

Development of learning module to improve competency achievement in the department of civil engineering education in Indonesia

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Abstract: The purpose of this study was to determine the process of preparation and feasibility of the Building Maintenance learning module as a teaching material for class XI in the Department of Civil Engineering in vocational high schools. This research is a research and development (R&D) study using the Four D model. Data collection tool in the form of a Likert scale questionnaire model of four choices. The Building Maintenance learning module is validated by one material expert and one media expert and the Building Maintenance subject teacher. The module contains the title, introduction, learning, evaluation questions, end of semester tests, answer keys, and bibliography. The results of the feasibility of the media by material experts obtained an average value of 90.0% so that it is included in the category of “very feasible”, the average total score of the results of eligibility by media experts obtained a value of 74.194% so that it is included in the category of “feasible”, as well as the average total score from the results of the feasibility of the media by subject teachers earned a value of 88.46% so that it is included in the “very feasible” category. Then it can be concluded that the Building Maintenance module is in the category of very feasible to be used as teaching material.

Keywords: learning module, building maintenance, civil engineering, vocational high school

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INTRODUCTION

Education is a conscious and planned effort to create an atmosphere and learning process so students actively develop their potential to have spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and state. In an effort to produce quality human resources and ready to work, it is necessary to improve the quality of education to prepare students who have certain skills to enter the workforce and compete globally with their competitors (Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional, 2003). The challenge of 21st-century education today is to prepare human resources to have the ability to communicate and the mastery of science and technology through the learning process. The 21st-century competency skills include critical thinking and problem-solving skills, communication skills, creativity and innovation, and collaboration. The four skills or abilities of students are fostered and developed in each subject. To respond to global challenges, Indonesian people need to have high-level thinking skills, which can be realized by vocational education (Joo, 2018). One of the government's efforts in developing quality resources, one of which is through quality vocational education learning (Prayitno & Jaedun, 2018). Vocational education aims to prepare graduates to work in certain fields in accordance with the demands of the business and industrial world (Triyono et al., 2018) and technological development (Manap et al., 2017). Vocational High School is a form of formal education unit that can produce students in accordance with the demands and technological developments of the business and industrial world (Daryono et al., 2020).

Vocational education must be adjusted to industry needs (Soenarto et al., 2017). The problem is that industry is much lower than the number of annual vocational graduates. Based on these data it can be concluded that the purpose of vocational education that prepares students to be ready to work after graduation is interpreted as not optimal. In addition, there is a mismatch between vocational education competencies and those needed by the world of work, so to be able to align these competencies with the industry needs to involve the industry in implementing learning programs (Fakhri & Munadi, 2019). Learning in vocational high schools should emphasize the psychomotor aspects of students because by strengthening these aspects students will get real experiences with what they understand. Psychomotor aspects will be able to bring students to increase their life skills. Vocational high school is education at a level that prioritizes the development of student skills to carry out certain types of work. Vocational high schools also prioritize student preparation and form professional attitudes to enter the workforce (Pamungkas et al., 2020). The existing expertise program at the vocational high school level must adjust to the demands of the workforce because the competencies that must be mastered by graduates will later be used to prepare for fulfillment in the world of work (Husain et al., 2014).

Improving the quality of vocational secondary education can be through various strategies, one of which is through the application of competency-based education and training approaches. The competency-based approach is used as a reference in development of vocational education curriculum, development of teaching materials, implementation of learning and development of assessment procedures (Departemen Pendidikan Nasional Republik Indonesia, 2008). One way to improve the quality of education is through the development of existing teaching materials so that they are practical to use (Pamungkas et al., 2020). Teaching materials are learning tools or tools that contain teaching materials, frameworks of material coverage, methods, boundaries by evaluating which are completed systematically and attractively to achieve the expected goals of achieving competencies or sub-competencies (Muslim et al., 2018). Printed teaching materials that are often found include books, modules, and student worksheets.

Modules are one form of teaching material that is packaged in a whole and systematic manner, which contains a set of learning experiences that are planned and designed to help students master specific learning goals. Modules are teaching materials that are written with the aim that students can learn independently without or with the guidance of the teacher (Susanti et al., 2018). So it can be concluded that the module is a systematically packaged teaching material designed to help students learn with or without teacher guidance to master learning objectives (Lestari, 2013). Modules must contain instructions for learning, competencies to be achieved, supporting information, practice questions, work instructions, evaluations, and feedback on evaluation results (Sukoco et al., 2014; Suyitno, 2016)

The Building Maintenance course is one of the compulsory courses for students in vocational secondary education majoring in civil engineering. Vocational secondary education has used the 2013 curriculum which prioritizes the orientation of the learning process (Putri & Prodjosantoso, 2020). The teaching and learning process that is still ongoing in schools, educators still use conventional methods, namely lectures and are still the main learning source because there are no other learning sources that are relevant and in accordance with the expected competencies. This causes students to rely on the role of educators so that there is almost no motivation for independent learning due to the lack of other learning resources in the form of media that can help in the learning process of students (Sarwinda et al., 2020). The problems faced in the learning process of Building Maintenance subjects that have used the 2018 revised curriculum are the absence of printed learning resources that can support classroom learning and independent learning. These problems can be observed during the learning process both in the classroom, outside the classroom, and when observations have been made. During the observation activity, it was found that students only learned when given independent assignments, and students had difficulty finding answers to the assignments given. Students are also confused because many materials obtained from online media or other media are not in accordance with the rules and competencies that must be achieved.

Based on a review of the problems experienced during teaching and learning activities, the module can be used as a learning medium for students who can help students understand the subject matter and meet the competencies that must be achieved by students. The developed module contains theory, steps, assignments, evaluation of learning so that students can learn and can evaluate the learning outcomes that are being carried out. The existence of a module as a learning medium for building

maintenance subjects can be combined with learning in schools, which is expected to facilitate the process of understanding students' learning materials, increasing learning achievement, and motivating students to learn independently.

METHOD

This research is a research and development (R&D) research. According to Sugiyono (2019) the research development method is a research method used to produce certain products and test the effectiveness of these products. R&D research in education aims to produce new products through the stages of development. Research products in this field can be in the form of media, books, evaluation tools and learning tools; curriculum, school policy and others. The model used in this study is the Four D (4-D) development model. According to Thiagarajan et al. (1974) the development model consists of 4 stages: (1) define; (2) design; (3) develop; (4) disseminate. At the stage of define is done to set and define the conditions of media development. In general, activities at this stage include identifying potential and problems, gathering information, curriculum analysis, formulating learning objectives, analysis of student characteristics, analysis of material. At the design stage, researchers have made a prototype or product design. In the development activities carried out an evaluation by experts in their fields. The suggestions given are used to improve the material, media, and learning design that has been prepared. The dissemination stage is carried out to promote products that have been developed to be accepted by users or students. Instrument validation and data collection by material and media experts from the Civil Engineering and Planning Education Program, Yogyakarta State University and the Building Maintenance subject at SMK Negeri 2 Yogyakarta. Tests conducted by media experts are to determine the appropriateness of the media in the Building Maintenance subjects learning module and to determine whether the material in the learning media is in accordance with the basic competencies used in civil engineering in vocational schools.

Techniques or methods used for data collection in the development of building maintenance learning modules are observation, a document study, questionnaire. Observations were made to observe and explore the needs of instructional media in vocational high schools, particularly in the civil engineering department, questionnaires in research and development are used to measure how feasibility the learning modules are developed. The questionnaire in this study consisted of material and media aspects given to material experts, media experts, and subject teachers to evaluate the teaching material modules that had been developed (Fathia et al., 2018; Majid & Ridwan, 2019). The measuring instrument used in this study was a questionnaire with a measurement scale used was a Likert scale with 4 alternative answers. According to Sudaryono (2013), the Likert Scale is used to measure the attitudes, opinions, and perceptions of a person or group about social events or symptoms. Alternative answers are presented in Table 1 and the categorization of the results of data analysis is presented in Table 2.

Table 1. Instrument Item Score Rules

Rating	Information	Score
A	Agree	4
QA	Quite Agree	3
NA	Not Agree	2
D	Disagree	1

Table 2. Data Processing Results Category

No.	Value Interval	Category	Score
1.	3.25 - 4.00	Very Feasible	4
2.	2.50 - 3.25	Worthy	3
3.	1.75 - 2.50	Feasible Enough	2
4.	1.00 - 1.75	Not Feasible	1

RESULTS AND DISCUSSIONS

The research and development of this product has a purpose in between to find out the feasibility of problem-based learning modules. The stages of development in this study used a model from (Sugiyono, 2019). The research procedure used is a research and development procedure developed by (Thiagarajan et al., 1974) using 4D model. The activities at the define stage aim to set

and define development requirements. At the define stage, researchers conducted a study of documents and interviews with teachers in the Building Maintenance subject at SMK Negeri 2 Yogyakarta. The document study was conducted by reviewing the subject matter of class XI Building Maintenance in the Department of Civil Engineering in the last semester.

The activities defined in the module development include: (1) identifying potentials and problems; (2) gathering information; (3) analysis of module requirements which includes curriculum analysis of the 2013 revised 2017 building maintenance subjects, establishing basic competencies according to the syllabus, adjusting to the learning implementation plan (RPP), drafting the learning module draft, setting module titles, determining learning objectives, gathering reference material; (4) needs analysis of building maintenance subjects modules that compile the module outline.

The second stage is designing the results of the analysis carried out from the define stage. Based on the data obtained from the define phase, data obtained that the media developed were media learning modules that can help students improve motivation and assist in understanding both theory and practice in Building Maintenance subjects. The process of developing a problem-based Building Maintenance module for researchers in this development includes: (a) media selection; (b) format selection; (c) initial design. The choice of format is adjusted to the selection of strategies and learning methods used in learning. The teacher will use the presentation media to explain the learning material, therefore the development of the media used is a printed media module that students can use to help the learning process independently. Table 2 explains the selection of formats for media that have been developed.

Table 3. Format Selection

No.	Indicator	Sub Indicator	Information
1.	Module size	Size	The module in this study uses A4 size (210X297 mm) in accordance with ISO standards. Module size is considered in the selection of module formats because the material presented is quite large and there are pictures that must be presented with large dimensions to facilitate students' understanding of the material presented.
2.	Module cover design	Cover module layout	The composition presented on the cover contains illustrated material, module titles, education unit classes, skills programs, semesters, and module makers. The layout arrangement is done so as to give a good and attractive impression to students.
		Cover module typography	The cover module is presented using a good combination of color, font size, and writing.
		Module skin illustration	On the cover presented illustrations of images that are expected to make students have a picture of the material presented.
3.	Module content design	Layout of module contents	The material presented is made in a uniform format so that the display contents of the module will be consistent. Things that will be included in the format of the module contents include chapter titles, chapter subtitles, page numbers, image captions, chapter titles in the header of each page, subjects in the footer of each page, spaces, and margins.
		Module content typography	Module content typography contains the display of letters and sentences in the module, so that the display contents of the module are consistent and comfortable to read
		Illustration of module contents	Illustration of module content in the form of pictures and tables is expected to increase students' understanding of the material presented.

Material assessment data in building maintenance modules were obtained from material experts who provided advice and opinions. Material expert validation was carried out by Civil Engineering and Planning Education Lecturer. The assessment is done by filling out the validation sheet which is assessed from 7 aspects namely self-instruction, self-contained, stand alone, adaptive, user friendly, truth of teaching material and benefits. The following are the results of the material expert judgment data.

The feasibility of the Building Maintenance subjects module is reviewed from material experts using the Likert scale 1-4. The aspects that become indicators in assessing the feasibility of the material include 7 aspects, namely self-instruction, self-contained, stand alone, adaptive, user friendly,

correctness of teaching material and benefits. Table 3 explains of data analysis on the results of the feasibility the material expert.

Table 4. Convert Analysis of Data on Expertise Results

Validation Test	Number Questions	Total score	Maximum Score	Minimum Score	The mean	Conversion (%)
Material Expert	35	126	35 x 4 = 140	35 x 1 = 35	3.60	90.0

The results of the assessment of the level of eligibility in the XI learning module of the Civil Engineering Department Maintenance Building for Vocational High Schools that have been validated by material experts are shown in Table 5 obtained an average score of 3.60 with a percentage of 90.00%. Assessment is based on seven aspects of assessment, the Learning module for Building Maintenance subjects is "very feasible" to be used as a learning medium for Class XI students in Civil Engineering majors.

Table 5. Percentage of Material Expertise Eligibility Results

No.	Aspect	Total score	Max score	Percentage (%)
1.	Self-instruction	64	72	88.89
2.	Self-contained	8	8	100.0
3.	Stand alone	7	8	87.50
4.	Adaptive	4	4	100.0
5.	User friendly	14	16	87.50
6.	Teaching material	11	12	91.67
7.	The benefits	18	20	90.0
Average Score		3,6	4	90.00

Based on Figure 1 it can be explained that the bar chart is the result of the feasibility of the material expert with aspects self-instruction produce a percentage of 88.89%, aspects self-contained generate percentage at 100.0%, aspects stand-alone by 87.50%, aspects adaptive produce a percentage of 100.0%, aspects user friendly generate percentage by 87.50%, aspects teaching material amounted to 91.67% and aspects the benefits generate percentage by 90%. So, obtained an average total percentage of results from the worthiness of material experts by 90.00%. From the analysis of media feasibility data by material experts, it can be concluded that the testing of the media module for class XI Building Maintenance subjects from material experts in the "very feasible" criteria.

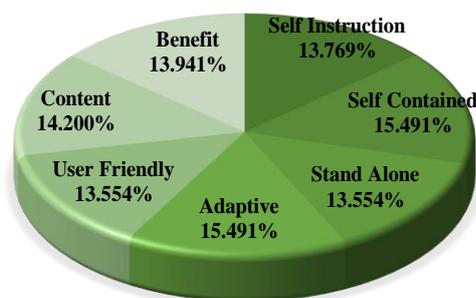


Figure 1. Pie Chart for Material Expert Feasibility Results

Data on the results of media assessments in the Building Maintenance subjects module were obtained from media experts who provided advice and opinions. The assessment is done by filling out the validation sheet which is assessed from 3 components namely module size, module cover design and module content design. The feasibility of the learning module Building Maintenance subjects is reviewed from media experts using the Likert scale 1-4. The aspects that become indicators in the assessment of material eligibility include 3 components, namely the module size, module cover design and module content design. Table 5 explains the conversion of data analysis on the results of the feasibility the material media.

Table 6. Conversion of Data Analysis on the Feasibility Result of Media Experts

Validation Test	Number Questions	Total score	Maximum Score	Minimum Score	The mean	Conversion (%)
Media Expert	31	92	31 x 4 = 124	31 x 1 = 31	2.97	74,194

Results the assessment in the module learning subjects in Building Maintenance class XI competence in the department of Civil Engineering that has been validated by media experts shown in Table 7 obtained an average score of 2.97 with a percentage of 74,194 ratings based on three components of the research instrument, the Building Maintenance subjects learning module "Feasible "is used as a learning medium for grade XI civil engineering education shown in Table 7.

Table 7. Percentage of Data Analysis on Feasibility Results of Media Experts

No.	Aspect	Total score	Max score	Percentage (%)
1.	Module Size	6	8	75,000
2.	Module Cover Design	26	36	72,222
3.	Module Content Design	60	80	75,000
Average Score		2.97	4	74,194

Based on Figure 2 it can be explained that the results bar chart the feasibility of the media expert with the first component of module size producing a percentage of 75,000%, the module design module of the book producing a percentage of 72.222%, the component design content of the module (cover) of 75,000%. so, obtained an average total percentage of results from the worthiness of material experts amounted to 74.194%. From the analysis of media feasibility data by media experts, it can be concluded that the testing of the media module for class XI Building Maintenance subjects from media experts is in the "feasible" criteria.

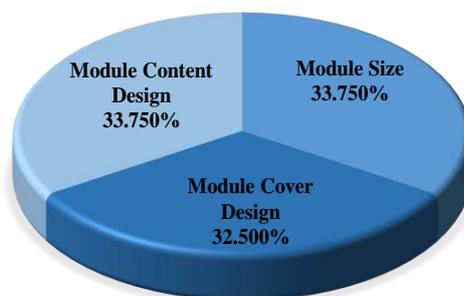


Figure 2. Pie Chart for Media Expert Feasibility Results

Data on the results of media assessments in the Building Maintenance subjects module were obtained from the Building Maintenance subject teachers who provided advice and opinions. The Validation of the Building Maintenance subject teachers from SMK Negeri 2 Yogyakarta. The assessment is done by filling out the validation sheet which is assessed from 3 aspects namely media, material and benefits aspects, the rating scale used is the Likert scale 1-4. The number of questions for validation consists of 26 items. Eligibility modules for Building Maintenance subjects reviewed from Building Maintenance teacher by using the Likert scale 1-4. Aspect which is an indicator in the assessment of material feasibility includes 3 aspects, aspects of media, material and benefits. Table 8 explains the conversion of data analysis on the results of the feasibility the subject teachers.

Table 8. Convert Analysis of Data on Feasibility Results for Teacher in Building Maintenance Subjects

Validation Test	Number Questions	Total score	Maximum Score	Minimum Score	The mean	Conversion (%)
Building Maintenance Subject Teacher	26	91	26 x 4 = 104	26 x 1 = 26	3.54	88.46

The results of the assessment of the feasibility of developing modules in the subject of Building Maintenance in the civil engineering department that has been validated by subject teachers are shown in Table 8 obtained an average score of 3.54 with a percentage of 88.46%. The assessment of the feasibility of media based on subject teachers is based on three aspects of assessment namely Media Aspects, Material Aspects, and Benefits Aspects shown in Table 9.

Table 9. Percentage of Teacher Feasibility in Building Maintenance Subjects

No	Aspect	Total score	Max score	Percentage (%)
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1	Media Aspects	36	40	90.0
2	Material Aspects	34	40	85.0
3	Benefits Aspect	22	24	91.667
Average Score		3.54	4	88.46

Based on Figure 3 it can be explained that the results bar chart the feasibility of subject teachers on the media aspect produced a percentage of 90.00%, the material aspect produced a percentage of 85.0% and the benefit aspect amounted to 91.667%. So, obtained an average total percentage of results from the worthiness of material experts by 88.46%. From the results of data analysis of media feasibility by subject teachers, it can be concluded that the testing of the media module for Building Maintenance for class XI in the subject of Building Maintenance is in the criteria of "very feasible".

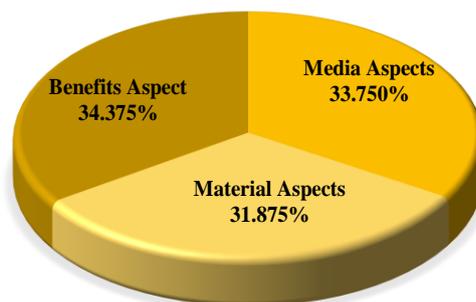


Figure 3. Pie Chart for Subject Teacher Feasibility Results

The distribution phase of learning media products that have been developed after going through an assessment of the material experts and media experts and carried out revisions based on suggestions obtained from the material experts and media experts and subject teachers. The goal at this stage is to disseminate research products so that they can be used as learning media in Building Maintenance subjects. The phase of spreading the product area is done through packaging, that is, the media is packaged in modules which are then handed over to the subject matter teachers in the Building Maintenance so that it can be utilized in classroom learning activities.

Define, activities at this stage are carried out to establish and define development requirements. Design phase, this design phase aims to design Building Maintenance subject modules that can be used in learning in vocational high school. Develop at the develop stage is a validation that aims to determine the feasibility of the modules that have been developed, namely the expert validator assessment of the module Building Maintenance subjects developed an average score of 3.60 or 90.0% with the category "very feasible", the results of the assessment of the validator of media experts obtained an average score of 2.97 or 74.194% with the category "feasible", the results of the assessment of the media by the teacher, the feasibility of learning media modules Building Maintenance subjects developed obtained an average score of 3.54 or 88, 46% with the category "very feasible".

Disseminate, is the stage of dissemination of learning media products that have been developed. The goal at this stage is to disseminate research products so that they can be used as learning media in Building Maintenance subjects. The phase of spreading the product area is done through packaging that is the media packed in physical form so that it can be easily distributed to students. This developed module contains 6 learning activities including: (1) occupational safety and health procedures and the environment in carrying out building maintenance; (2) maintenance system of building parts; (3) maintenance and repair of building frame and wall construction; (4) ceiling roof maintenance and repair; (5) maintenance and repair of floor and finishing components; (6) maintenance and repair of door and window frames. Module development from the subject of Building Maintenance for class XI students in the civil engineering department can be seen and downloaded on this google drive link <https://bit.ly/39PFNIC>, with the hope that the development of the module can be accessed and useful by vocational education students, teachers, lecturers, readers, and other researchers.

Research on the development and validation of learning modules is in line with the results of research by Gao (2008) on the development of construction management modules for vocational education with the results of research developing modules for basic abilities, special abilities, in construction management courses. The developed modules are expected to improve the quality of the

learning process and the professionalism of teachers and can inspire students in their interest in learning. Furthermore, research by Risnawati et al. (2019) aims to develop modules to improve students' reasoning skills. This development research aims to produce a product in the form of a module at the tertiary level. The modules developed are in the criteria of feasible, practical, and effective. Further research by Wicaksana et al. (2020) aims to determine the effectiveness of the critical thinking aspects of the module in improving student academic achievement. The use of critical thinking aspects in the module has a good impact on student achievement.

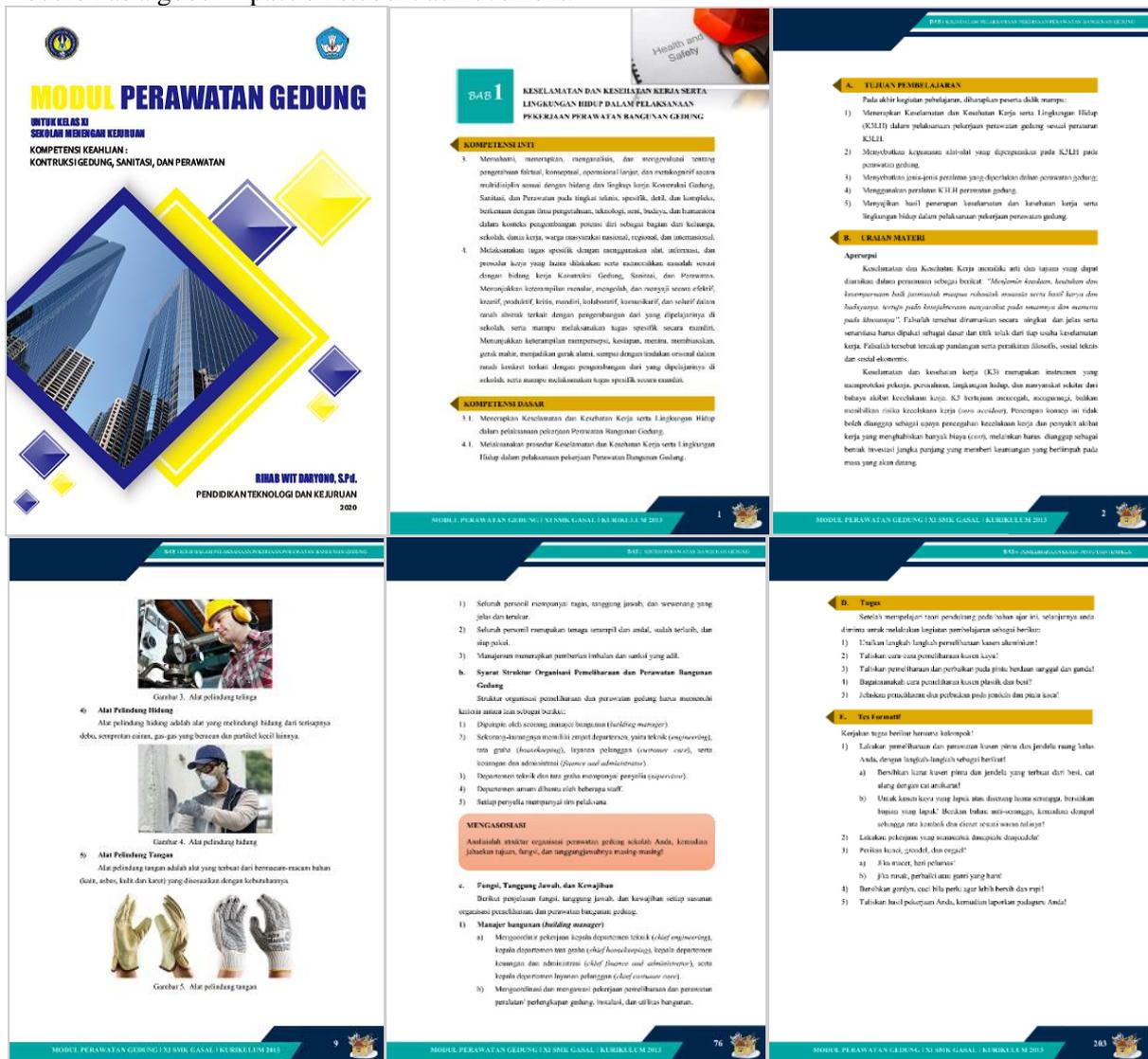


Figure 4. Building Maintenance Learning Module

CONCLUSION

Based on research development that have been described, the results of research at the define stage were carried out to determine and define development requirements for designing building maintenance subject modules that can be used in vocational high school learning. In the development stage is validation which aims to determine the feasibility of the module that has been developed, namely the evaluation of the material expert validator who obtained an average score of 3.60 or 90.0% with the category "very feasible", the results of the assessment of the media expert validator obtained an average score 2.97 or 74.194% with the "feasible" category, the results of the media assessment by the teacher, the feasibility of the learning media module for Building Maintenance subjects obtained an average score of 3.54 or 88.46% with the "very feasible" category. The disseminate stage is to disseminate research products so that they can be used as learning media in building maintenance subjects.

The product distribution stage is carried out through packaging and uploaded via google drive so that it can be accessed by the public.

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