

Effectiveness of Using Learning Modules Software Autodesk Revit Architecture to Support Capabilities in BIM Elements at SMK Negeri 7 Semarang

Rida Aisya Fitriani^{1*}, Bambang Sugiyarto¹, Nur Qudus¹, Aris Widodo¹

¹Construction Engineering Education Program, Faculty of Engineering, Universitas Negeri Semarang

*Corresponding author. Email: ridaaisyaf@gmail.com

ABSTRACT

There is no guide for independent learning *Software Autodesk Revit Architecture* at SMK Negeri 7 Semarang, this is an obstacle for students in developing skills to prepare for internships or to work in the industrial world in the future. In this case, it can also be seen through the learning outcomes for the Building Vocational School level that there are elements of BIM that should be applicable, but because it is a new element, it has not been implemented at SMK Negeri 7 Semarang. Learning media in the form of modules is a guide for honing skills in use *Software Autodesk Revit Architecture* so that it can be used as a template in making 3D images. This research aims to find out the qualification of the module *Software Autodesk Revit Architecture* according to material experts, media experts and also the opinions of students. The research method used is *Research and Development* (R&D) with a development model *Four – D* using quantitative descriptive analysis techniques. The development procedure for this research is based on the 4D development model, namely *define* (Definition), *design* (Planning), *development* (Development) and disseminate. The subjects of this research were students in Phase F class XII of the Sanitation and Maintenance Building Construction Skills Program. Based on the results obtained from assessing the feasibility of the learning module according to material experts by covering various aspects including Aspects *Self Instruction*, Aspect *Self Contained*, Aspect *Stand Alone*, Aspect *Adaptive*, and Aspect *User Friendly* got a percentage of 87.8% and was categorized as very suitable for use. In the feasibility assessment according to media experts, covering various aspects including Format aspects, Organizational aspects, Attractiveness aspects, Letter Shape and Size aspects, Space aspects, Consistency aspects obtained a percentage of 85.8% and were categorized as very suitable for use. Meanwhile, assessment of students' opinions regarding the learning module *Autodesk Revit Architecture* This obtained a percentage of 91.9% which was categorized as very suitable for use. Based on these results, it shows that the module that has been created can be a companion teaching material for learning on future BIM elements.

Keywords: *E-module, AutoCAD, Case method, Learning*

1. INTRODUCTION

In an era that is increasingly advanced and developing along with the times, there is intense competition to obtain jobs, which requires a person to have several abilities that must be mastered in the field of technology. These technological developments make it easier for people in their field of work to reduce the level of errors made by humans. Along with the development of science and technology, this is also in line with developments in the world of education which are increasingly rapid, this requires human resources (HR) who must have high quality in various fields.

Vocational High School (Vocational High School) or better known as Vocational Secondary Education is

education that prioritizes developing students' abilities to carry out certain types of work. Vocational Secondary Education prioritizes preparing students to enter the workforce and developing professional attitudes. In accordance with its form, Vocational High Schools organize educational programs that are adapted to the types of employment opportunities (Government Regulation Number 29 of 1990). At this vocational school level there are many majors, one of which is KGSP (Building Construction, Sanitation and Maintenance). The KGSP skills program has several elements, one of which is CAD [1]. In CAD, there is learning about software by using supporting applications in creating 2D and 3D drawings. This application is also inseparable from updates as time

goes by, for example nowadays there is BIM (*Building Information Modeling*).

BIM (*Building Information Modeling*) is one of the increasingly advanced technological innovations, which includes several important information in the process *Design, Construction, Maintenance* integrated into 3D modeling [2]. *Software Autodesk Revit Architecture* is one of *software* that supports the BIM concept. *Building Information Modelling* (BIM) [3], more effective and efficient because all information from structural and architectural elements is stored in one 3D model *file* digital. *Building Information Modeling* (BIM) has many advantages in the world of construction in that it can predict the shape of a building before the construction process, thus further reducing the failure rate in construction. In reducing uncertainty, increasing security and safety, resolving problems that arise and also analyzing the potential impact, it becomes a BIM concept to imagine a building in virtual construction form. BIM is considered to have the advantage of speeding up the construction project process compared to conventional methods so that it can be completed according to the desired design.

Most of the construction world in Indonesia still relies on its *AutoCAD* for drawing design, *SAP* for analyzing structures, *Microsoft Excel* to take into account volume and costs as well *Microsoft Project* to make a schedule. With so many applications used, the construction process takes a little longer. The existence of BIM can make it easier for the construction world to create a virtual building design because construction documents such as drawings, procurement details and other specifications can be linked together. The use of BIM in Indonesia has been regulated in the PUPR Ministerial Regulation Number 2 of 2018 as something that must be applied to non-simple state buildings with an area of more than 2000 m². One of *software* that supports this BIM system is *Software Autodesk Revit* [3].

Autodesk Revit is one of the *software* of BIM which is used to plan construction projects in a more efficient way, which provides new challenges for educators to prepare their students [4]. This new challenge of course starts from introducing the basics regarding the application *Autodesk Revit* so that students have adequate understanding and abilities for internships or entering the world of work. Accompanied by development *software* It is hoped that this will produce workers who have skills that are in line with technological developments so that they can face the competitive world of work without abandoning their existing and accountable competencies.

Software Autodesk Revit is still relatively new to be implemented at vocational school level so there are not many reference sources that can be used to help create 3D images. The lack of reference sources in learning makes students tend to forget what they have been taught at school. The rise of construction projects in

Indonesia means that job opportunities are increasingly tight, with this, students are burdened with having skills that can be excelled when doing internships or entering the world of work. *Autodesk Revit* is *software* BIM-based which has begun to be implemented in several construction projects in Indonesia, for example the GBK Main Stadium Renovation, Solo Manahan Stadium Renovation and Development, Ujung Menteng Flats Project, Cakung Cilincing Flats Project, as well as other projects. Therefore, have the ability to operate *Autodesk Revit* considered important in the world of construction [2].

On *Software Autodesk Revit Architecture* This itself includes architectural, structural and *Mechanical, Electrical, Plumbing* (MEP). *Revit architecture* is the first step that needs to be understood before entering *Revit structural* nor *Revit Mechanical, Electrical, Plumbing* (MEP) [3].

The implementation of BIM as a skills competency at the vocational school level is one of the government's efforts to socialize the use of BIM with the aim of increasing the number of workers who understand the BIM concept. The number of experts in Indonesia who are competent in implementing BIM is still relatively low. Addressing students' lack of skills in mastering *Autodesk Revit* based on BIM, students need learning media that can support students' understanding in this field.

There is no guide for independent learning *Software Autodesk Revit Architecture* at SMK Negeri 7 Semarang, this is an obstacle for students in developing skills to prepare for internships or to work in the industrial world in the future. There are several construction companies that use it *Software Autodesk Revit Architecture* so that vocational school students who undertake internships are required to understand and be able to operate *Software Autodesk Revit Architecture*. In this case, it can be seen through the learning outcomes for the Building Vocational School level that there are elements of BIM that should be applicable, but because they are relatively new elements, these elements have not been implemented at SMK Negeri 7 Semarang. Learning media in the form of modules is a guide for honing skills in use *Software Autodesk Revit Architecture* so that it can be used as a template in making 3D images.

Based on this idea, researchers will study it through *Research and Development* (RnD) with the thesis title "Effectiveness of Using Learning Modules *Software Autodesk Revit Architecture* to Support Learning on BIM Elements at SMK Negeri 7 Semarang".

2. METHODOLOGY

This research uses a Research and Development approach or *research and development* (R&D) modification of the development model according to Borg and Gall. This research development procedure is

based on the Thiagarajan development model which applies 4D research and development procedures (*define, design, development, disseminate*) goes through a number of sections with various adjustments aimed at creating a learning module [5].

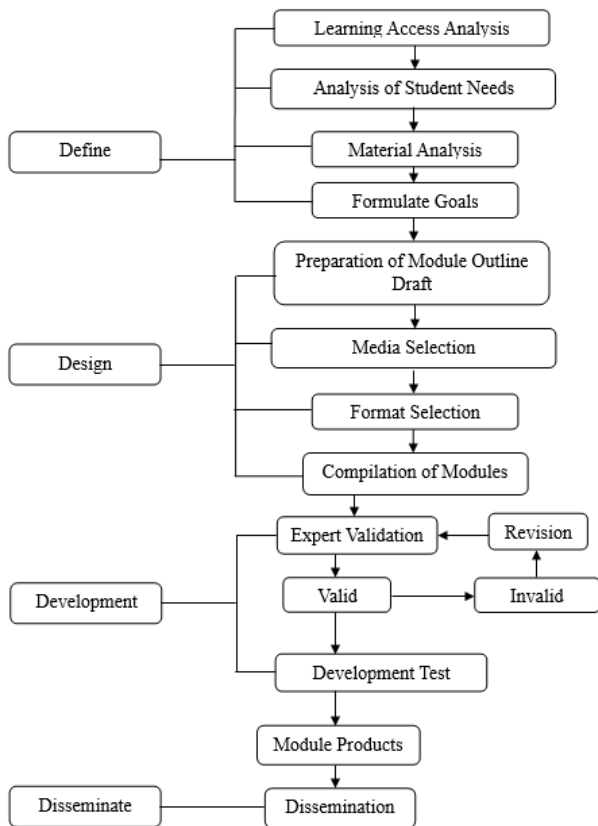


Figure 1 Research Flow

The following are the stages of conducting research using the 4D development model 4D:

2.1. Define

At this stage, definition is carried out to collect various data regarding what is needed for the teaching and learning process and determine the products that will be developed in BIM elements.

2.2. Design

After a problem is discovered at stage *define*, then proceed with the planning stage. Planning is the stage for Arranging *draft* the beginning of the learning media that will be developed in this BIM element. The aim is to design a structured and organized form of learning module for BIM elements. Starting from preparation *draft out line* modules, media selection, module learning format selection, and module preparation. The beginning of the learning media that will be developed in this BIM element. The aim is to design a structured and organized form of learning module for BIM elements. Starting from preparation *draft out line* modules, media selection, module learning format selection, and module preparation.

2.3. Development

In this stage the aim is to create learning media products that have been improved based on input and assessments from expert validators.

2.4. Disseminate

Disseminate is the final stage of module development research Autodesk Revit Architecture. At this stage, the aim is to spread the products that have been made and developed so that they can be accepted by users either individually or in groups. After being revised in accordance with the instructions from media members at the development stage (Development) mode Autodesk Revit Architecture This will be distributed to teachers majoring in Building Construction, Sanitation and Maintenance at SMK Negeri 7 Semarang.

Data analysis in this study used a measurement scale in a questionnaire. The scores obtained from the questionnaire results will be converted into four eligibility categories in the form of percentages.

Table 1. Measurement Scale

Questionnaire Measurement Scale	
Answer	Score
SS (Strongly Agree)	4
S (Agree)	3
TS (Disagree)	2
STS (Strongly Disagree)	1

To calculate the percentage interval from the data from the distributed questionnaire/questionnaire, you can use the following formula:

$$P(s) = f/N \times 100\%$$

After obtaining the interval for each measurement scale, the placement of the intervals is adjusted to the measurement scale using categories.

Table 2. Feasibility Score

No	Percentage	Category
1.	81.25% < x ≤ 100%	Very Worth It
2.	62.5% < x ≤ 81.25%	Worth it
3.	43.75% < x ≤ 62.5%	Decent Enough
4.	25% ≤ x ≤ 43.75%	Not feasible

Before obtaining the final results in the form of the category intervals above, it is necessary to calculate the percentages in the questionnaire using the formula:

$$\text{Eligibility \%} = (\text{actual score}/\text{maximum score}) \times 100 \%$$

3. RESULTS AND DISCUSSION

The results of this research were obtained in the form of a module as a companion tool for learning. This

research, which was conducted at SMK Negeri 7 Semarang, used a development model *four – D*. In the development model there are four steps, among others (1) *Define* (Definition) which includes initial analysis, student analysis, task analysis, concept analysis, and formulating goals; (2) *Design* (Planning) which includes Drafting *draft out line* module, media selection, format selection, and module compilation; (3) *Development* (Development) which includes material expert validation, media expert validation, and student opinions; (4) *Disseminate* (Dissemination).

The Design Stage has a goal to find the information needed in the module development process. This stage is divided into several stages, namely initial analysis, student analysis, task analysis, concept analysis, and formulating objectives. This stage produces printed images for the module *Autodesk Revit Architecture* which is depicted in the picture below.



Figure 2 Cover

This Define stage refers more to the process of creating learning modules that originate from the analysis that has been carried out previously. The stages in this design stage include preparing the module outline draft, media selection, format selection, and module preparation.

The Development stage is the third stage in the model Four – D, which aims to produce products in the form of learning modules whose suitability has been validated by material experts and media experts. The results achieved at this stage include material expert validation, media expert validation and student opinions.

This validation test by material experts is carried out by distributing a questionnaire to validate the feasibility of the learning module which covers several aspects, among others *Self Instruction*, *Self-Contained*, *Stand Alone*, *Adaptive*, and *User Friendly*.

Table 3. Material Expert Validation Results (%)

Indicator	Percentage (%)		Rate-rate (%)
	Validator	Validator	

	1	2	
Clarity of learning objectives	100	100	100
Packaging material	75	75	75
Learning material supported by examples and illustrations	82.5	100	91.3
Availability of questions and assignments to measure students' mastery	87.5	87.5	87.5
The material presented is related to the atmosphere, tasks and context of students' environmental activities	100	100	100
Language usage	75	100	87.5
Contains all learning material in accordance with the expected competencies	92.5	82.5	87.5
Does not depend on other teaching materials/media	75	87.5	81.25
Ease of using the module	75	87.5	81.25
The instructions presented are easy to understand	87.5	87.5	87.5
Friendly with the user	92.5	82.5	87.5
Amount (%)	85.7	90	87.8
Qualification Category	Very Worth It	Very Worth It	Very worth y

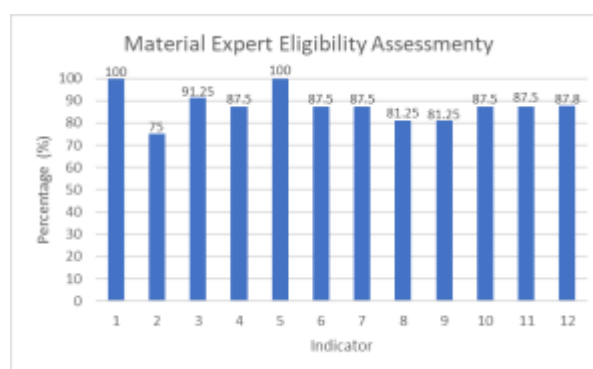


Figure 3 Material Expert Eligibility Assessment

Based on the calculation results of the average percentage obtained from all aspects, according to the assessment of the feasibility of the material in the module from the material expert, it is in the very feasible category. However, there are several shortcomings that lie in the packaging of the material, where there are several strings of words that are less

connected between one paragraph and another in several parts.

This validation test by media experts was carried out by distributing a questionnaire to validate the suitability of the learning module which covers several aspects, including Format, Organization, Attractiveness, Letter Shape and Size, Spacing, Consistency.

Table 4. Media Expert Validation Results (%)

Aspect	Score obtained		Rate-rate (%)
	Validator 1	Validator 2	
Paper format	100	87.5	93.75
Use of pictures	100	87.5	93.75
Completeness of the module parts	82.5	82.5	82.5
Systematic description of learning materials	87.5	75	81.25
Assignment and Exercise Packaging	100	75	87.5
Harmony of color combination, illustration images, shape and size of letters on the cover	92.5	75	83.75
Illustrative images and tables on the module contents	75	75	75
Layout	87.5	75	81.25
Letter shape and size	87.5	75	81.25
Use of capital letters	75	75	75
Comparison of letters between titles, subtitles and text content	87.5	75	81.25
Empty room	100	75	87.5
Design consistency	87.5	75	81.25
Consistency of spacing	87.5	87.5	87.5
Letter/font consistency	100	100	100
Typing layout consistency	100	100	100
Amount (%)	90.6	80.9	85.8
Eligibility Category	Very Worth It	Worth it	Very worthy

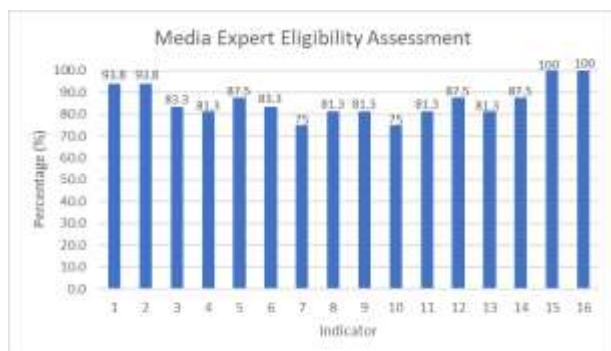


Figure 4 Media Expert Eligibility Assessment

Based on the results of calculating the average percentage obtained from all aspects according to the media feasibility assessment in the module from media experts it is in the very feasible category. However, there are several shortcomings in the cover and also the existing illustration images that need to be corrected by increasing the quality of the images. Thus, it can be concluded that this module can be categorized as very suitable for use as a learning module, but needs improvement.

The results of this student opinion were carried out by distributing a questionnaire based on an analysis of students' needs, which includes several aspects, including students' opinions regarding the learning resources used, students' needs for the form of learning media, students' knowledge of the material. *Revit*, Student needs for module content *Revit*, Students' needs for material exposure *Revit*.

Table 5. Results of Student Opinions (%)

No.	Aspect	Average Score obtained	Average score (%)
1.	Students' opinions regarding the learning resources used	3.8	94.5%
2.	Students' knowledge of the material <i>Revit</i>	3.1	77.4%
3.	Students' needs for the form of learning modules	3.7	91.7%
4.	Student needs for <i>Revit</i> module content	3.8	96.1%
5.	Student needs for exposure to <i>Revit</i> material	4	100%
Average Amount		3.7	91.9%

Based on the results of the calculation of the average percentage obtained from all aspects that meet the needs of students, it can be said to meet the needs of students, but there needs to be improvements to the image display which needs to be improved again.

The final stage in compiling this module is stage *Disseminate*, at this stage the aim is to disseminate learning modules and can be used in the learning process. This stage was not implemented because at this stage the results of the assessment from material experts and media experts had not yet reached a percentage of 100% even though it was said to be very suitable for use and the school in question had not directly implemented

learning on this element due to a lack of resources who understood about it. *Revit*.

4. CONCLUSIONS

The preparation of this learning module uses research methods *Research and Development*, with models *four – D*. The stages in this model include: *define* (definition), *design* (planning), *development* (development), and *Disseminate* (Dissemination). Based on the results obtained from assessing the feasibility of the learning module as seen by material experts covering various aspects including *Aspects Self Intruction*, *Aspect Self Contained*, *Aspect Stand Alone*, *Aspect Adaptive*, and *Aspect User Friendly* got a percentage of 87.8% and was categorized as very suitable for use. Meanwhile, based on the results obtained from the assessment of the feasibility of the learning module as seen from media experts covering various aspects including *Format aspects*, *Organizational aspects*, *Attractiveness aspects*, *Letter Shape and Size aspects*, *Space aspects*, *Consistency aspects*, the percentage was 85.8%. categorized as very suitable for use. Assessment of students' opinions regarding the learning module *Autodesk Revit Architecture* This obtained a percentage of 91.9% which was categorized as very suitable for use. These results show that the module that has been created can be a companion teaching material for learning on future BIM elements. However, these results cannot yet be disseminated because they have not yet obtained 100% results, so there needs to be development related to this module.

Based on the results of the research that has been carried out, the researchers provide suggestions for schools, namely that it is hoped that this module can be used as a companion in the learning process *Revit*, and can be used by students to further develop in training *Skill* in operating *Autodesk Revit* independently. For further research, this module can be developed even better and, in the future, it can be used in learning activities.

AUTHORS' CONTRIBUTIONS

Rida Aisya Fitriani carried out data collection, module design, participated in data analysis, module design and wrote the manuscript. Bambang Sugiyarto participated in analysis design and data analysis. Nur Qudus participated in and assisted with data analysis. Aris Widodo participated in and assisted with data analysis. All authors read and approved the final manuscript.

ACKNOWLEDGMENTS

The researcher would like to express his sincere thanks to the Faculty of Engineering, Semarang State University and the lecturers involved in this research.

REFERENCES

- [1] Badan standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, & dan Teknologi Republik Indonesia. (2022). *Capaian Pembelajaran Mata Pelajaran Desain Pemodelan dan Informasi Bangunan Fase F Untuk SMK/MAK*.
- [2] PUPR. (2020). Pengertian BIM (Building Information Modelling). *Dinas PUPR*.
- [3] Khairi, I. F., Bayzoni, Husni, H. R., & Siregar, A. M. (2022). Penerapan Building Information Modeling (BIM) pada bangunan gedung menggunakan software Autodesk Revit (Studi Kasus: Gedung 5 RSPTN Universitas Lampung). *Jrsdd*, 10(1), 15–026. <https://media.neliti.com/media/publications/486228-none-33a1d680.pdf>
- [4] Wibowo, A. (2021). Evaluasi Penerapan Building Information Modelling (BIM) Pada Proyek Kontruksi Di Indonesia. *Teknik Sipil*, 1-97.
- [5] Sugiyono. (2021). Metode penelitian kuantitatif, kualitatif, dan R&D. *Bandung: Alfabeta*.