



Module Development Based on Project Based Learning on the Material Types of Heavy Equipment

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Abstrak

This study concentrates on crafting a module geared towards project-based learning (PBL) centered on heavy equipment material types. Given the increasing demand for adept heavy equipment operators, it is crucial to employ effective educational strategies to impart pertinent knowledge to learners. Commencing with an exhaustive literature review encompassing PBL, heavy equipment operations, and commonly utilized materials in heavy equipment manufacturing, the research proposes a systematic methodology for module development. This approach incorporates pivotal PBL principles like practical problem-solving, collaboration, and inquiry-based learning. The module's design seamlessly blends theoretical underpinnings with hands-on applications, thereby furnishing learners with practical experiences and opportunities for honing critical thinking and skills. Evaluation of the module's effectiveness is conducted through both qualitative and quantitative means, encompassing pre and post-assessments, student feedback, and performance evaluations. The outcomes underscore the module's efficacy in augmenting learners' comprehension of heavy equipment material types and their application in real-world scenarios. This research contributes to the enhancement of educational methodologies in heavy equipment operations by furnishing a structured framework for deploying PBL modules tailored to specific learning objectives.

Key Words: *Project-based learning (PBL), heavy equipment material types, educational strategies, literature review, module development, practical problem-solving, collaboration*

INTRODUCTION

In essence, education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual potential, self-control, personality, intelligence, noble character, and the skills needed.

Government Regulation No. 19 of 2005 concerning National Education Standards "SMK is education at the secondary level that prioritizes the development of students' abilities for certain types of work". SMK is one of the institutions that produces graduates who are competent both effectively, cognitively, and psychomotorically. SMK graduates are expected to be a breakthrough in helping the government reduce the number of educated unemployment. SMK graduates in Indonesia are still seen as less competent by the business/industrial world. In this case, the industrial world requires middle-aged experts, in this case SMK graduates. Peri this is a challenge for the government to reduce educated unemployment, especially SMK graduates, so that later SMK graduates are absorbed in the industrial world according to their respective expertise.

The organization of education, learning activities become a fundamental element that leads to the achievement of certain educational goals and has organizational guidelines contained in the curriculum. In the 2013 curriculum, the government has prepared various subjects as a means of revamping attitudes, knowledge, and skills in realizing quality students, one of which is the subject of Basic Building Construction and Land Measurement Techniques. The subject of Basic Building Construction and Land Measurement Techniques which contains one of the learning materials about Types of Heavy Equipment is one of the subjects applied at SMK Negeri 1 Mandrehe Barat.

The educational process always assists students in developing their potential to know more and continue learning in the broadest possible sense. Belief in individual potential puts special emphasis on the importance

(emergence) of critical consciousness in education, as a driver of cultural emancipation so that individuals can understand their objective reality correctly.

According to Al Wartul Wutstaqa (2022) Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and state.

According to Ubabuddin (2019) Learning is the process of interacting students with educators and learning resources in a learning environment. Learning is assistance provided by educators so that the process of acquiring knowledge and knowledge, mastering skills and habits, and forming attitudes and beliefs in students can occur. So it can be said that learning is a process to help students to learn well. According to Endang Nuryasana et al (2020) teaching materials are materials or subject matter that are arranged systematically, which are used by teachers and students in the learning process.

Teaching materials can be interpreted as learning materials consisting of knowledge, attitudes and skills developed based on Core Competencies and Basic Competencies in content standards that must be studied. Teaching materials are also one of the tools in learning used by educators to support their learning so that students easily capture the material that educators explain.

According to Elfita Rahmi et al (2021) Modules are learning materials that are systematically designed based on a specific curriculum and are packaged in the form of the smallest learning units and allow independent study in a certain unit of time.

Purwanto et al (2017) Module is a printed teaching material whose contents are about a summary of the materi summary which is explained in simple language so that it is easily understood by students. Modules can also be called one of the learning tools needed in the learning process made by educators by adjusting the materials and basic competencies. Modules are used to make it

easier for students to understand the material presented, independently or through the guidance of educators with interesting module material content. Educators see that students must go through abilities and intellectual processes with a variety of experiences. In order to make the module more interesting, therefore researchers innovate to develop modules based on approaches, methods or methods, but the author will discuss model-based modules.

According to Suprijono in the journal Wahyu Bagja et al, the learning model is a pattern or design used to sequence the curriculum, organize the material used by educators as a reference or guideline when implementing the learning process. Nowadays, many learning models have been introduced, including the Project-Based Learning Model.

Based on the explanation from above, it can be concluded that education is a process of learning knowledge, skills, and habits of a group of people that are passed from one generation to the next through teaching, training, and research and also as a conscious effort carried out systematically in realizing a teaching and learning atmosphere so that students can develop their potential. With education, a person can have intelligence, noble character, personality, spiritual strength, and skills that are beneficial for themselves and society.

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So the Project Based Learning model is a student-centered learning model that departs from a problem background, which is then continued with an investigation so that

students gain new experiences from real activities in the learning process and can produce a project to achieve aspective, cognitive, and psychomotor competencies. The end result of the project work is a product which includes a written or oral report, presentation or recommendation.

In reality, currently the learning of students at SMK Negeri 1 Mandrehe Barat has not related many problems in real life. So the task of educators is to solve these problems by using teaching materials in the form of modules. The teaching material in question is expected to solve the problems that occur in the learning process which has not linked it to real life, if the educator uses real examples in everyday life, students will easily understand the lesson, therefore it will make students' learning outcomes increase. In the learning process at SMK Negeri 1 Mandrehe Barat in the subjects of basic building construction and land measurement techniques, one of the materials is the types of heavy equipment. Heavy equipment is an important factor in large-scale construction projects. From this material, it is hoped that students can understand the various types of heavy equipment used in various forms of building construction work.

But in reality at this time students prioritize large grades rather than paying attention to the learning process when in the classroom, therefore as educators we must have a way for students to be interested in learning and be able to pay attention to every gesture and word of educators, for example educators must develop teaching materials that already exist in schools, for example such as modules.

By using modules based on project-based learning, teaching and learning activities are more effective and efficient because the modules already contain student learning materials that are arranged systematically according to the basic competencies they must achieve. It is hoped that with the module, students can easily understand the material being studied and are more motivated by teaching and learning activities and also

students can find learning concepts through solving everyday problems. Therefore, the module contains material that is structured, concise, concise and clear.

Based on the results of interviews that have been conducted at SMK Negeri 1 Mandrehe Barat, there are still problems in teaching and learning activities. The problem consists of the students' low understanding of the material, the limited availability of teaching material books, students' interest in re-learning the material is lacking because there is no teaching material such as modules that are material to be re-learned, the teaching method is still a lecture method still centered on the teacher so that students during the learning process only tend to listen to what the teacher says and have an impact on the achievement of student learning outcomes that do not meet the applicable KKM.

LITERATURE REVIEW

Vocational Education

Vocational education in Indonesia is juridically regulated in the National Education System Law (Sisdiknas) No. 20/2003 Article 15, which states that vocational education is a secondary education that prepares students primarily to work in a particular field. Domestic experts also participate in defining vocational education.

Wenrich and Galloway (Rasto, 2012: 2) suggest that the terms vocational education, technical education, and occupational education are used interchangeably. These terms may have different connotations for readers, but they all refer to education for work.

Based on the definitions of some of these experts, it can be concluded that vocational education is an education system that focuses on developing certain skills and expertise of its students so that they can work properly and professionally.

Definition of Learning Process

According to Andi Setiawan (2017) The learning process is a process of change in

learning outcomes that cover all aspects of life to achieve a certain goal.

According to Sujarwo et al (2018) The learning process is a process in which there are activities of teacher-student interaction and mutual communication that take place in educational situations to achieve learning goals.

From the above explanation, it can be concluded that the learning process is all joint efforts between teachers and students to share and process information, with the hope that the knowledge provided is useful in students and becomes the basis for continuous learning, and it is hoped that there will be better changes to achieve a positive improvement characterized by changes in individual behavior in order to create an effective and efficient teaching and learning process.

Definition of Learning Resources

According to Sujarwo et al (2018) Learning resources are any sources that can be utilized for learning activities. Learning can occur anywhere, anytime, to anyone, without being limited to place and time. Learning resources are all forms of sources in the form of data, images, people, the environment, or certain forms used by students either in separate or combined forms to make it easier for students to achieve learning objectives and competencies to be achieved.

According to Muhammad (2018) learning resources is a term that describes everything in student learning activities or in learning and learning activities in educational, training, industrial, and other non-formal settings.

According to Ani Cahyadi (2019) Learning resources are all sources in the form of data, people and certain forms that can be used by students in learning, either separately or in combination so that it makes it easier for students to achieve learning objectives or achieve certain competencies.

Based on some of the views described above, it can be concluded that learning resources are everything (in the form of objects, data, facts, places, environments, ideas and / or people) that contain information to cause the learning process and can be used

to facilitate learning activities. Thus, learning resources are one of the important parts in a learning implementation.

Types of Learning Resources

According to Sujarwo at al (2018), the forms of electronic learning resources consist of text, images, video, audio, and other forms. In general, the types of learning resources can be divided into 2, namely:

a. Learning resources by design such as: books, brochures, enclopedia, films, videos, tapes, slides strips, and OHP. These learning resources are specifically designed for specific learning purposes. For example, a book about animals, of course, the book is deliberately made for the purpose of introducing animal names and other things related to animals.

b. Learning resources by utilization. A person can take advantage of sources that are already available and are around him to learn. For example, markets, shops, museums, public figures, plants, and others. The market is a meeting place between sellers and buyers. However, one can unintentionally learn from life in the market. Learn about how someone makes transactions, bargains, displays merchandise, and more.

According to Muhammad (2018) learning resources can be divided into two types, namely

a. Planned learning resources, namely all learning resources that are specifically developed as instructional components to provide directed and formal learning facilities.

b. Learning resources that are utilized are learning resources that are not specifically designed for learning purposes, but can be utilized, and used for learning purposes.

Learning Source Function

According to Sujarwo at al (2018) The benefits of learning resources are numerous and varied. The existence of learning resources is definitely inseparable from benefits. Of the various types of learning resources that exist, of course they have

benefits. Some of the benefits of learning resources include:

a. Provide learning experiences directly to students so that understanding can run quickly.

b. Can present something that is impossible to visit, or see directly. For example: Borobudur Temple, Volcano.

c. Can add and expand the knowledge of the presentation in the classroom. For example: textbooks, photographs, movies magazines and others.

d. Can provide accurate information. For example, encyclopedia reading books, magazines.

e. Can help solve educational problems both in micro and macro scopes. For example, on a macro level: distance learning system through modules, on a micro level: attractive spatial arrangements (environment), simulations, use of films and OHPs.

f. Can provide positive motivation, if arranged and planned for proper utilization.

g. Can spur to think, behave and develop further. For example textbooks, reading books, films and others, which contain reasoning power so that they can spur students to think, analyze and develop further.

According to Kemp and Smile in Muhammad (2018) the function of learning resources is to.

a. Increase learning productivity

b. Provide the possibility of more individualized learning

c. Gives a more scientific way to learning

Definition of Module

According to Asyar in Cecep Kustandi (2020) that in learning there are many known print-based media used in learning such as books, magazines, brochures, leaflets, and modules. Modules are one of the print-based teaching materials designed for independent learning by learning participants. According to Prawiradilaga in Cecep Kustandi (2020) says that "a module is a learning process about a certain unit of material that is arranged systematically, operationally and directed to

be used by students, accompanied by user guidelines for teachers".

According to Sukiman (2019) that Module is a complete measuring instrument. The module is a unit of program that can measure objectives, the module can be seen as a program package arranged in the form of certain units for learning purposes. According to Cecep Kustandi et al (2020), a module is a learning tool or tool that contains material, methods, boundaries and ways to evaluate which are systematically designed and attractive to achieve the expected competencies according to the level of complexity.

Based on some descriptions of the opinions of the experts above, it can be concluded that the module is one of the learning print media that is planned and designed in the form of printed material to assist students in achieving the objectives / competencies in each subject. Module is one form of teaching material that is packaged as a whole and systematically. In the module there is a set of learning experiences that are planned and designed to help students master specific learning objectives.

Module Functions

There are several functions of modules in the implementation of programs in improving the quality of applied activities. Cecep Kustandi et al (2020), namely

a. Overcoming the weaknesses of conventional learning

Conventional learning emphasizes more on teacher activities, where a teacher acts as the main source of information, while the activities of students are more listening and recording what the teacher says. Through this module, students are expected to try to find and explore information themselves more actively and optimize all their abilities and learning potential.

b. Increase learning motivation

Through modules, students' learning motivation is expected to increase, because the learning system can be adjusted to their respective learning opportunities and speed.

c. Increase teacher creativity in preparing individualized learning

Through the use of modules, a teacher is required to be more creative in preparing individualized learning plans.

d. Realizing the principle of sustainable progress

Through the use of modules, students who have mastered the material in the first learning activity can individually continue the next activity.

e. Increase learning concentration

Modules can realize learning with increased concentration. This learning concentration is very important so that students do not experience difficulties when they have to complete the tasks or exercises suggested in the module.

According to Cece Wijaya et al in Sukiman (2019) Through the module teaching system it is possible to have the following functions: an increase in learning motivation to the maximum, an increase in teacher creativity in preparing the necessary tools and materials and more stable individualized services, the ability to realize the principle of unlimited sustainable progress, and can realize more concentrated learning.

According to Purwanto et al (2017) The function of the module is as learning material used in student learning activities. With modules, students can learn more purposefully and systematically.

Purpose of Module Preparation

According to Rili Konita Zahara (2020) the module has several objectives, namely:

a. So that students can carry out learning activities independently without or guidance from educators (which is minimal).

b. Train the honesty of students.

c. So that students are able to measure their own level of mastery of the material they have learned.

d. Accommodate various levels and learning speeds of learners. For students whose learning speed is high, they can learn faster and complete the module faster too. And vice versa for those who are slow then they are welcome to repeat it again.

e. So that the role of educators is not too dominant and authoritarian in learning activities, it is the learners who are more dominant during the learning process.

Module Characteristics

According to Cecep Kustandi et al (2020) modules have five characteristics, namely:

a. Independent learning (self-instruction)
The module is structured in such a way that learners can understand it without or with minimal assistance from others.

b. Whole (self-contained)
What is meant by self-contained is that all learning material from one unit of competency or sub-competency studied is contained in one module as a whole.

c. Stand-alone
Stand-alone means that the module developed does not depend on other media or does not have to be used together with other media.

d. Adaptive
It is said to be adaptive if the media can adjust the development of science and technology in development within a certain period of time and is flexible to use.

e. Familiar with the user (user-friendly)
The modules used are easy to operate, the instructions conveyed are easy to understand and easy for readers to respond to. The language used is general, simple and easy for students to understand.

Steps of Module Preparation

According to Fahrurrozi et al. (2020) the steps for preparing or writing a module are ordered as follows

a. Determine the title of the module to be compiled

b. Prepare source books and other reference books.

c. Identifying the basic competencies, conducting a study of the learning material, and designing the appropriate form of learning activities.

d. Identify indicators of competency achievement and design the form and type of assessment that will be presented.

e. Designing the module writing format

f. Drafting the module

Principles of Module Preparation

According to Cecep Kustandi et al (2020) the module has six principles, namely:

a. Oriented on goals / competencies
Learners are required to achieve goals / competencies in learning activities completely.

b. Independent learning
Learners are required to learn independently without optimal assistance from teachers or facilitators.

c. Continuous advancement
The principle of sustainable progress in this module directs learners who have above-average abilities to complete the material faster, which has implications for the speed of study completion.

d. Whole and complete arrangement of material

The module must contain material that is presented as a whole (not cut into pieces) and presents all the learning substance needed by students.

e. Cross-referencing between the contents of learning subjects.

In the module, learning materials need to appear that can be used as references between learning activities. In addition, students are required to be able to find materials/sources that are relevant to the material studied in each learning activity.

f. Self-study assessment

To determine the extent of understanding of each learning activity, students must conduct an independent assessment through the test work provided in the module.

Module Development Methods

Modules can be developed in various ways, among others:

a. Adaptation

Module adaptation is learning material developed on the basis of books on the market.

b. Compilation

Compilation modules are learning materials developed on the basis of books on the market, scientific journal articles and pre-existing modules.

c. Writing

Writing is the most ideal way of module development. For teachers, lecturers or widiaiswara, writing their own modules used in learning is to prove themselves as professionals.

From the description above, it can be concluded that module development is a process of designing teaching materials that are systematically arranged in a printed media format to achieve specific learning objectives. One of the written teaching materials developed is a module. Modules were chosen because they allow students to learn independently and provide immediate feedback from students. by developing modules can overcome the limitations of teaching materials in accordance with curriculum demands, target characteristics and demands for learning problem solvers. In developing modules we must analyze the needs of teaching materials, choose learning resources, compile a map of teaching materials.

METHOD

Research and Development Method

The type of research used is development research (Research and Development). Development research is an activity in the scientific corridor that is adjusted to the academic or scientific field which includes the process. In principle, development researchers are carried out to make a product easier and cheaper (effective and efficient) based on the level of usefulness or benefits of the product, which means that the value of the product benefits is equivalent to the costs incurred for development or much cheaper.

The types of data used in this research are qualitative and quantitative. Qualitative data was obtained from criticisms and suggestions from validators and trial correspondents. Quantitative data was obtained from validation data from validators and from trial data.

This development research refers to the 4-D teaching material development model, consisting of four stages, namely, the definition stage (define), the design stage (design), the development stage (develop) and dissemination (Disseminate).

The 4-D development model is used by researchers because it produces teaching material products in the form of modules. The developed product is then tested for feasibility by validation and product testing to determine the learning motivation of students after learning.

This development model has focused on the development of teaching materials developed by researchers. In this study, up to the limited distribution stage. This is because the time taken by researchers in developing is very limited.

Development Procedure

The development procedure used in this study is in accordance with the 4-D development model. According to Nusa Putra (2020), the 4-D model procedure is as follows:

a. Defining stage (define)

This defining stage aims to determine and define the needs in the learning process and collect various information related to the product to be developed. This stage is divided into several steps

1. Initial - final analysis

At this stage, the researcher conducts research at SMK Negeri 1 Mandrehe by collecting information that occurs in the field in the form of problems that are being experienced in the learning process, so that researchers can, develop the right product to overcome these problems, the information obtained by researchers in the field is the low understanding of students of the material, limited availability of teaching materials, students' interest in relearning the material is lacking, the teaching method is still a lecture

method still centered on the teacher. Based on these problems, it is necessary to develop a Module Based on Project Based Learning.

2.Learner analysis

At this stage the researcher analyzes the characteristics of students during the learning process.

3.Material analysis

This material analysis is the basis for preparing learning objectives. This material analysis is also useful in determining the parts of the material that will be learned in learning.

4.Task analysis

This task analysis is compiled based on the basic competencies and achievement indicators on the material.

5.planning stage.

The purpose of this stage is to produce a learning device design. The results at this design stage are called the initial draft (draft I). The activities at this stage are:

1.Media selection

At this stage is to choose learning media in accordance with the Project Bossed Learning Based Module on the Material Types of Heavy Equipment. The media used in this study are print media.

2.Format selection

At this stage the researcher chooses a format for designing content, selecting learning strategies, and learning resources that are in accordance with the principles, characteristics, and steps that are in accordance with the learning model used.

3.Initial design

The initial design is the Module design that has been made by the researcher and then given input by the supervisor. Input from the supervisor will be used to improve the module before production. Then make revisions after getting suggestions for improving the module from the supervisor and later this design will

be carried out in the validation stage. This design is in the form of draft I

a. Development stage

The aim of the development stage is to produce a final draft of a good learning tool. Activities at this stage are:

1. Expert validation

This expert validation functions to validate part of the material on the types of heavy equipment in the module before trials are carried out and the results of the validation will be used to revise the initial product. The results of the initial draft, namely draft I, were validated by the validator, and the revisions were used as a basis for improving the learning tools to obtain draft II.

2. Test the product

Trials were carried out on several selected students and colleagues to measure the practicality of students' learning through learning motivation. The results obtained from this stage are in the form of revised modules.

b. Deployment stage

After limited testing and the instrument has been revised, the next stage is the dissemination stage. The aim of this stage is to disseminate the module. In this research, only limited distribution was carried out, namely by disseminating and promoting the final module product on a limited basis.

RESULT

This research was conducted at SMK Negeri 1 Mandrehe Barat from 04 September to 05 October 2023. The aim of this research is to produce a product in the form of a Project Based Learning-based module. This module was created as a teaching material to support learning on the basics of building construction and land measurement techniques on types of heavy equipment. The availability of complete teaching materials is one of the important things in achieving learning goals.

In this research, researchers used a 4-D model, namely: Definition, Design, Development, Dissemination.

The following is an explanation of each stage in detail:

1. Definition (define)

In this stage, the researcher carries out the definition stage or finds out what is needed, concepts, evaluation, learning specifications that will be applied later in the module by analyzing as follows:

a. Initial Final Analysis (Front-End Analysis)

At this stage the aim is to collect information that occurs in the field in the form of problems that are being experienced in the learning process. The analysis was carried out in research stages through the results of observations at school by observing the learning process of class X students at SMK Negeri 1 Mandrehe Barat. Based on the results of observations, students' low understanding of the material, limited availability of teaching material books, students' interest in re-studying the material is lacking because there are no teaching materials such as modules that can be used as material for re-study, the teaching method is still a lecture method which is still teacher-centered so that students during the learning process they only tend to listen to what the teacher says and this has an impact on the achievement of student learning outcomes that do not meet the KKM. So the researchers developed materials in the form of modules based on project based learning on materials on types of heavy equipment

b. Learner Analysis

Researchers conducted an analysis of students on the psychomotor aspect, it was found that students had different levels of understanding, different age levels ranging from 15 to 16 years, from these differences' students had different characteristics. From the cognitive aspect of vocational school children, this includes increasing intellectual function and conceptual thinking. In this phase, students experience an increase in their ability to express themselves, their ability to solve problems will increase.

Through project-based learning, it is possible to train students to learn independently, train students' reasoning abilities, and actively involve students in learning activities to

discover concepts and principles based on the students' experiences.

c. Material Analysis

At this stage, the activity carried out was that the researcher conducted interviews with subject teachers to identify the main concepts being taught, as well as looking in detail at the concepts that had to be taught. In this stage, the main parts have been designed and arranged sequentially and in accordance with the Core Competencies (KI) and Basic Competencies (KD).

d. Task Analysis

At this stage the aim is to analyze what the students' main tasks are to be done according to the module material being taught.

2. Design Stage (Design)

The systematic design of module writing has three main parts, namely the opening section, the module contents section and the closing section. The preparation of the module framework is as follows:

a. Opening Part

This section consists of the front cover of the module, cover, foreword, and table of contents.

b. Module content section

This section is filled with material on Types of Heavy Equipment. This module contains learning material, practice questions on student learning activities.

c. Closing part

This section consists of a bibliography, researcher biodata, summary and back cover of the module.

3. Development Stage (Development)

At this stage the researcher has developed a product in the form of a learning module based on project-based learning. The module is developed in accordance with the steps for compiling the module. At this stage the researcher has developed a teaching material product in the form of a module. After the design results were realized in real form, the researcher revised the product to validators, material experts, language experts and media experts. The purpose of product revision is to find out weaknesses and suggestions from validators for the module that has been developed. After identifying the weaknesses

and suggestions from the validator, improvements are then made to improve the product being developed. Then the product that has been declared suitable for use is tested in individual trial classes and small group trials to see the practicality of the module that has been created.

Module Eligibility

a. Materials Expert

The results of the assessment of the feasibility of project-based learning-based modules by material experts in the first revision obtained 80% "Suitable for use with the Revision". In the second revision, it obtained 100% "Suitable for use without revision".

From the results of the material expert validator revision above, it shows an increase in percentage from the first revision to the last revision. Thus, the project-based learning module from the content feasibility aspect to the presentation feasibility aspect is very suitable for use.

b. Subject teachers

The results of the assessment of the feasibility of project-based learning-based modules by subject teachers in the first revision obtained a percentage of 94% in the category "Suitable for use without revision".

c. Linguist

The results of the assessment of the feasibility of project-based learning based modules by linguists in the first revision for the language feasibility aspect obtained a percentage of 80% in the category "Suitable for use with Revision". In the second revision, the appropriateness aspect of the language obtained a percentage of 100% in the category "Suitable for use without revision".

From the results of the linguist validator revision above, it shows an increase in the percentage from the first revision and the last revision. Thus, the project-based learning-based module from the aspect of language suitability is very suitable for use.

d. Media Expert

The results of the feasibility assessment of project-based learning-based

modules by design experts in the first revision obtained a percentage of 60% in the category "Suitable for use with Revision". In the second revision, it obtained a percentage of 100% in the category "Suitable for use without revision".

From the results of the design expert validator revision above, it shows an increase in percentage from the first revision and the last revision. Thus, the project-based learning module is very suitable for use in the learning process at West Mandrehe 1 Vocational School in class X DPIB in the Basics of Building Construction and Land Surveying Techniques.

Module Practicality

a. Individual Trial

Student responses in individual trials were carried out at the West Mandrehe 1 Vocational School, in class X DPIB by taking a sample of 3 students. Student responses covering aspects of interest, material and language obtained a score of 62 out of a maximum score of 69 with a percentage level of 90% with the criteria "Very Practical", showing that project based learning based modules can be used in learning.

b. Small Group Trials

Student responses in individual trials were carried out at the West Mandrehe 1 Vocational School, in class X DPIB by taking a sample of 5 students. Student responses covering the aspects of interest, material and language obtained a score of 105 out of a maximum score of 115 with a percentage level of 91% with the criteria "Very Practical", showing that project-based learning based modules can be used in learning.

c. Field Trials

Students' responses to individual trials were carried out at the West Mandrehe 1 Vocational School. in class X DPIB by taking a sample of 10 students. Student responses covering aspects of interest, material and language obtained a score of 227 out of a maximum score of 230 with a percentage level of 99% with the criteria "Very

Practical", showing that project-based learning-based modules can be used in learning.

Based on the three trials mentioned above, it shows that there is an increase in results in each practicality test. Based on the assessment that the percentage of 80% -100% category is very practical. So the achievement at the field trial stage with a percentage level of 99% criteria is very practical to be used in the learning process at SMK Negeri 1 Mandrehe Barat in class X DPIB in the Basics of Building Construction and Land Surveying Techniques subjects.

Module Effectiveness

Based on test analysis, student learning outcomes show that 10 students have completed their learning scores on the types of heavy equipment. The 9 students were declared complete, while the 1 student received a score below the KKM and was declared incomplete. From the results of this assessment, the percentage of student learning completeness was 90%. So from these results, the project based learning based module was declared "Very Effective"

CONCLUSIONS

Based on the results of the presentation and analysis of data from module development research that has been carried out by researchers regarding Module Development based on project-based learning in the Basics of Building Construction and Land Measurement Techniques for class West Mandrehe as follows:

1. The learning module based on project-based learning was obtained by material experts at 100% in the very feasible category, by teachers in the field of study it was obtained at 94% in the very feasible category, by language experts it was obtained at 100% in the very feasible category, by design experts it was obtained at 100% in the category very worthy.

2. Project based learning module on types of heavy equipment for class

3. Project based learning modules on types of heavy equipment have achieved very effective criteria with a classical completion percentage of 90%.

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