Enhancing Manufacturing Optimization Course Through SIPEJAR Content Development-Based Micro Learning Approach

Suprayitno, Yanuar Rohmat Aji Pradana, Redyarsa Dharma B., Muhammad Yandi Pratama, and Haydar Yahya

Department of Mechanical and Industrial Engineering, Faculty of Engineering, Malang, Universitas Negeri Malang, Indonesia
suprayitno@um.ac.id

Abstract. Proper learning media is important to use to facilitate the delivery of material by teachers to students. The lack of interactive learning media that is suitable for use in manufacturing optimization courses, causes classroom learning to be inactive and seem boring. To get the right learning media, the ADDIE development model is commonly used in many studies. The aim of this research was to develop learning content for manufacturing optimization courses using the ADDIE learning media development model. The methods used generally consist of condition analysis, designing content, developing content, implementing content in the learning process, and evaluation containing feedback from users. The result of this research is the development of learning content for manufacturing optimization courses in the form of power points integrated e-book manufacturing optimization for 14 chapters. Power point integrated e-book manufacturing optimization learning content received a good response from students with a percentage of 80% falling into the very good category. By developing learning content in PPT integrated e-book manufacturing optimization form, it is hoped that learning can take place better than before. The conclusion of this research is that 14 chapters of learning content have been developed in the form of PPT integrated e-book manufacturing optimization and this content received a good response from students in the manufacturing optimization course with a percentage of 80% in the very good category.

Keywords: Learning Content, SIPEJAR, Microlearning, ADDIE Model.

1 Introduction

Good quality learning talks about how students are facilitated to build an understanding of the material [1]. To achieve this, the presentation of content or learning materials in the classroom is an important thing to be developed to be interesting and interactive [2], [3]. This task is assigned to lecturers as classroom teachers [4]. State University of Malang (UM) itself uses SIPEJAR as a digital learning platform [5]. Lecturers can use this platform to share learning content, such as power points, videos, and other types of learning content. However, there are shortcomings in the manufacturing optimization course, where there is no main

P. C. Kuswandi et al. (eds.), *Proceedings of the 6th International Conference on Current Issues in Education (ICCIE) 2023*, Advances in Social Science, Education and Humanities Research 847,
https://doi.org/10.2991/978-2-38476-245-3_18

reference book on optimization that is structured according to the number of lecture meetings.

To overcome this, a textbook on optimization should be developed which is structured according to the number of lecture meetings. Books as learning media can improve the quality of learning and student achievement, and can form a pleasant learning atmosphere in the classroom [6]–[10]. So the presence of textbooks is very necessary. At present, printed books have begun to be replaced by electronic books or e-books. E-books are books that are integrated with electronic devices such as smartphones [2]. The development of learning media for use in courses in Mechanical Engineering at State University of Malang (UM) has been carried out several times with satisfactory results [11]–[16]. Where, with the existence of learning media such as books, the quality of learning in the classroom is better than in the absence of learning media [1], [17], [18]. Other research that develops learning media such as power-point integrated with interactive media also shows positive results, the developed media gets positive attention from students, then also makes it easier for teachers to convey information to students.

On the basis of the description above, research on the development of learning media such as e-books and power points shows positive things in the learning process in the classroom. We want to continue these positive results where in this study due to the absence of proper learning media in this course, even though learning media is very important for its presence in the learning process in class as explained in the previous paragraph, especially to get optimal learning results in this course, it is also supported that the manufacturing optimization course is a compulsory course for mechanical engineering students UM. The specific objectives of this research are to develop micro learning-based content in SIPEJAR for a complete 16-week meeting, and create an power point integrated e-book for use in the Manufacturing Optimization Course in the UM Mechanical Engineering Undergraduate Study Program.

2 Method

Learning content in manufacturing optimization courses is developed using the ADDIE model. This model is very often used, especially in developing learning media, in which it consists of the stages of analysis, design, development, implementation, evaluation. In the analysis stage, researchers focus on the condition of learners. The intended conditions are such as knowing the educational background, age, and level of knowledge of students. This aims to adjust the conditions of students to the learning media developed. In addition, at the analysis stage, researchers also identify the focus of learning objectives, with a view to knowing the subject matter that must be presented, suitable learning models and strategies to use, and also as a reference indetermining the right practice questions.

The design stage is designing learning content. The process of designing learning content is based on the results of the analysis stage, from starting to determine the content that is suitable for educational background, student characteristics based on age and level of knowledge. After that, determine the subject matter presented in the right order in order to build a systematic understanding, determine models, learning

strategies and determinethe type of exercise in each learning material. At this stage, the learning media chosen is also determined, the form of validation instruments for experts, and the assessment ofstudent responses to the developed media.

At the development stage, the learning content is validated by three experts consisting of 1 material expert, 1 design expert, and 1 linguist. Material experts are mechanical engineering lecturers who have research experience in the field of manufacturing optimization. Media design experts are vocational education lecturers who have experiencen research in the field of learning content development. Linguists are industrial engineering lecturers who have research experience in the field of system optimization. Research instruments for validation are made in the form of a google form containing statements about learning media that have a Likert scale to assess the score chosen by expert.

Table 1. Interpretation of response criteria.

Score	Criterion
10 - 20%	Very poor
21 - 40%	Not good enough
41 - 60%	Good enough
61 - 80%	Good
81 - 100%	Excellent

The implementation stage is using the developed learning content in the classroom. At this stage, it aims to get feedback responses from students to the use of the developed learning media. The media is implemented to students as many as 22 students of manufacturing optimization courses. By getting students, it can be an additional reference worthy or not like media, apart from the results of validation by experts.

Table 2. Interpretation of validity criteria.

Score	Criterion
0-0.9	Highly invalid
1 – 1.9	Not valid enough
2 – 2.9	Valid enough
3 – 3.9	Valid
4 - 5	Highly valid

The evaluation stage is assessing the quality of the developed learning content. Evaluation is based on the results of validation by experts, the response of student participants to learning media, and the efficiency of the implicationsof the learning media in the classroom.

The developed learning content was tested on 22 students who are currently enrolled in the manufacturing optimization course for the 2023/2024 academic year, which is intended in this study as micro learning. To assess the quality of the developed learning content, students were given an instrument to measure their response to the learning media. Then at the development stage, experts are given validation instruments to measure the validity of the developed learning content whether it is feasible or not as learning media. The equation for evaluating response and validity is presented below.

$$Percentage\ of\ response\ (\%) = \frac{Number\ of\ scores}{Maximum\ number\ of\ scores} \quad (1)$$

$$Score\ of\ validity = \frac{Number\ of\ scores}{Number\ of\ statement\ items} \quad (2)$$

The results of the calculation of student responses and the validity of learning media are interpreted into response and validity criteria as in table 1 and table 2 [19], [20].

3 Result and Discussion

3.1 Result

The result of the analysis stage is the general learning objectives of the developed learning content. The reference follows the semester learning plan of the engineering design optimization course that has been made by the lecturer. The results are 1) explain optimization in product design and manufacturing process; 2) explain variability and probability in manufacturing optimization; 3) explain robust design in manufacturing optimization. 4) review the latest application of robust optimization in product design and manufacturing process. Based on the reference to the general learning objectives that have been determined, it can be determined the subject matter that must be present in the learning media, while the subject matter and sub-material determined based on the learning objectives are presented in Figure 3. Then the background of the audience is 5th semester mechanical engineering S1 students, adult age around 20-2 2years, the level of knowledge of undergraduate students. The learning model suitable for each meeting is Cooperative Project-Based Learning (CPBL). CPBL is a learning model that prioritizes group learning by investigating projects as the main object of learning. The selection of this model is based on the condition of Audie ns as a mechanical engineering student where mechanical engineering graduates are required to be able to work in a team and have good communication skills to complete a given project.

The design stage produces the design of the developed learning content, such as the initial design of the power point and the outline of the material for each meeting. These are presented in Figure 1 and Figure 2. Based on the results of the analysis stage, learning content is determined using international languages, namely English, this is based on students who have a 5th semester mechanical engineering self-engineering student education background, where in general mechanical engineering materials have main sources in English, so that content using international languages is chosen for further strengthen their understanding of the use of this language in the field of mechanical engineering. After that, the selected media is power point media integrated with e-books. Power point media as a place to present the gist of each material and manufacturing optimization e-books to present the

complete material from the power point. Power point was chosen as a medium because of its ease of access and e-books were chosen to reduce the use of paper, especially in this era, books are generally in digital form.

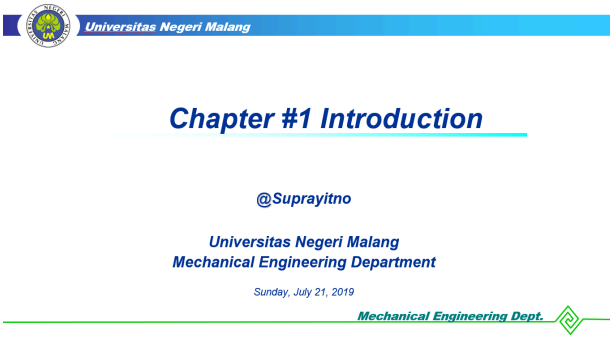

Fig. 1. Initial design of learning content.

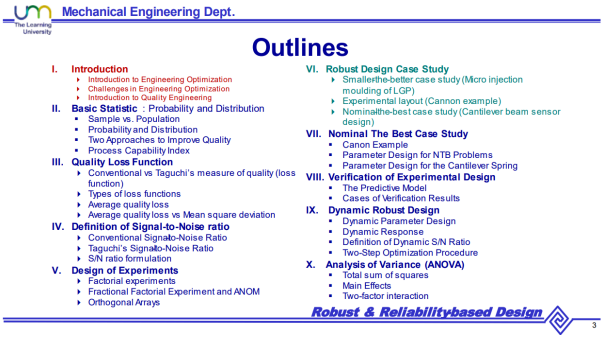

Fig. 2. Initial design of the learning content outline of each meeting.

The development stage is actually the stage where the developed learning content is assessed by experts. This is intended to determine the extent of feasibility as learning media in the classroom. The validation instrument used as a measuring tool to assess validity refers to research [19]. Learning content is validated by material experts, design experts and language experts. The results of the validation process are presented in Table 3 and Figure 3.

Table 3. Validity scores of learning media.

Description	Score	Validity
Material	4	Highly Valid
Language	4,1	Highly Valid
Design	4	Highly Valid

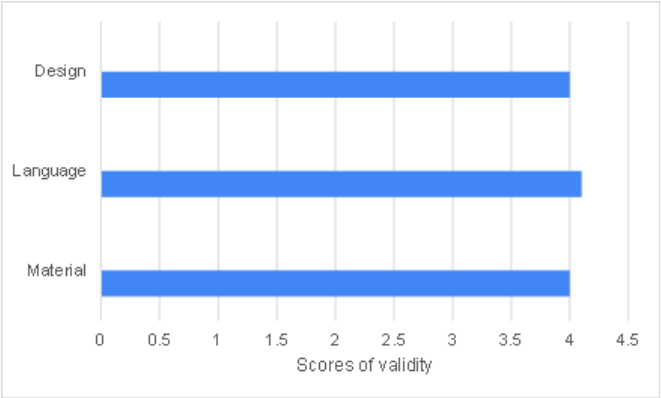

Fig. 3. Validity score bar chart.

The implementation stage is the application or use of learning content developed for use in the classroom. The developed learning content is used in manufacturing optimization lectures with 22 students in the 2023/2024 academic year of mechanical engineering at the State University of Malang. At this stage the response instrument is distributed to students to capture their opinions about the learning content developed and to get feedback such as suggestions or criticisms.

Table 4. Response percentage of learning media.

Description	Score (%)	Criterion
Display	82	Excellent
Presentation of material	84	Excellent
Benefit	84	Excellent

The evaluation stage contains the analysis of the effect or feedback from the implementation of the developed learning content. It can be known from student responses obtained at the implementation stage. The results of the student response data that have been collected are presented in Table 4, Figure 4, and Table 5.

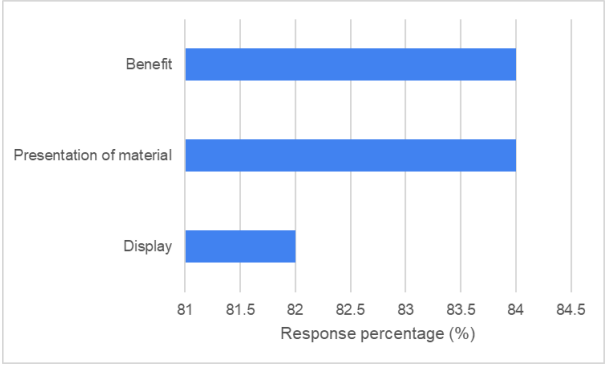

Fig. 4. Response percentage bar chart.

Table 5. Suggestions from students.

Suggestions	Sum
Learning media is considered good	11
More enlarged font size is expected	2
It is expected to add optimization simulation animations	2
Multiply image visualization examples	2
The material is made more concise	3
Add deployment examples to different fields	2

3.2 Discussion

From the learning content development process using the ADDIE model, Produced models and learning media products in the form of Power Point integrated with e-book optimization of tour manufak. This model and learning media are made based on the results of analysisat each stage of the ADDIE development model. In the analysis and design stage, the sequence of materials is designed by starting with an understanding of the main concept, then followed by more complex material [21]. Then, the CPBL model was chosen on the basis of conditions where the audience is mechanical engineering students who are required to become graduates who have good skills, knowledge, and communication. In Lozano et al's study, the CPBL model was efficient in improving knowledge, skills, and communication skills, and effectively encouraged positive emotions in learning [22]. While the choice of integrated power point learning media with manufacturing optimization e-books was chosen because of its ease of use [23]

At the development stage, the learning media product was validated by three experts. It is found that the developed learning content gets an average validity score of 4 which means excellent. These validation results indicate that the learning content developed is feasible as learning media for use in the classroom. Validation of the product or media developed aims to determine the level of feasibility [24]. At this stage, feedback from experts is also obtained to improve the developed media. Design experts recommend enlarging the size of the letters so that students are comfortable in reading. While material experts suggest that examples of problems in each material are more multiplied to manufacturing optimization rather than design optimization. Validation by experts is expected so that the developed media is accurate and provides the right level of information [25].

In the fourth stage, the implementation of the developed media is applied in the classroom. At this stage, response instruments are also distributed to find out feedback on the developed media. Then from the results of the percentage of student responses shows that this learning media gets a good response from students with an average percentage of 82%. In addition to data in quantitative form, data in qualitative form is also obtained.

4 Conclusion

Learning content developed using the ADDIE model is not only limited to power point media integrated with e-books but also learning models that suit the conditions

of students. Learning content for manufacturing optimization courses has been developed which is declared feasible as learning media based on an average validity score of 4, which is obtained from the expert research process, and the developed learning content also gets a good response from students with an average score of 82%. The work in the future is to perfect the learning media developed based on the inputs obtained in the media development process.

References

1. A. Alzaber, S. Suripah, and W. D. Susanti, "Pengembangan Buku Ajar Untuk Memfasilitasi Perkuliahan Dasar Dan Proses Pembelajaran Matematika (Dppm)," AKSIOMA: Jurnal Program Studi Pendidikan Matematika, vol. 10, no. 4, p. 2291, 2021, doi: 10.24127/ajpm.v10i4.4131.
2. R. T. Lestari, E. P. Adi, and Y. Soepriyanto, "Ebook Interaktif," JKTP: Jurnal Kajian Teknologi Pendidikan, vol. 1, no. 1, pp. 71–76, 2018.
3. M. A. Susilo and S. Suwahyo, "Pengembangan Media Pembelajaran Interaktif Berbasis Aplikasi Android Untuk Meningkatkan Hasil Belajar Kewirausahaan," Jurnal Pendidikan Ekonomi, vol. 12, no. 1, pp. 72–77, 2019.
4. Anna Maria; Hartini H, "Pengaruh Kompetensi Pedagogik dan Profesional Dosen Terhadap Indeks Prestasi Mahasiswa Semester II AKJP II Pekanbaru," Jurnal HUMMANSI (Humaniora, Manajeme, Akuntansi), vol. 3, no. 1, pp. 15–22, 2020.
5. M. D. K. Degeng, "Daya Tarik Pembelajaran SIPEJAR Ditinjau dari Sisi Locus of Control Mahasiswa yang Berbeda di Masa Pandemi Covid-19," Jurnal Pendidikan: Teori Penelitian dan Pengembangan, vol. 6, no. 1, p. 10, 2021, doi: 10.17977/jptpp.v6i1.14368.
6. R. Roemintoyo and M. K. Budiarto, "Flipbook as Innovation of Digital Learning Media: Preparing Education for Facing and Facilitating 21st Century Learning," Journal of Education Technology, vol. 5, no. 1, p. 8, 2021, doi: 10.23887/jet.v5i1.32362.
7. Suprihatien et al., "Blog Implications as Learning Media in Improving Learning Achievement of Students," J Phys Conf Ser, vol. 1175, p. 012260, Mar. 2019, doi: 10.1088/1742-6596/1175/1/012260.
8. D. Ayu, S. Ningsih, and H. Komikesari, "Kelayakan Media Pembelajaran Prezi Menggunakan Pendekatan Saintifik Feasibility of Prezi Learning Media Using Scientific," Indonesian Journal of Science and Mathematics Education, vol. 02, no. 2, pp. 204–209, 2019.
9. I. Rahayu and S. Sukardi, "The Development Of E-Modules Project Based Learning for Students of Computer and Basic Networks at Vocational School," Journal of Education Technology, vol. 4, no. 4, p. 398, Mar. 2021, doi: 10.23887/jet.v4i4.29230.
10. Y. D. Puspitarini and M. Hanif, "Using Learning Media to Increase Learning Motivation in Elementary School," Anatolian Journal of Education, vol. 4, no. 2, pp. 53–60, 2019.
11. N. Huda, M. Marsono, and Y. Yoto, "Learning Media Development Android Based on Basic Programming Subjects in a Pandemic Period," Budapest International Research adn Critics Institute-Journal, vol. 4, no. 4, pp. 11723–11734, 2021.
12. E. Sutadji, "Interactive Multimedia Development Engine Management System (Ems) Using the Addie Model," PalArch's Journal of Archaeology of Egypt/Egyptology, vol. 17, no. 4, pp. 609–629, 2020.
13. Y. Yoto, W. Widiyanti, S. Solichin, and T. Tuwoso, "Development of Life-Based Teaching Material on Welding Fields to form Entrepreneurial Characters," in International Conference on Vocational Education and Training, 2019, pp. 36–39. doi: 10.2991/icovet-18.2019.9.

14. M. Rohman, D. A. Sudjimat, M. Sugandi, and D. Nurhadi, “Developing an interactive digital book to improve the technical drawing abilities of mechanical engineering students,” Global Journal of Engineering Education, vol. 21, no. 3, pp. 239–244, 2019.
15. A. Suyetno and Y. Yoto, “Learning media development based on CNC simulator as the digital tool to support the CNC practice learning during COVID-19 new normal,” J Phys Conf Ser, vol. 1833, no. 1, 2021, doi: 10.1088/1742-6596/1833/1/012009.
16. M. Ihwanudin, L. Anwar, S. Sumarli, and S. Suhartadi, “Pengembangan Media 3D Exploded View pada Asynchronous Learning,” JINOTEP (Jurnal Inovasi dan Teknologi Pembelajaran): Kajian dan Riset Dalam Teknologi Pembelajaran, vol. 8, no. 3, pp. 247–257, 2021, doi: 10.17977/um031v8i32021p247.
17. T. P. R. N. Hapsari and A. Wulandari, “Analisis Kelayakan Buku Ajar Milenial Berbasis Augmented Reality (AR) sebagai Media Pembelajaran Teks Prosedur di Magelang,” Diglosia: Jurnal Kajian Bahasa, Sastra, dan Pengajarannya, vol. 3, no. 4, pp. 351–364, 2020, doi: 10.30872/diglosia.v3i4.125.
18. Damayanti et.al, “Kelayakan Media Pembelajaran Fisika Berupa Buku Saku Android pada Materi Fluida Statis,” Indonesian Journal of Science and Matematics Education, vol. 1, no. 1, pp. 63–70, 2018.
19. M. Y. Pratama and W. Warju, “Pengaruh Penggunaan Modul Chassis Dynamometer Terhadap Respon Mahasiswa Pada Mata Kuliah Analisis Performansi Mesin Di Jurusan Teknik Mesin FT Unesa,” Jurnal Pendidikan Teknik Mesin, vol. 10, no. 03, pp. 61–66, 2021.
20. S. R. Ariyanto, I. M. Arsana, and R. Ulum, “Pengembangan Modul Radiator Trainer untuk Meningkatkan Hasil Belajar Mahasiswa Jurusan Teknik Mesin UNESA,” Jurnal Dinamika Vokasional Teknik Mesin, vol. 4, no. 2, pp. 83–92, Sep. 2019, doi: 10.21831/dinamika.v4i2.27387.
21. D. Kay and J. Kibble, “Learning theories 101: application to everyday teaching and scholarship,” Adv Physiol Educ, vol. 40, no. 1, pp. 17–25, Mar. 2016, doi: 10.1152/advan.00132.2015.
22. A. Lozano, R. López, F. J. Pereira, and C. Blanco Fontao, “Impact of Cooperative Learning and Project-Based Learning through Emotional Intelligence: A Comparison of Methodologies for Implementing SDGs,” Int J Environ Res Public Health, vol. 19, no. 24, p. 16977, Dec. 2022, doi: 10.3390/ijerph192416977.
23. D. E. Frederick, “EBooks as a disruptive technology,” in Managing eBook Metadata in Academic Libraries, Elsevier, 2016, pp. 11–24. doi: 10.1016/B978-0-08-100151-6.00002-0.
24. C. H. Nabilah, A. Sesrita, and I. Suherman, “Development of Learning Media Based on Articulate Storyline,” 2020.
25. L. N. Lior, “Design and Development Models and Processes,” in Writing for Interaction, Elsevier, 2013, pp. 21–42. doi: 10.1016/B978-0-12-394813-7.00002-X.