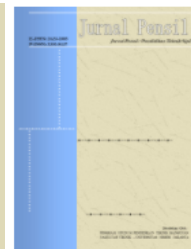


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## THE DEVELOPMENT OF E-MODULE SOFTWARE AND BIM-BASED BUILDING INTERIOR DESIGN

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### Abstract

This research aims to develop e-module for Software and Building Interior Design subjects based on Building Information Modeling (BIM) using the ArchiCAD software. The method used was the research and development method (R&D) from Thiagarajan which has 4 stages, namely define, design, develop, and dissemination. The data analysis technique uses instruments for expert appraisal. The developmental testing of e-module is used to determine the effectiveness of using e-modules software and BIM-based building interior design by users. This test was carried out by two selected schools, which consisted of 52 students. The results shows percentage of material expert validation obtained was 89% and the percentage of media expert validation was 84.58% and the effectiveness of the e-module reaches 0,84 in the n-gain score and 90.4%, which means the e-module are very feasible and can be used in the learning process of Software and Building Interior Design subjects.

**Keywords:** Teaching Materials, E-Modules, Software, Building Interior Design, BIM

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## **Introduction**

The development of digital information technology in the 4.0 era (Qureshi et al., 2021) created an innovation for education (Setiami & Maulana, 2021), which means these era taken to improve the quality of learning. The education policy in various countries (Holmes & Crossley, 2004) especially Indonesian, stated the digital technology so important for the quality of learning at all levels (Taplin, 2002). In this case, digital technology become a big demand and challenge for education. Solutions that are considered to be able is adjustments to competencies (Gay & Airasian, 2003), optimizing abilities of students, developing the character values of students (Suyatno et al., 2019), prepared a human resources in Information and Communication Technologies (ICT) (Aisyah, 2011), and prepared by digital-based learning facilities and infrastructure (Reflianto & Syamsuar, 2018).

Building Information Modeling (BIM) is one of ICT, which means can provide new opportunities, good influence, and improving the quality of learning (Oktaviyanthi et al., 2017). Indonesian government also try to BIM-implementation as a skill competency at the vocational high school level (Prasetyo & Ramadhan, M. A., Sumarsono, 2021). Modeling Design and Building Information is another name from BIM in vocational school (Ramadhan & Maulana, 2020). The PUPR has socializing BIM through the seminars and webinars to adjust competencies and optimize abilities of academic (B. K. P. K. PUPR, 2020) in this case, students.

The BIM-based software in the AEC (Architecture, Engineering, and Construction) industry (Bosch-Sijtsema et al., 2021) can simulate all information in projects 3-dimensional models, Autodesk Revit, ArchiCAD, Allplan, Lumion, Bentley, and many software (B. PUPR, 2020). ArchiCAD is used for architectural planning to create and manage full technical documentation (2D and 3D) (Tubielewicz-Michalczuk, 2019) showing the perspective and juxtaposing all the necessary materials,

as well as, preparing a cost estimate (BPSDM PU, 2018). The point is ArchiCAD will be the main course of BIM-software for vocational schools' class to designed structured.

In direct, subject of Software and Building Interior Design is knowledge is well interior structured and can be taught step by step (Subiyantari et al., 2019). But, learning components in school available with printed books, printed modules, and the others. These components did not effective because of the online class due to the Covid-19 (Corona Virus Disease) pandemic (Dewi, 2020) so the learning process has not been carried out properly. Pandemic makes all of school in this world held a discussed online everyday, even a practicum. There are difficulties because of the different locations between the teachers and students (Wahyuni et al., 2021).

The solution is developing a new and better learning components in form of e-module (Prasetyowati & Tandyonomanu, 2015). The e-module accessible to the public, so that teachers can utilize it as well (Pratiwi et al., 2021). The developing content like the text, image, animation, audio, and video (Febro et al., 2020) that will aid students to improve their learning. The e-module is also found to be suitable to serve as an alternative learning material (Lim et al., 2005) that assists the learning of ArchiCAD in the subject of Software and Building Interior Design.

This research consisted with two schools selected, which was SMK Negeri 35 Jakarta and SMK Negeri 1 Jakarta has available with subjects of Software and Building Interior Design. Data analysis start from SMK Negeri 35 Jakarta and the results shows 96.2% of a respondents stated they need more for the development of ArchiCAD teaching materials in the form of e-module to be used in Software and Building Interior Design class.

## **Research Methods**

This research was conducted on the competency (Sibuea, 2000) skill of Modeling and Building Information Design

students in two vocational schools selected, which is SMK Negeri 35 Jakarta and SMK Negeri 1 Jakarta. These school have a training class from subject of Software and Building Interior Design. The development uses the 4D Thiagarajan model because it has practical work stages (Indrianus et al., 2020). The model consists of four steps namely define, design, develop, and dissemination (Kurniawan et al., 2017). Data analysis techniques were used after collecting judgments from material experts, media experts, and users.

The preparation of the instrument in the form of a questionnaire is based on the assessment instruments from the National Education Standards Agency or Badan Standar Nasional Pendidikan (BSNP). The formula is used:

$$Average\ Score\ (\%) = \frac{Total\ Score}{Maximum\ Score} \times 100$$

The average score obtained will be adjusted to the score interpretation criteria table to determine the e-module eligibility category.

Table 1. Interpretation Criteria Score

Score (%)	Category
81 – 100	Very Feasible
61 – 80	Feasible
41 – 60	Enough

21 – 40	Unfeasible
0 – 20	Very Unfeasible

Source: (Riduwan, 2011)

Learning outcomes from students (H et al., 2021) are used as an assessment of the cognitive aspect, how much students understand the subject. An N-gain test shows the difference a posttest and pretest value. The formula is used:

$$N - gain = \frac{post\ test\ average\ score - pre\ test\ average\ score}{maximum\ score - pre\ test\ average\ score}$$

### Result and Discussion

The n-gain obtained will be adjusted to the cognitive improvement criteria scale to determine the effectiveness of the BIM-based e-module.

Table 2. Cognitive Improvement Criteria Scale

Score (%)	Category
(g) ≥ 0,7	High
0,3 ≤ (g) ≤ 0,7	Medium
(g) ≤ 0,3	Low

Source: (Hikmah, 2019)

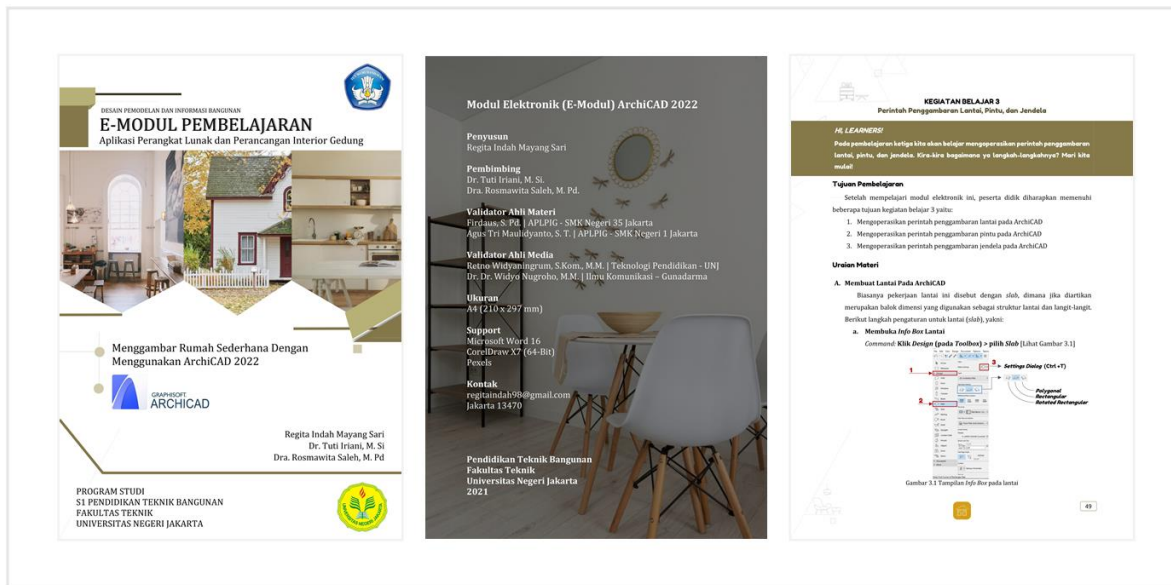


Figure 1. The Display of BIM-based E-Module

The competency of Modeling and Building Information Design skills is carried out to meet the needs of teaching materials (Ahyari & Nugroho, 2019) for students and provide guidance in operated the software, ArchiCAD. The research model used is 4D Thiagarajan (Al Fitani & Gazali, 2021) starting from the defining where observations in class to find out the teaching materials needed, followed by collecting learning components at the design to making product designs, develop and validated by material experts and media experts (H et al., 2021) to get the final product so that it can be disseminated in the vocational schools and universities.

The product assessment was carried out by two material experts (Ramadhan & Murtinugraha, 2020) from Software and Building Interior Design teachers, two media experts from media lecturers, and users who were students with Modeling and Building Information Design expertise competencies. Based on the results shows the percentage of material experts is 89% and the percentage of media experts is 84.58%.

Table 3. Results of Pretest and Posttest Score from Limited Trial

No	Name	Pre	Post	Increase
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		test	test	in Score
1.	Student I	80	100	20%
2.	Student II	50	90	40%
3.	Student III	70	100	30%
4.	Student IV	40	90	50%
5.	Student V	80	90	10%
6.	Student VI	50	80	30%
7.	Student VII	70	100	30%
8.	Student VIII	60	90	30%
9.	Student IX	70	100	30%
No	Name	Pre test	Post test	Increase in Score
10.	Student X	50	100	50%

<b>Average</b>	<b>62</b>	<b>94</b>	<b>32%</b>
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Source: The BIM-based E-Module Research Data, 2022

The results of the pretest and post-test in the limited trial showed that the students experienced an increase in the mean score of 32%. Then, from the study results, an n-gain of 0.84 (Table 2) was also obtained, which means the e-module is in the effectiveness category (Asmi et al., 2018). Response from a students, e-modules are very worthy (Imbatami et al., 2020) of being teaching materials in the learning process. The large-scale BIM-based e-module distribution activities shows the percentage of 90.4%, which means these module very feasible (Siahaan, 2018). E-modules were distributed as learning materials to 52 students, then students were directed to fill out the user response instrument as the effectiveness.

The other research conducted by (Permana, 2017) showed the Autocad module obtained a feasibility rate of 87% by material experts, 89% by media experts, and 82% by students responses so the learning module is included in very feasible category and suitable to be used as student learning teaching materials. Meanwhile, research by (Akhmadi, 2019) showed the computer and basic network e-module products obtained a feasibility level of material experts 1 and 2 of 98% and 94.2%, then media experts 1 and 2 were 66% and 91% and gets average pretest and posttest scores around of 65.46 and 82.53 makes the e-module become a good category and is suitable for use in the learning process .

The developed BIM-based e-module teaching materials are disseminated through authorized teachers, in this case to teachers of Software and Building Interior Design at SMK Negeri 1 Jakarta. This activity gets an users around 52 students and this number will shows the effects of the product on the effectiveness in the learning process (Masdayaroh et al., 2022). E-module are also distributed through the Learning Management System (LMS) for Interior

Design courses with the permission of the lecturer.

The research gets a supported by the validation activities, it takes one weeks in the trial proceed, positive responses from a students and teachers in product testing activities, as well as input and suggestions from various parties to make the e-modules better (Rahdiyanta, 2016). Meanwhile, several factors hindered research, only a few students were due to lack of self-preparation, then the e-module trial activity and the Professional Certification Institute ArchiCAD held in same time, so it takes a long time to work on BIM-based e-modules.

The development has advantages like the product as an alternative learning material, classes have an software e-module, the display of e-modules has its color that can attract users to learn and more interesting (Cahyanto & Afifulloh, 2020) than the previous teaching materials. E-Module packaged in PDF format, so the device must have a PDF reader such as WPS, OneDrive PDF, Nitro Reader, Foxit Reader, and others. In the trial, one application was found that cannot read this e-module, Drive PDF Viewer. Students who error navigation in the e-module are directed to available link.

## Conclusion

The result of research and development is a BIM-based e-module product that used the ArchiCAD software. In the learning process, the e-module affects the effectiveness because available with a material content, formative tests, evaluations, videos, and any features which can assist an users in Software and Building Interior Design class. The BIM-based e-module development has gone through the validation of media and materials as well as product trials. Based on the results, the validator shows the BIM-based e-module is very feasible as teaching material in the learning process.

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