implementation. Guidelines are called effective if the percentage of classical learning completeness reaches a good classification that is above 60% [10]. Table 6 shows the evaluation of the observations of the guidelines for preparing scientific paper reports on 105 XI grade students majoring in Industrial Electronics Engineering at SMK 1 Katapang.

TABLE VI. EVALUATION OF THE IMPLEMENTATION RESULTS OF THE GUIDELINES.

Completeness	Before Implementation		After Implementation		Criteria
	F	%	F	%	
<b>Complete learning participants</b>	36	34.3	105	100	Effective
<b>Participants whose learning is not yet complete</b>	69	65.7	0	0	

*B. Discussion*

Based on the results of development research that has been described, the design of guidelines conducted using the TIER (Training intervention Effectiveness Research) model through the following stages, namely formative research, process research, research outcome) and impact assessment (impact assessment). Then resulted in the implementation of guidelines for the preparation of scientific paper reports which are declared to meet valid, practical and effective quality.

The guideline that was designed was declared valid because it met the minimum classification well. The average score given for expert judgment on the guidelines is 4.25 with a very good classification. The average score given for the assessment of the feasibility of the contents, the feasibility of the presentation, aspects of the feasibility of the language, aspects of the contextual assessment, and the form of guidelines with the score. The guideline is declared practical because it meets the minimum classification well with the average score given through the results of the user questionnaire being 4.1 with a good classification. The guideline was categorized as effective shown by the acquisition of the percentage of mastery learning of all learning participants by 100%, showing significant progress, namely from 36 students to 105 students or 34.3% to 100% of the study sample.

#### IV. CONCLUSIONS

Based on the findings of the study it can be concluded that the design and implementation of guidelines for scientific paper reports are considered valid, practical, and effective. This is evidenced from the results achieved, as follows.

- The results of the assessment carried out by expert experts, that the designed guidelines were declared valid with a score of 4.25 validation guidelines in the classification of very good.
- The results of data analysis from the student response questionnaire, the guidelines declared practical with the results of the user's questionnaire on the learning guidelines material with a score of 4.1 in good classification.
- The results of the implementation of the guidelines carried out after project-based learning, guidelines for preparing scientific paper reports for students that are designed are categorized as effective with the percentage of student's completeness learning that is 100% in very good classification.

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