



Development of Interactive Learning Media for the Lathe Machining Subject among Twelfth-Grade Mechanical Engineering Students at SMK Muhammadiyah 3 Yogyakarta

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ABSTRACT

This study aims to identify the characteristics and evaluate the feasibility of an interactive learning media developed for the Lathe Machining subject, specifically addressing Basic Competency 3.1 for twelfth-grade Mechanical Engineering students at SMK Muhammadiyah 3 Yogyakarta. The research employed a Research and Development (R&D) approach that followed the Four-D (4D) model, which consists of four systematic stages: Define, Design, Develop, and Disseminate. In the define stage, the researcher analyzed learning needs, content structure, and competency standards to determine the instructional requirements of the media. The design stage focused on creating a prototype with both conceptual and visual frameworks, including a storyboard and flowchart. The develop stage involved constructing and validating the media through evaluations by subject matter experts and media experts, followed by revisions based on the obtained feedback. In the disseminate stage, the final product was packaged and distributed for classroom use. The resulting interactive learning media contains five main menus: About the Media, Instructions, Learning Materials, Evaluation, and References. It integrates text, images, audio, video, and animation across 80 pages with a total file size of 236 MB. The navigation features include Home, Exit, Sound, Next, Back, Cancel, and Table of Contents, which improve user interaction and accessibility. The instructional content covers trapezoidal threads, worm threads, eccentric shafts, and turning equipment, and it aligns with the 2013 Curriculum's scientific learning approach. The feasibility assessment results show that the developed media is highly feasible, as indicated by expert validation with an average score of 3.31, categorized as very feasible. Furthermore, field trials involving students resulted in an average score of 3.23, categorized as feasible. These findings indicate that the interactive learning media is pedagogically appropriate, user-friendly, and suitable for implementation in vocational machining education.



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1. INTRODUCTION

In the current era of development, education has become an essential necessity that must be fulfilled to support human life (Yoga et al., 2024). Education is a deliberate and systematic effort to create a learning process aimed at developing learners' potential, skills, and personal characteristics that are beneficial both to themselves and to society at large. Furthermore, Article 3 of Law No. 20 of 2003 explicitly states that education aims to cultivate individuals who are faithful and devoted to God Almighty, possess noble character, are healthy, knowledgeable, capable, creative, independent, and responsible democratic citizens.

Educational goals can be achieved only when the learning process functions effectively in both classrooms and laboratories (Ma'ruf et al., 2024). According to Government Regulation No. 32 of 2013 concerning National Education Standards, learning is defined as an interactive process among students, educators, and learning resources within a specific learning environment. Consequently, the success of the learning process largely depends on the educator, the students, and the learning resources. The

educator, as a facilitator, determines learning success through the teaching methods employed; students, as the central subjects, through their level of understanding of the material; and learning resources, through the availability of adequate facilities and media. Successful students are those who achieve the intended learning objectives (Suyitno et al., 2018). Therefore, educational technology plays a vital role in supporting learners, particularly in self-directed learning (Darmono et al., 2025).

Based on the Ministry of Education and Culture Regulation No. 65 of 2013 regarding the Process Standards for Primary and Secondary Education, paragraph 14 emphasizes the integration of information and communication technology (ICT) to enhance the efficiency and effectiveness of learning. This regulation also introduced significant changes to learning characteristics by incorporating inquiry-based and discovery-based learning approaches, as well as problem- and project-based learning models. These methods emphasize students' engagement with authentic problems, enabling them to construct knowledge independently, develop higher-order thinking and inquiry skills, foster autonomy, and build self-confidence (Arends in Hosnan, 2014, p. 295). In these models, learners are required to actively participate in the learning process, making it easier to internalize and master the material, while the teacher's role shifts from authority to facilitator. Student-centered learning demands specific strategies to ensure the process runs smoothly and aligns with educational objectives. One strategy that aligns with these approaches is PAIKEM.

PAIKEM stands for Pembelajaran Aktif, Inovatif, Kreatif, Efektif, dan Menyenangkan (Active, Innovative, Creative, Effective, and Enjoyable Learning). Within the PAIKEM framework, to ensure learning effectiveness, teachers must manage time efficiently, accommodate various learning styles (auditory, visual, and kinesthetic), provide clear task instructions, utilize appropriate learning resources and media, and maintain effective classroom management with clear rules and structure (Chotimah & Fathurrohman, 2018, p. 206). To realize PAIKEM principles, teachers and students must not rely on a single medium but instead integrate multiple forms of media within the learning process.

SMK Muhammadiyah 3 Yogyakarta, an accredited vocational high school specializing in Engineering and Information and Communication Technology, is located at Jalan Pramuka No. 62, Giwangan, Umbulharjo, Yogyakarta. Theoretical instruction in this institution is largely dominated by the lecture method, occasionally supplemented with question-and-answer sessions. This approach results in limited student participation and a teacher-dominated classroom environment, causing students to remain passive during lessons. Teachers primarily use the blackboard as the instructional medium, which makes the learning atmosphere monotonous and less engaging for students.

Therefore, it is crucial to develop appropriate learning media. Learning media are essential in the teaching and learning process in vocational education (Darmono et al., 2024). Media can represent what cannot be fully conveyed verbally by the teacher, and abstract concepts can be made more concrete through their use (Djamarah & Zain, 2006). The use of such media can enhance students' cognitive abilities as a foundation for practical application. The instructional media developed in this study are computer-based interactive materials incorporating text, audio, visuals, and animations created using Lectora Inspire.

Lectora Inspire is an application that can be used to develop presentations and educational media. It offers user-friendly features for creating learning materials and assessments, and its outputs can be published both online and offline, allowing students to engage in independent study. The software is designed specifically for e-learning purposes, integrating Flash objects, video recording, images, and screen capture tools. According to Mas'ud in Shalikhah (2016, p. 112), Lectora Inspire has become increasingly popular among educators.

The focus of this study is to develop an interactive instructional media product using Lectora Inspire based on the stages of instructional media development, ensuring its effectiveness for the Machining Techniques (Lathe Technology) course at SMK Muhammadiyah 3 Yogyakarta. The study also aims to analyze and interpret media feasibility instruments to determine the appropriateness of the developed instructional media and assess students' responses.

2. RESEARCH METHODS

A. Type of Research

This study employed a Research and Development (R&D) approach using the 4D model, which has been proven effective in designing and testing learning media (Setiawan & Purnomo, 2019).

B. Development Model

The development model applied in this research was the Four-D model proposed by Thiagarajan (1974), which consists of four stages: *Define*, *Design*, *Develop*, and *Disseminate*.

C. Time and Location of Study

The research was conducted at SMK Muhammadiyah 3 Yogyakarta in September 2019.

D. Research Subjects

The subjects of this study were 21 students from Class XII TP1 of the Machining Engineering Program.

E. Data, Instruments, and Data Collection Techniques

The data were analyzed using a descriptive quantitative approach. The measurement used a four-point Likert scale with the following response categories:

- Very Good (score 4)
- Good (score 3)
- Poor (score 2)
- Very Poor (score 1)

According to Widoyoko (2012, p. 123), the classification table is arranged based on the highest score, lowest score, number of classes, and interval range, as shown in Table 1.

Table 1. Feasibility Classification Criteria

Mean Score	Classification
> 3.25 to 4	Very Eligible
> 2.50 to 3.25	Eligible
> 1.75 to 2.50	Not Eligible
1 to 1.75	Very Eligible

The mean score for each aspect was calculated using Equation (1):

$$A = \frac{B}{C \times D} \dots \dots \dots (1)$$

Where:

A = mean score

B = total score obtained

C = number of respondents

D = number of instrument items

The resulting mean score was then compared with Table 1. The interactive learning media developed in this study was considered feasible for instructional use if the overall mean score across all aspects of the instrument reached 2.51 or higher, corresponding to at least the “*Feasible*” category.

3. RESULTS AND DISCUSSION

A. Stages of Interactive Learning Media Development

The interactive learning media product for the *Lathe Machining Techniques* course, designed for Grade XII Machining Engineering students at SMK Muhammadiyah 3 Yogyakarta, was developed using an adaptation of the 4D (Four-D) research and development model, consisting of four stages: *Define*, *Design*, *Develop*, and *Disseminate*.

1) Define Stage

The define stage involved determining the requirements and specifications necessary for developing the interactive learning media. Data for this stage were collected through observation and interviews, which were then analyzed descriptively based on relevant theoretical frameworks. Based on the previously identified issues, the development of the *Lathe Machining Techniques* interactive learning media aimed to address several key problems: (1) 42.85% of students perceived the subject as difficult due to its complexity; (2) teachers continued to rely on conventional lecture-based instruction,

leading to low student engagement and passivity during learning activities; and (3) the limited use of instructional media made lessons less appealing to students. From the analysis of theoretical content in the *Lathe Machining Techniques* course, one core competency was selected for inclusion in the media: Basic Competency 3.1 Applying Complex Turning Techniques, which covers topics such as *trapezoidal threading, worm threading, eccentric shafts, and turning using auxiliary tools*.

2) Design Stage

The design stage focused on preparing the initial design of the interactive learning media. Since this study utilized non-test instruments, the parameters for assessing media feasibility were derived from questionnaire results. The questionnaires included material expert validation forms, media expert validation forms, and student response questionnaires.

The choice of media platform for developing the *Lathe Machining Techniques* interactive learning tool was based on prior needs analysis, which identified Lectora Inspire 17 as the most suitable software.

The initial design process was divided into two major activities.

- a) Content Design: This activity involved structuring the media content using a flowchart and a storyboard. The flowchart illustrated the navigational flow among pages, while the storyboard described the detailed layout and elements of each page.
- b) Media Production: This activity focused on developing the interactive learning media based on the prepared content design. It consisted of several steps: designing the user interface, inputting learning materials, integrating supporting media (audio, images, video, and animations), and publishing the prototype.

The resulting prototype featured five main menus: *About Media, Guidelines, Materials, and Evaluation*. The main navigation buttons included *Home, Exit, Sound, Next, Back, Cancel, and Table of Contents*. The media integrated text, images, audio, video, and animations.

The content was presented through a scientific learning approach aligned with the 2013 Curriculum, encompassing the activities of *observing, questioning, gathering information, associating, and communicating*. The evaluation section contained 50 questions, including multiple-choice, matching, and drag-and-drop types, with a 60-minute duration and a passing score (KKM) of 75. The entire media consisted of 80 main pages with a file size of 236 MB.

3) Develop Stage

The develop stage aimed to produce the final version of the interactive learning media after revisions were made based on expert feedback and trial results. The prototype created in the design stage was validated by subject matter experts and instructional media experts who possessed expertise in *Lathe Machining Techniques* and *Instructional Media Development*.

The material validation was conducted by two experts: one lecturer from the Department of Mechanical Engineering Education, Yogyakarta State University (UNY), and one *Machining Engineering teacher* who teaches *Lathe Machining Techniques* at SMK Muhammadiyah 3 Yogyakarta. The media validation was performed by two media experts: one lecturer from the same department at UNY and the Vice Principal for Curriculum Affairs at SMK Muhammadiyah 3 Yogyakarta.

The material experts assessed the learning media based on three aspects:

- a) Material Quality – to evaluate the overall quality of the content presented through the media.
- b) Content Quality – to assess the accuracy and relevance of the instructional content.
- c) Instructional Quality – to examine the effectiveness of content delivery and the media's contribution to the learning process.

The assessment results from both material experts, converted into categorical scales, are presented in Table 2, which illustrates the evaluation of the interactive learning media based on these three aspects.

Table 2. Data Analysis Results Based on Material Expert Evaluation

Aspects	Expert 1	Expert 2	Average	Category
Material Quality	2.83	3.17	3	Eligible
Material Content	2.82	3.18	3	Eligible
Learning Quality	3	3	3	Eligible
Average	2.88	3.12	3	Eligible

The evaluation of the interactive learning media by media experts covered three primary aspects: communication, display, and usability.

- The communication aspect aimed to assess the media's effectiveness in conveying information to students.
- The display aspect evaluated the quality and aesthetic design of the interactive media interface.
- The usability aspect measured the reliability and ease of use of the developed learning media.

The results of the media experts' assessments, converted into categorical scales, are summarized in Table 3.

Table 3. Data Analysis Results Based on Media Expert Evaluation

Aspects	Expert 1	Expert 2	Average	Category
Communication	3.78	3.56	3.67	Very Worthy
View	3.81	3.18	3.5	Very Worthy
Usage	3.6	3.8	3.7	Very Worthy
Average	3.73	3.51	3.62	Very Worthy

The interactive learning media for Lathe Machining Techniques produced in the initial design stage constituted Prototype I. After expert evaluations and subsequent revisions, Prototype II was developed. The next step involved field testing with the student participants to refine Prototype II and produce the final version of the learning media.

The field testing was conducted with 21 students from Class XII TP1 of the Machining Engineering Program at SMK Muhammadiyah 3 Yogyakarta. The purpose of this phase was to gather student feedback regarding the feasibility and usability of the developed interactive learning media.

The students' feedback data were then used as the basis for further improvements to the media. The evaluation aspects assessed during the field trial included display, content, instructional quality, and usability. The converted results of the limited field trial are presented in Table 4.

Table 4. Summary of Student Responses from Field Testing

Aspect	Mean	Category
Display	3.22	Feasible
Content	3.28	Feasible
Instructional Quality	3.23	Very Feasible
Usability	3.20	Feasible
Average	3.23	Feasible

4) Dissemination Stage

The dissemination stage represented the final phase in the development of the interactive learning media. At this stage, the completed media application was packaged into a Compact Disc (CD) and distributed to the research site, SMK Muhammadiyah 3 Yogyakarta. Additionally, the multimedia file was shared online via Google Drive to enable public access and download through the following link: https://drive.google.com/drive/folders/1yV3gKB9rOT99SJ6R2Gy_fpAwFwYN5qGE?usp=sharing

B. Feasibility of the Interactive Learning Media

The feasibility of the *Interactive Learning Media for Lathe Machining Techniques* was evaluated through validation assessments conducted by material experts and media experts. The material validation focused on three aspects: material quality, content accuracy, and instructional quality. Meanwhile, the media validation encompassed communication effectiveness, visual presentation, and usability aspects.

Based on the evaluation by two material experts, the material quality aspect obtained an average score of 3.0, categorized as *feasible*. Similarly, the content accuracy and instructional quality aspects both received an average score of 3.0, also categorized as *feasible*. Thus, the overall material validation results classified the interactive learning media as *feasible* with a mean score of 3.0. The results of the material expert assessment are illustrated in Figure 1.

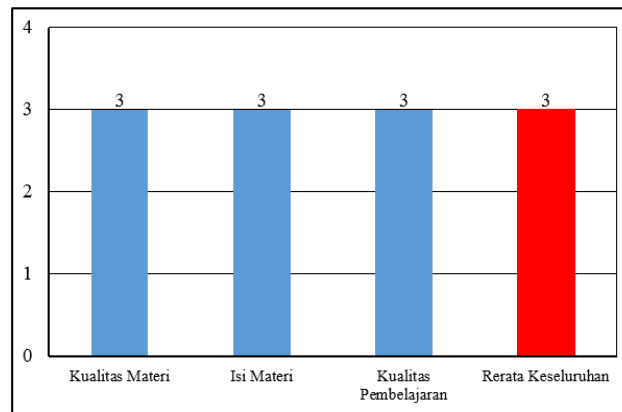


Figure 1. Material Expert Assessment Results

In contrast, the assessment results from two media experts indicated that the communication aspect achieved an average score of 3.67, the visual presentation aspect obtained 3.5, and the usability aspect scored 3.7. All three aspects fall within the *highly feasible* category. Therefore, the overall media validation of the *Interactive Learning Media for Lathe Machining Techniques* is classified as *highly feasible* with a mean score of 3.62. The media expert evaluation results are presented in Figure 2.

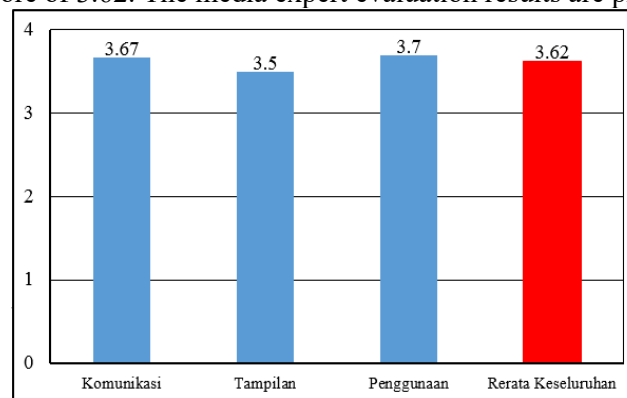


Figure 2. Media Expert Assessment Results

The cumulative analysis of both material and media expert assessments yielded an overall mean score of 3.31, which corresponds to the *highly feasible* category. This result indicates that the developed media meets the necessary standards for instructional implementation. The combined mean scores from both material and media experts are shown in Figure 3.

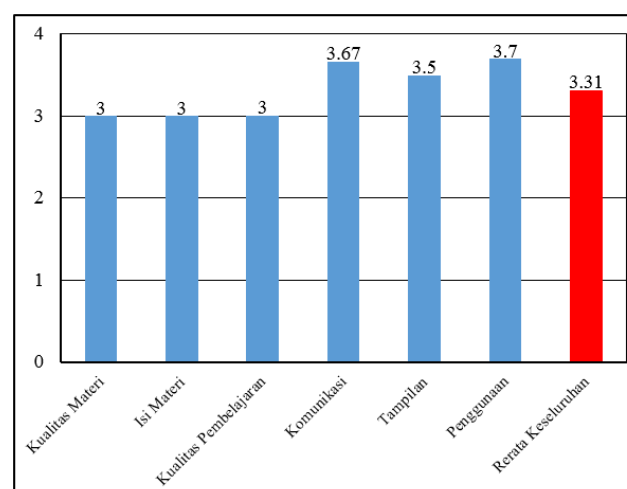


Figure 3. Combined Evaluation Results of Material and Media Experts

The graph in Figure 3 shows that the media achieved the highest scores in the communication and usability aspects, with average scores of 3.67 and 3.7, respectively—both classified as *highly feasible*. This demonstrates that the media is not only communicative but also user-friendly. The material quality, content accuracy, instructional quality, and visual presentation aspects scored 3.0, 3.0, 3.0, and 3.5, respectively. Based on the cumulative mean score of 3.31, the *Interactive Learning Media for Lathe Machining Techniques* is conclusively deemed *highly feasible*.

A field trial was conducted to obtain student feedback as the end users of the developed media, focusing on four aspects: visual presentation, material content, instructional quality, and usability. The trial involved 21 students from Class XII TP1 of the *Lathe Machining Techniques* program. The average scores obtained from the field test are depicted in Figure 4.

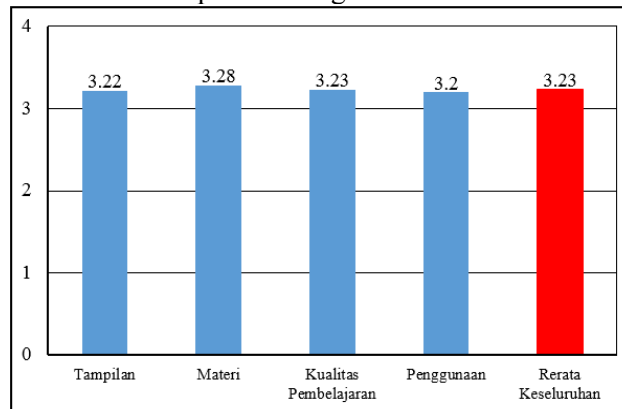


Figure 4. Student Response Results from Field Testing

Based on the analysis of student responses, the media obtained an average score of 3.22 for visual presentation, 3.28 for material content, 3.23 for instructional quality, and 3.20 for usability. These results indicate that the interactive learning media is classified as *feasible* across all four aspects.

Overall, the field trial produced a mean score of 3.23, indicating that the *Interactive Learning Media for Lathe Machining Techniques* is *feasible* for classroom implementation and ready for use in instructional activities.

4. CONCLUSION

Based on the research and development process conducted, it can be concluded that the developed interactive learning media for the *Lathe Machining Techniques* course—specifically for Basic Competence 3.1—intended for twelfth-grade students of the *Machining Engineering Program* at SMK Muhammadiyah 3 Yogyakarta, consists of five main menus: *About the Media*, *Instructions*, *Learning Materials*, *Evaluation*, and *References*. The main navigation buttons include *Home*, *Exit*, *Sound*, *Next*, *Back*, *Cancel*, and *Table of Contents*.

The learning materials within the media cover topics such as *trapezoidal threads*, *worm threads*, *eccentric shafts*, and *turning accessories*. These materials are presented through a combination of text, images, audio, video, and animations, comprising a total of 80 pages with a file size of 236 MB.

Furthermore, the feasibility of the interactive learning media was classified as highly feasible, based on validation results from both material and media experts, who provided a combined average score of 3.31. Additionally, user responses obtained through field testing with students yielded an average score of 3.23, categorized as *feasible*.

Based on the findings, several recommendations can be proposed, the first is future studies should conduct effectiveness testing to measure the impact of the interactive learning media for *Lathe Machining Techniques* on students' learning outcomes in the twelfth-grade *Machining Engineering Program*. Then, it is recommended to develop similar interactive learning media for other subjects and educational levels to broaden its applicability. Furthermore, the last is further development should focus on creating interactive learning media with enhanced accessibility, ensuring compatibility across various platforms and devices beyond desktop computers.

REFERENCES

- Chusnul Chotimah & Muhammad Fathurrohman. (2018). *Paradigma baru sistem pembelajaran: dari teori, metode, model, media, hingga evaluasi pembelajaran*. Yogyakarta: Ar-Ruzz Media.
- Darmono., Setiawan, R. J., & Khakam, M. (2025). Determining Factors Influencing Indonesian Higher Education Students' Intention to Adopt Artificial Intelligence Tools for Self-Directed Learning Management. *European Journal of Educational Research (EU-JER)*, 14(3), 805-828.
- Darmono., Setiawan, R. J., Khakam, M., Hudha, M. E. A., & Khosyati, N. E. (2024). Analysis of Autodesk Inventor E-Module Implementation in Engineering Drawing Subject (Case Study at SMKS Alkhairaat Bahodopi Vocational High School Morowali). *JUTECH: Journal Education and Technology*, 5(1), 1-11.
- Djamarah, S.B. & Aswan Zain. (2013). *Strategi belajar mengajar*. Jakarta: PT. Rineka Cipta.
- Hosnan, M. (2014). *Pendekatan saintifik & kontekstual dalam pembelajaran abad 21*. Bogor: Penerbit Ghalia Indonesia.
- Ma'ruf, K., Setiawan, R. J., Darmono., Khosyati, N. E., & Azizah, N. (2024). Optimizing The Application Of Occupational Safety And Health (K3) Culture In The Learning Process Of Mechanical Engineering Practice. *Prima Magistra: Jurnal Ilmiah Kependidikan*, 5(1), 93-104.
- Menteri Pendidikan & Kebudayaan Republik Indonesia. (2013). *Peraturan menteri pendidikan & kebudayaan republik Indonesia nomor 65 tahun 2013 tentang standar proses pendidikan dasar & menengah*. Jakarta.
- Presiden Republik Indonesia. (2013). *Peraturan pemerintah republik Indonesia nomor 32 tahun 2013 tentang standar nasional pendidikan*. Jakarta.
- _____. (2003). *Undang-undang republik Indonesia nomor 20 tahun 2003 tentang sistem pendidikan nasional*. Jakarta.
- Setiawan, R. J., & Purnomo, E. (2019). Pengembangan Media Pembelajaran Interaktif Pemesinan Frais Untuk Siswa Kelas XI Teknik Pemesinan SMK Muhammadiyah 3 Yogyakarta. *Jurnal Pendidikan Vokasional Teknik Mesin*, 7(2), 109-118.
- Shalikhah, N. D. (2016). Pemanfaatan aplikasi lectora inspire sebagai media pembelajaran interaktif. *Jurnal Cakrawala*, 11 (1), 101-115.
- Suyitno., Iis W., & Suryaneta B.M. (2018). Development of learning media for the course of two-stroke gasoline motors to improve students' learning outcomes. *Jurnal Pendidikan Teknologi & Kejuruan*, 24 (1), 83-90.
- Thiagarajan, S., Semmel, D.S., & Semmel, M.I. (1974). *Instructional development for training teachers of exceptional children*. Indiana: Indiana University Bloomington.
- Widoyoko, E. P. (2012). *Teknik penyusunan instrumen penelitian*. Yogyakarta: Pustaka Pelajar.
- Yoga, Y. N. P., Darmono., Setiawan, R. J., & Ma'ruf, K. (2024). The Implementation of Autodesk Inventor E-Module in The Study of Manufacturing Engineering Drawings. *Journal of Educational Learning and Innovation (ELIa)*, 4(1), 53-64.