

Available online at: <http://journal.unj.ac.id>

Jurnal
Pensil

Pendidikan Teknik Sipil



Journal homepage: <http://journal.unj.ac.id/unj/index.php/jpensil/index>

DEVELOPMENT OF ENGINEERING DRAWING LEARNING MODULE FOR VOCATIONAL STUDENT AT PROPERTY CONSTRUCTION BUSINESS EXPERTISE PROGRAM

Luthfi Arfianti^{1*}

¹ Program Studi Pendidikan Teknik Bangunan, Universitas Negeri Medan, Jl. Willem Iskandar, Medan, 20221, Indonesia

*luthfiarfianti25@gmail.com

Abstract

This study aims to: (1) develop the learning media for the Technical Drawing module in the engineering drawing subject of class X Property Construction Business (BKP) at SMK Negeri 1 Percut Sei Tuan, (2) To determine the validity level of the material and media as learning media for students. This study uses the Research and Development development research method which includes the stages of identifying potentials and problems, gathering information, product design, design validation, and design improvement. The instrument used was a questionnaire. This questionnaire is used to test the feasibility of the media in the module through material validation and media validation. Based on the research results it is known that the Technical Drawing module as a learning medium for Engineering Drawing subjects refers to a curriculum consisting of 6 chapters. The results of the feasibility test for material experts with an average score of 125 are in the very good category. And the results of the feasibility test for media experts with an average score of 148 are in the very good category. The results showed that the Engineering Drawing learning module was feasible to use for class X BKP students at SMK Negeri 1 Percut Sei Tuan.

P-ISSN: [2301-8437](#)
E-ISSN: [2623-1085](#)

ARTICLE HISTORY

Accepted:
7 Januari 2021
Revision:
14 Januari 2022
Published:
30 Januari 2022

ARTICLE DOI:

[10.21009/jpensil.v11i1.18950](https://doi.org/10.21009/jpensil.v11i1.18950)



Jurnal Pensil :
Pendidikan Teknik
Sipil is licensed under a
[Creative Commons
Attribution-ShareAlike
4.0 International License](#)
(CC BY-SA 4.0).

Keywords: Module Learning, Media Development, Vocational School, Property Construction Business

Introduction

The digital revolution and the era of technological disruption are other terms of industry 4.0. The digital revolution is due to the proliferation of computers and the automation of record keeping in all fields. New technologies and approaches that combine the physical, digital, and biological worlds will fundamentally change the way people live and interact (Tjandrawinata, 2016). The development of education is always directly proportional to the development of the times (Wati, dkk., 2019). Educational institutions must be able to improve the quality of education and develop the existing potential in order to meet the demand for quality human resources in this century (Hasibuan et al., 2019).

The challenges of the globalization era in the world of education are currently growing rapidly (Ciffolilli & Muscio, 2018; Jima'ain, Mahpuz, Rahman, & Mohamad, 2019; Subekti, Taufiq, Susilo, Ibrohim, & Suwono, 2018), namely with the development of modern science and technology (Dewi, 2019; Suprpto, 2018). The development of technology in education has a positive impact on the teaching and learning process. Thus, this requires educators to update the learning system by utilizing the latest technology. Efforts that can be made by educators are to utilize the latest technology to be applied to the learning process (Indra & Saleh, 2021). One form of formal education unit that organizes vocational education at the secondary level as a continuation of SMP, MTs or other equivalent forms of school is SMK (Vocational School) (Lubis, 2020). Sekolah Menengah Kejuruan (SMK) memiliki banyak program keahlian, program keahlian yang dilaksanakan di SMK menyesuaikan

dengan kebutuhan dunia kerja yang ada. Salah satunya yaitu program keahlian Bisnis Konstruksi dan Properti. Secara umum Bisnis Konstruksi dan Properti atau biasa disebut BKP mempelajari ilmu tentang konstruksi bangunan dan furniture perkayuan, pengukuran tanah, rancangan anggaran biaya (RAB) konstruksi bangunan, perencanaan bisnis konstruksi dan properti, pelaksanaan dan pengawasan konstruksi.

The success of the teaching-learning process is inseparable from the availability of facilities and infrastructure owned by the school (Yulando & Chi, 2019). In improving the quality of vocational education, the problem that must be considered is the problem of student learning. The use of information technology in learning leads to technology products, one of which is learning media (Gunawan, 2016). Learning media facilitates the process of delivering information carried out by educators and becomes a tool for students to participate in the learning process (Negara, dkk., 2019). Sanaky (2013: 4) emphasizes that learning media are facilities and infrastructure in the form of tools that are used to assist learning success, so that learning success can be achieved properly. Learning media can also convey learning messages in a more programmed manner, so that classroom conditions become more conducive and there is good communication and interactive between teachers and students directly. Teaching materials that are often used in the learning process in general are printed media (Situmorang et al., 2020).

The teaching system with modules is a learning delivery system that is used in efforts to develop a more efficient, relevant, and effective education system (Putra, 2020). The

learning module is one of the media that is often used in vocational education. The module is one part of the printed learning media. According to Mulyasa (2006: 148) The module is a self-paced learning package that includes a series of learning experiences that are planned and systematically designed to help students achieve learning goals. Modules are learning media that are designed in such an interesting way with the hope that they can help students become more enthusiastic about learning and not depend on the teacher in studying the material (Abdul Majid, 2008: 176).

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 (Daryono & Rochmadi, 2020). Modules are generally in the form of print containing the material in one unit for students to study (Made Wena, 2009:230). Within a certain time, students will study a unit of material developed in the module through various activities and evaluations. The module must contain learning instructions, competencies to be achieved, supporting information, practice questions, work instructions, evaluations, and feedback on evaluation results (Sukoco et al., 2014; Suyitno, 2016). Rosa (2015) shows that the module is very helpful for students to learn independently, modules that are equipped with simple experiments help and are needed by students as study guides. Modules make students learn more systematically (Wibowo et al., 2015).

SMK Negeri 1 Percut Sei Tuan is one of the leading vocational schools in Deli Serdang Regency, the school is located at Jalan Pool No. 3 Metan Estate. SMK Negeri 1 Percut Sei

Tuan has several majors, one of which is the Department of Building Engineering. In the Department of Building Engineering, SMK Negeri 1 Percut Sei Tuan consists of 3 Expertise Programs, namely Modeling Design and Building Information, Construction and Property Business and Geomatics.

Engineering drawing is one of the subjects in the Department of Building Engineering. Engineering drawing is a tool to express the ideas or ideas of technical experts (Amri & Sumbodo, 2018; Putra, I Nyoman Pasek Nugraha, S.T., & Kadek Rihendra Dantes, S.T., 2018; Wahyudi, Widiyanti, & Nurhadi, 2018). One of the abilities that must be possessed by people working in the world of engineering is the engineering drawing ability (Ardiansyah, Yoto, & Sumarli, 2017; Lestari & Basuki, 2018). Therefore, engineering drawing must be in accordance with the right and correct criteria (Ihsan & Efendi, 2018). Along with the development of science and technology, technical drawings can be done using Computer Aided Design software (CAD) (Li, Lange, & Ma, 2018; Priono, Purnawan, & Komaro, 2019). CAD is a program used in engineering drawing (Bisono & Hendarti, 2019; Gembarski, Li, & Lachmayer, 2017). CAD is only used for computer-aided design and drafting (Shisir, Manjunath, Pavanasudan, & Sathyajith, 2015; Zhang & Zhou, 2019). Many CAD programs are used in the industrial world, including AutoCAD, Solidworks, Autodesk Inventor, Catia, and so on. (Lingenfelter & Rew, 2019).

According to the data from the needs analysis survey that has been carried out on the Construction and Property Business expertise program, generally not many teaching materials have been created and used by teachers in learning. These results are

reinforced by the results of interviews conducted with teachers of Engineering Drawing subjects in the Construction and Property Business Skills Program in the form of: 1) Teachers have not used modules in Engineering Drawing lessons; 2) Learning resources (references) on Engineering Drawings are still limited owned by the Construction and Property Business Skills Program; 3) In learning students tend to be inactive and only pay attention to what is presented by the teacher; 4) The teacher conveys that it is very important and useful if there are other types of teaching materials taught in technical drawing lessons, such as modules.

A lot of research and module development has been done before. The research entitled Development of Engineering Drawing Learning Module for Class X Students of Electrical Engineering Department at SMK N 1 Magelang which was developed by (Saputra, 2017) with the results of the assessment that the learning module is suitable for use in learning with the percentage of eligibility from media experts and material experts of 100% and 67%, respectively. In addition, research on E-Module Development in Engineering Drawing Courses with BIM System Building Modeling Applications was carried out by (Setiami & Maulana, 2021) obtained a decent percentage result by material and media experts as well as students of 91%, 83% and 79%. In addition, according to research conducted (Nendra et al., 2019) stated that the development of the Engineering Drawing module received high marks from media experts and material experts, besides that the module was declared effective and could improve student learning outcomes.

Based on the description above, a research entitled: "Development of a Class X Engineering Drawing Learning Module for the BKP Expertise Program in SMK Negeri 1 Percut Sei Tuan will be conducted". This study aims to develop learning media for Engineering Drawing subjects in the form of modules. In addition, this module is expected to make it easier for students to carry out learning, and can increase student interest and learning outcomes.

Research Method

This type of research is research and development according to Sugiyono (2014: 407) in which there is a reference in conducting development research. This research was conducted in class X of the Construction and Property Business Expertise Program in the Engineering Drawing subject at SMK Negeri 1 Percut Sei Tuan for the 2019/2020 academic year. This module development research time is carried out in the second semester (even semester) of the 2019/2020 academic year. The population and sample in this study were class X students of the Construction and Property Business Skills Program at SMK Negeri 1 Percut Sei Tuan for the 2019/2020 academic year as many as 32 people.

The model used in this study adapts the Borg & Gall development research procedure which was carried out with restrictions. Borg & Gall in Emzir (2013: 271) said that it is possible to limit the research to a small scale including limiting the research steps. The simplification of the Borg & Gall research procedure includes 5 steps, which include: (1) Identifying potential and problems, (2) Gathering information, (3) Product design, (4) Design validation, (5) Design

improvement. The following stages of the module development model are carried out.

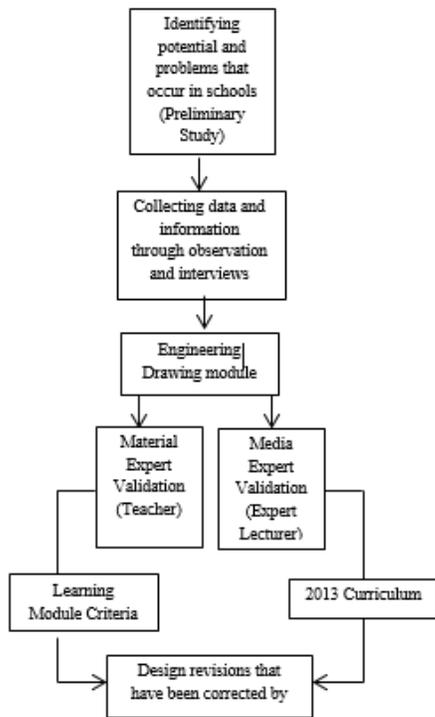


Figure 1. Module Development Stages

The data collection technique used in this study was using a questionnaire or questionnaire. The questionnaire used in the form of a questionnaire for media experts, material experts and also students which serves to determine the level of feasibility of the product to be developed. The data analysis technique used is a qualitative descriptive analysis. The analysis technique is carried out by grouping information from qualitative data in the form of input, suggestions or criticism contained in the questionnaire. Through the results of the analysis, the developed interactive learning media will be improved.

$$Percentage = \frac{\text{Observed score}}{\text{Expected score}} \times 100\%$$

The data obtained in the form of percentages is then converted by using the reference table of feasibility interpretation according to Riduwan (2013: 22) as in Table 1.

Table 1. Interpretation of Eligibility Score

Rating	Value Scale
Very Inappropriate	0%-20%
Not feasible	21%-40%
Decent enough	41%-60%
Worthy	61%-80%
Very Worthy	81%-100%

After that, the scores obtained from the material expert and media expert questionnaires were then converted into four scales of eligibility categories as shown in the table below:

Table 2. Eligibility Category

No	Score Interval	Category
1	$M_i + 1,5 S_{bi} < X \leq M_i + 3S_{bi}$	Very Worthy
2	$M_i < X \leq M_i + 1,5 S_{bi}$	Worthy
3	$M_i - 1,5 S_{bi} < X \leq M_i$	Decent enough
4	$M_i - 3 S_{bi} < X \leq M_i - 1,5 S_{bi}$	Not Feasible

Source: Sudjana (2014: 257)

With information:

Mi : ideal average

Sbi : Ideal standard deviation

Mi : $1/2$ (ideal highest score + ideal lowest score)

SBI : $1/6$ (ideal highest score – ideal lowest score)

Results and Discussion

Based on the validation that has been carried out by media experts and material experts, the following results are obtained: (1) The results of validation by media experts show a percentage of 148 eligibility which is in the "Very Eligible" category; (2) The results of the validation by material experts show the percentage of eligibility of 125 which is in the "Very Eligible" category.

1. Media Development Results

The results of the research on module development using Research and Development research methods are:

- Identifying Potentials and Problems

This research begins with the potential or problems found during observations in class X of the Construction and Property Business Engineering Department at SMK Negeri 1 Percut Sei Tuan. The problem found was the unavailability of Engineering Drawing teaching materials (modules) for class X students of the Construction and Property Business Engineering Department. Researchers also found problems with student learning activities in the class that were still less active, therefore it was necessary to include supporting facilities for problem-based learning so that learning objectives could be achieved properly and students' dependence on teachers was reduced.

- Gathering Information

Information was obtained from research observations during the Engineering Drawing subject in class X of the Construction and Property Business Engineering Department at SMK Negeri 1 Percut Sei Tuan and conducting interviews with teachers in Engineering Drawing subjects related to the material needed in the preparation of the Engineering Drawing Module. The goal is that the material included in the module is related to the syllabus used in class X of the Construction and Property Business Engineering Department

- Product Design

(1) Needs analysis, determining competence here is the systematic preparation of material descriptions in accordance with the 2013 Curriculum syllabus to achieve learning objectives. (2) Drafting learning modules, including: (a) Determine module titles (b) Determine learning titles (c) Develop module outlines (d) module development. At the design stage, the module layout design is made to be attractive and compatible with the existing material. The material manuscript is written in Microsoft Word using A4 paper (21 cm x 29.7 cm). The manuscript is typed using Arial font with a text size of 12. The spacing between lines is 1.15 cm to make the text on the module easier to read.



Figure 2. Module Cover Design

2. Validation Results of Material Experts and Media Experts

At this stage the researcher validates the design by material experts and media experts for product assessment. (1) material validation was carried out by Mrs. Irma Novrianty S.T., M.Ds. from the UNIMED Building Engineering Education lecturer and Mrs. Dra. Hapsah Nasution from subjects at SMK Negeri 1 Percut sei Tuan. Validation was carried out on July 22, 2020. The results of the material expert validation can be seen in the following diagram:

Table 3. Score of Material Expert Validation Results

No	Aspect	Number of Items	Score	Maximum Score	Average
1	Self instruction	18	63	72	3,5
2	Self contained	2	7,5	8	3,75
3	Stand alone	2	6	8	3
4	Adaptive	1	4	4	4
5	User friendly	4	13,5	16	3,37
6	Keberanan Materi	3	12	12	4

	materi	bahan	Ajar		
7	Manfaat	5	19	20	3,8
Total		35	12	14	3,57
			5	0	

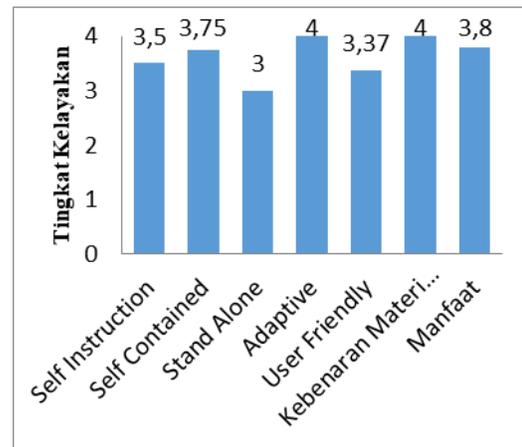


Figure 3. Graph of Material Feasibility Average Score

Then, to find out the feasibility of the material in the module, it is necessary to calculate the ideal mean (Mi) and calculate the ideal standard deviation (Sbi) and then convert it. Here are the results of the calculation: Analisa Kelayakan Materi

- Calculating the ideal mean (Mi)

$$Mi = \frac{x}{2} (\text{ideal maximum score} + \text{ideal minimum score})$$

$$Mi = \frac{1}{2} \times (140 + 35)$$

$$Mi = 87,5$$
- Calculating the ideal standard deviation (Sbi)

$$Sbi = \frac{1}{\sqrt{6}} \times (\text{ideal maximum score} - \text{ideal minimum score})$$

$$Sbi = \frac{1}{\sqrt{6}} \times (140 - 35)$$

$$Sbi = 17,5$$
- Conversion

- (a) Very Worthy
 $= Mi + 1,5 Sbi < X < Mi + 3 Sbi$
 $= 87,5 + 1,5 (17,5) < X < 87,5 + 3 (17,5)$
 $= 113,75 < X < 140$
- (b) Worthy
 $= Mi < X < Mi + 1,5 Sbi$
 $= Mi < X < 87,5 + 1,5 (17,5)$
 $= 87,5 < X < 113,75$
- (c) Fairly Eligible
 $= Mi - 1,5 Sbi < X < Mi$
 $= 87,5 - 1,5 (17,5) < X < 87,5$
 $= 61,25 < X < 87,5$
- (d) Not Eligible
 $= Mi - 3 Sbi < X < Mi - 1,5 Sbi$
 $= 87,5 - 3 (17,5) < X < 87,5 - 1,5 (17,5)$
 $= 35 < X < 61,25$

Table 4. Material Criteria Score

No.	Score Range	Score	Category
1.	$Mi + 1,5 Sbi < X \leq Mi + 3 Sbi$	$113,75 < X < 140$	Very Worthy
2.	$Mi < X \leq Mi + 1,5 Sbi$	$87,5 < X < 113,75$	Worthy
3.	$Mi - 1,5 Sbi < X \leq Mi$	$61,25 < X < 87,5$	Fairly Eligible
4.	$Mi - 3 Sbi < X \leq Mi - 1,5 Sbi$	$35 < X < 61,25$	Not Eligible

Based on the overall material assessment criteria with a score of (x) 125 getting the predicate "Very Good" Media Validation, conducted by Mr. Dr. Darwin, M.Pd. as a lecturer in the field of learning media expertise, which was held on September 14,

2020. The results of the media expert validation can be seen in the following diagram:

Table 5. Media Expert Validation Results Score

No.	Aspect of Items	Number	Score (x)	Max. Score	Average
1	Format	4	15	16	3,75
2	Organisasi	9	33	36	3,666
3	Daya tarik	8	30	32	3,75
4	Bentuk dan ukuran huruf	6	20	24	3,333
5	Ruang (spasi kosong)	5	20	20	4
6	Konsistensi	8	30	32	3,75
Total		40	148	160	3,7

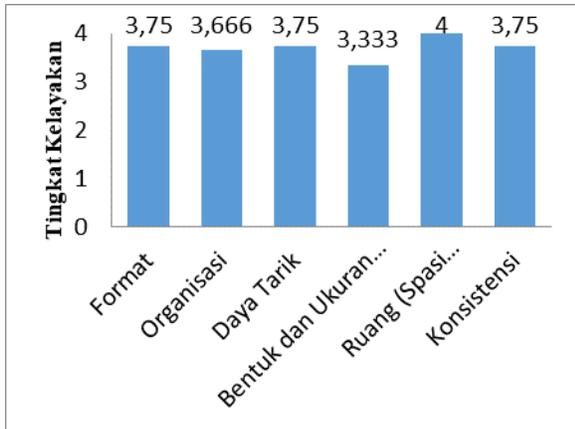


Figure 4. Graph of Media Feasibility Average Score

To determine the feasibility of the media in the module, it is necessary to calculate the ideal mean (Mi) and calculate the ideal standard deviation (Sbi) and then convert it. Here are the results of the calculation:

a. Media Feasibility Analysis

1) Calculating the ideal mean (Mi)

$Mi = \frac{x}{n}$ (ideal maximum score + ideal minimum score)

$$Mi = \frac{1}{2} \times (160 + 40)$$

$$Mi = 100$$

2) Calculating the ideal standard deviation (Sbi)

$Sbi = \frac{1}{6} \times (\text{ideal maximum score} - \text{ideal minimum score})$

$$Sbi = \frac{1}{6} \times (160 - 40)$$

$$Sbi = 20$$

3) Conversion

(a) Very Worthy

$$= Mi + 1,5 Sbi < X < Mi + 3 Sbi$$

$$= 100 + 1,5 (20) < X < 100 + 3 (20)$$

$$= 130 < X < 160$$

(b) Worthy

$$= Mi < X < Mi + 1,5 Sbi$$

$$= 100 < X < 100 + 1,5 (20)$$

$$= 100 < X < 130$$

(c) Fairly Eligible

$$= Mi - 1,5 Sbi < X < Mi$$

$$= 100 - 1,5 (20) < X < 100$$

$$= 70 < X < 100$$

(d) Not Eligible

$$= Mi - 3 Sbi < X < Mi - 1,5 Sbi$$

$$= 100 - 3 (20) < X < 100 - 1,5 (20)$$

$$= 40 < X < 70$$

Table 6. Media Criteria Score

No.	Score Range	Score	Category
1.	$Mi + 1,5 Sbi < X \leq Mi + 3 Sbi$	$130 < X < 160$	Very Worthy
2.	$Mi < X \leq Mi + 1,5 Sbi$	$100 < X < 130$	Worthy
3.	$Mi - 1,5 Sbi < X \leq Mi$	$70 < X < 100$	Fairly Eligible
4.	$Mi - 3 Sbi < X \leq Mi - 1,5 Sbi$	$40 < X < 70$	Not Eligible

Based on the overall media assessment criteria with a score of (x) 148, it gets the predicate "Very Eligible"

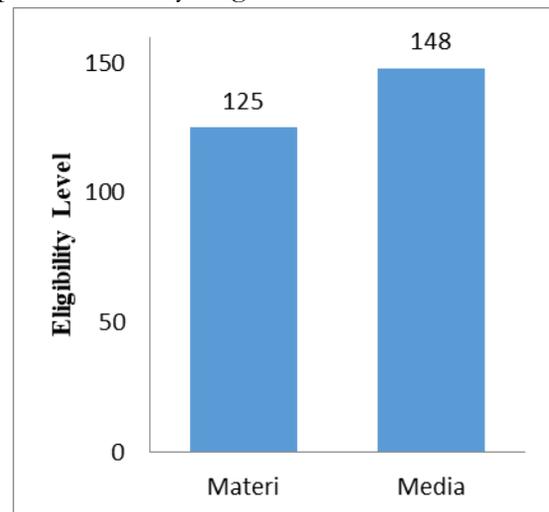


Figure 5. Module Feasibility Graph

Conclusion

The development of learning modules for Engineering Drawing subjects at SMK Negeri 1 Percut Sei Tuan has been carried out through several stages according to the Borg & Gall development model, namely: (1) identifying potential and problems, (2) collecting information, (3) product design, (4) design validation, (5) design improvement. The results of the feasibility test of the material expert with the average score of the expert feasibility test are 125 with the "very feasible" category. And the results of the media expert's feasibility test with the average score of the expert's feasibility test is 148 with the "very feasible" category.

Suggestions for further research

Based on the conclusions above, the suggestions that can be given in this study are as follows:

1. Further research is expected to carry out a usage test in order to determine the feasibility of the module used on students and to test the effectiveness of the use of the module to determine how much influence the module has in improving student learning outcomes
2. Modules that have been developed should be submitted for copyright
3. The teacher concerned should compile the module as the main teaching material with material that is easily understood by students and adapts to student characteristics. It is hoped that it will provide maximum learning outcomes.
4. Then it is hoped that researchers in the field of further development can develop the Engineering Drawing module with

more complete and up-to-date material according to the syllabus.

References

- Amri, A. A. N. & Sumbodo, W. (2018). Perancangan 3D Printer Tipe Core XY Berbasis Fused Deposition Modeling (FDM) Menggunakan Software Autodesk Inventor. *Jurnal Dinamika Vokasional Teknik Mesin*, 3(2), 110–115.
- Ardiansyah, M. F., Yoto, & Sumarli. (2017). Pengaruh Model Pembelajaran Kolaboratif dan Bakat Mekanik Terhadap Prestasi Belajar Siswa Program Keahlian Teknik Kendaraan Ringan Pada Mata Pelajaran Gambar Teknik Untuk Siswa SMK. *Jurnal Pendidikan Profesional*, 6(3).
- A. Putra, "Pengembangan Modul Berbasis Masalah pada Mata Pelajaran Dasar Listrik dan Elektronika," vol. 01, no. 01, pp. 48–52, 2020.
- Bisono, R. M., & Hendarti, D. R. (2019). Peningkatan Kemampuan Menggambar Teknik Siswa SMK Menggunakan Software Berbasis Computer Aided Design (CAD) Sebagai Upaya Pengembangan Kualitas Nilai Sumber Daya Manusia (SDM) Untuk Menghadapi Dunia Kerja. *Jurnal ABDINUS : Jurnal Pengabdian Nusantara*, 3(1), 11–19.
- Ciffolilli, A., & Muscio, A. (2018). Industry 4.0: national and regional comparative advantages in key enabling technologies. *European Planning Studies*, 0(0), 1–21. <https://doi.org/10.1080/09654313.2>

- Daryono, R. W., & Rochmadi, S. (2020). *Development of learning module to improve competency achievement in the department of civil engineering education in Indonesia*. 3(1), 34–43.
- Dewi, E. (2019). Potret Pendidikan di Era Globalisasi Teknosentrisme dan Proses Dehumanisasi. Sukma: Jurnal Pendidikan, 3(1), 93–116. <https://doi.org/10.32533/03105.2019>
- E. Mulyasa. (2006). *Kurikulum yang disempurnakan*. Bandung: PT. Remaja Rosdakarya.
- Emzir. (2013). *Metode Penelitian Kualitatif Analisis Data*. Jakarta: Rajawali Pers
- Gembarski, P. C., Li, H., & Lachmayer, R. (2017). *KBE-Modeling Techniques in Standard CAD Systems: Case Study—Autodesk Inventor Professional*. Switzerland: Springer International Publishing.
- Gunawan, A. (2016). Pemanfaatan Teknologi Informasi dan Komunikasi melalui Penggunaan Media Pendidikan dalam Pembelajaran IPS SD. *Pedagogi: Jurnal Penelitian*
- Ihsan, R. H., & Efendi. (2018). Perancangan Multimediainteraktif Pembelajaran Gambar Teknik Mesin Untuk Kelas Xi Menggunakan autocad Pada SMK Wisudha Karya Kudus. *Jurnal Ilmiah Komputer Grafis*, 11(1), 42– 54.
- Indra, M. R. I., & Saleh, R. (2021). Pengembangan E-Module Praktik Batu Beton Di Program Studi Pendidikan Teknik Bangunan Unj. *Jurnal PenSil*, 10(1), 41–46. <https://doi.org/10.21009/jpensil.v10i1.17781>
- Jima'ain, M. T. A., Mahpuz, A. N. 'Aqilah, Rahman, S. N. H. A., & Mohamad, A. M. (2019). Industrial Revolution 4.0: Innovation and Challenges of Islamic Education Teachers in Teaching. *BITARA International Journal of Civilizational Studies and Human Sciences*, 2(1), 38–47.
- Kristiawan, Pratama. S. (2017). *Pengembangan Modul Pembelajaran Gambar Teknik Untuk Siswa Kelas X Jurusan Ketenagalistrikan Di SMK N 1 Magelang*. Skripsi. Yogyakarta: Universitas Negeri Yogyakarta.
- Lestari, B., & Basuki, I. (2018). Pengembangan Perangkat Pembelajaran Problem Orientation, Observation, Elaboration, Explanation, and Write Report (Po2E2W) Ditunjang Dengan Video Tutorial Penggunaan Autocad Untuk Menggambar Teknik Listrik Di SMK Negeri 3 Surabaya. *Jurnal Pendidikan Teknik Elektro*, 7(3), 385–393
- Li, L., Lange, C. F., & Ma, Y. (2018). Artificial intelligence aided CFD analysis regime validation and selection in feature-based cyclic CAD/CFD interaction process. *Computer-Aided Design and Applications*, 15(5), 643–652. <https://doi.org/10.1080/16864360.2018.1441230>
- Lingenfelter, A. R., & Rew, L. S. (2019). Fragmentation Properties of Explosively Driven Additively Manufactured 15-5 PH Stainless Steel Cylinders. In *AIAA SciTech Forum*. California. <https://doi.org/10.2514/6.2019-0776>

- Negara, R. I. T. K., Iriani, T., & Lenggogeni. (2019). Pengembangan Multimedia Interaktif pada Mata Kuliah Manajemen Konstruksi di S1 Pendidikan Teknik Bangunan Universitas Negeri Jakarta. *Jurnal Pensil: Pendidikan Teknik Sipil*, 8(2).
- Nendra, F., Abdullah, R., & Jamilah, Y. (2019). *Developing CAD-Based Learning Module on Manufacturing Engineering Drawing*. 4(2), 215–226. <https://doi.org/10.24042/tadris.v4i2.5131>
- Priono, A. I., Purnawan, & Komaro, M. (2019). Pengaruh Penerapan Model Pembelajaran Blended Learning Terhadap Hasil Belajar Menggambar 2 Dimensi Menggunakan ComputerAided Design. *Journal of Mechanical Engineering Education*, 5(2), 129–140. <https://doi.org/10.17509/jmee.v5i2.15179>
- Putra, A. A. K. S., I Nyoman Pasek Nugraha, S.T., M. T., & Kadek Rihendra Dantes, S.T., M. T. (2018). Pengaruh Model Pembelajaran Quantum Teaching Terhadap Hasil Belajar Gambar Teknik Otomotif Siswa Kelas X TKRO SMK Negeri 3 Singaraja. *Jurnal Pendidikan Teknik Mesin Undiksha*, 6(3), 152–159. <https://doi.org/10.23887/jjtm.v6i3.18590>
- Riduwan. (2013). *Skala Pengukuran Variabel-Variabel Penelitian*. Bandung: Alfabeta.
- Rosa, F. O. (2015). Pengembangan Modul Pembelajaran IPA SMP Pada Materi Tekanan Berbasis Keterampilan Proses Sains. *Jurnal Pendidikan Fisika Universitas Muhammadiyah Metro*, 3(1), 49-63.
- Setiami, R., & Maulana, A. (2021). Development of E-Modules in Engineering Drawing Courses With the Bim System Building Modeling Application. *Jurnal PenSil*, 10(1), 1–7. <https://doi.org/10.21009/jpensil.v10i1.17013>
- Shisir, S., Manjunath, P., Pavanasudan, R., & Sathyajith, R. (2015). Design and Fabrication of Foldable Bicycle. *SSRG International Journal of Mechanical Engineering*, 2(6), 612.
- Situmorang, M., Yustina, & Syafii, W. (2020). E-Module Development using Kvisoft Flipbook Maker through the Problem Based Learning Model to Increase Learning Motivation. *Journal of Educational Sciences*, 4(4), 834–848.
- Subekti, H., Taufiq, M., Susilo, H., Ibrohim, & Suwono, H. (2018). Mengembangkan Literasi Informasi Melalui Belajar Berbasis Kehidupan Terintegrasi STEM untuk Menyiapkan Calon Guru Sains dalam Menghadapi Era Revolusi Industri 4.0: Reviu Literatur. *Education and Human Development Journal*, 3(1), 81–90.
- Sudjana, N, dan A., Rivai. (1992). *Media Pengajaran*. Bandung: Sinar Baru Algensindo.
- Sugiyono. (2014). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif dan R&D*. Bandung: CV. Afabeta.
- Sukoco, S., Arifin, Z., & Wakid, M. (2014). Pengembangan media pembelajaran interaktif berbasis komputer untuk peserta didik mata pelajaran teknik kendaraan ringan. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 22(2), 215–226. <https://doi.org/10.21831/jptk.v22i2.8937>

- Suprpto, A. (2018). Analisis dimensi kebutuhan pra implementasi elearning untuk meningkatkan mutu layanan pendidikan kampus di era revolusi industri 4 . 0. *Attarbiyah*, 28, 81–97. <https://doi.org/10.18326/tarbiyah.v28.81-97>
- Suyitno, S. (2016). Pengembangan multimedia interaktif pengukuran teknik untuk meningkatkan hasil belajar siswa SMK. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 23(1), 101. <https://doi.org/10.21831/jptk.v23i1.9359>
- Tjandrawina, R.R. (2016). Industri 4.0: Revolusi industri abad ini dan pengaruhnya pada bidang kesehatan dan bioteknologi. *Jurnal Medicinus*, Vol 29, Nomor 1, Edisi April. Pendidikan, 03(01), 24.
- Wahyudi, M. A., Widiyanti, W., & Nurhadi, D. (2018). Kecerdasan Visual Spasial Dan Kemandirian Belajar Pada Hasil Belajar Mata Pelajaran Gambar Teknik Di Smk. *Teknologi Dan Kejuruan: Jurnal Teknologi, Kejuruan, Dan Pengajarannya*, 41(2), 101–109. <https://doi.org/10.17977/um031v42i22018p101>
- Wati, I., & Kamila, I. (2019). Pentingnya Guru Professional dalam Mendidik Siswa Milenial Untuk Menghadapi Revolusi 4.0. *Prosiding Seminar Nasional Pendidikan Program Pascasarjana Universitas PGRI Palembang*, 12(1), 364–370.
- Wibowo, T., Supartono, & Supardi, K. I. (2015). Pengembangan Modul Termokimia dengan Pendekatan Inkuiri Terpadu Pendidikan Karakter untuk Meningkatkan Logika Siswa. *Journal of Innovative Science Education*, 4(1), 1–6.
- Yulando, S., & Chi, T. F. (2019). Electronic Module Design and Development: An Interactive Learning. *American Journal of Educational Research*. 7(10), 694–698. <https://doi.org/10.12691/education-7-10-4>
- Zhang, C., & Zhou, G. (2019). A viewbased 3D CAD model reuse framework enabling product lifecycle reuse. *Advances in Engineering Software*, 127(28), 82–89. <https://doi.org/10.1016/j.advengsoft.2018.09.001>
- Z. Lubis, “Pengembangan Modul Pembelajaran Operasi Dasar PLC Berbasis Masalah untuk Sekolah Menengah Kejuruan,” vol. 06, no. 02, pp. 442–448, 2020.