

DEVELOPMENT OF MODULE ELEMENTARY LINEAR ALGEBRA INTEGRATED TO MEDIA PREZI FOR PRE-SERVICE MATHEMATICS TEACHER

Meiva Marthaulina Lestari Siahaan¹, Fitriani², Damianus Dao Samo³, Juliana M H
Nenohai⁴

^{1,2}Universitas Timor, Kefamenanu, Indonesia
^{3,4}Universitas Nusa Cendana, Kupang, Indonesia
e-mail: meivamarthaulina@unimor.ac.id

Abstract

This study purposed to describe the development and produce elementary linear algebra course modules on system of linear equation (SLE) and matrices integrated with Prezi learning media that are valid, practical and effective. This development research referred to the development design steps developed by Allesi & Trollip. The development design is grouped into three development procedures, which include: planning, design, and development stage. The product trial consisted of an alpha test conducted by two material experts and two media experts, as well as a beta test which was carried out through 2 stages, beta test 1 (small group trial) to 8 subjects; representatives of two students at cohort 2019/2020, 2020/2021, 2021/2022, and 2022/2023. Beta test 2 was conducted on 70 students who took the Elementary Linear Algebra course in cohort 2023/2024. Data collection used questionnaires for material experts, questionnaires for media experts, student response questionnaires, and tests. The developed module has several advantages. First, the material is prepared based on the results of research that has been done in previous studies so that it can minimize epistemological learning obstacles. Second, it is integrated with Prezi-based learning media that supports a deeper understanding of SLE content material.

Keywords: development of module, matrix, system of linear equations, prezi, preservice mathematics teacher

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan pengembangan dan menghasilkan modul mata kuliah aljabar linier dasar pada sistem persamaan linier (SLE) dan matriks terintegrasi dengan media pembelajaran Prezi yang valid, praktis dan efektif. Penelitian pengembangan ini mengacu pada langkah-langkah desain pengembangan yang dikembangkan oleh Allesi & Trollip. Perancangan pengembangan dikelompokkan menjadi tiga prosedur pengembangan, yang meliputi: tahap perencanaan, tahap desain, dan tahap pengembangan. Uji coba produk terdiri dari uji alpha yang dilakukan oleh dua orang ahli materi dan dua ahli media, serta uji beta yang dilakukan melalui 2 tahap, uji beta 1 (uji coba kelompok kecil) kepada 8 subjek; perwakilan dua orang mahasiswa semester tahun ajaran 2019/2020, 2020/2021, 2021/2022, dan 2022/2023. Sedangkan beta test 2 dilakukan terhadap 70 mahasiswa yang mengambil mata kuliah Aljabar Linier Dasar tahun ajaran 2023/2024. Pengumpulan data menggunakan angket untuk ahli materi, angket untuk ahli media, angket respon siswa, dan tes. Modul yang dikembangkan memiliki beberapa keunggulan. Pertama, materi disusun berdasarkan hasil penelitian yang telah dilakukan pada penelitian sebelumnya sehingga dapat meminimalisir hambatan belajar epistemologis. Kedua, terintegrasi dengan media pembelajaran berbasis Prezi yang mendukung pemahaman materi konten SLE lebih mendalam.

Kata kunci: pengembangan modul, matriks, sistem persamaan linear, prezi, calon guru matematika

INTRODUCTION

This research as a followed-up research and recommendation from research (Siahaan, Fitriani, & Rosa Da Lima Leli, 2023) and (Siahaan, Fitriani, & Manek, 2023). This research is used to improve the quality of teaching materials that support student understanding.

Activities that can be carried out in the development of teaching materials are revision of teaching materials, in substance, how to deliver material, and display material. Elementary linear algebra course as the first abstract course obtained by students majoring in mathematics. The most basic material in the course is the System of Linear Equations (SLE) and Matrices. The method learned to solve SLE is the Gauss-Jordan method. The Gauss-Jordan elimination method has the benefit of solving a problem of SLE form efficiently. The benefits obtained from the Gauss-Jordan method should be followed by one's understanding to use it in solving problems. The operation in the row reduction process is the main thing that makes students occurs difficulty (Smith & Powell, 2011) .

The results of previous research revealed several findings. The first finding is the sequence of material between SLE and matrices, should be preceded by matrices because at the time of SLE material, students do not fully understand the row echelon matrix model or the reduced one. It also relates to the matrix principles needed in solving SLE. The second finding also states that the presentation of SLE material to students would be better if it is preceded by the introduction of 'may' and 'may not' operations on an SLE. So that students can fundamentally understand why only three elementary row operations (ERO) are used to get the solution of SLE. This explanation is also relevant to the elimination method commonly used at the secondary school level. So, basically these two methods are equivalent to produce the solution of an SLE.

The reality is this fundamental information does not exist in the explanation of SLE and matrix material in elementary linear algebra courses. This is characterized by the absence of teaching materials that can convey SLE and matrix material in depth and not only procedurally. Textbooks that have been used in learning, rely on the implementation of ERO procedurally and in the conceptual part, using language that is not clearly understood by students (Ningrum et al., 2019); which cannot be understood by students easily. This situation also supports the emergence of learning obstacles experienced by students.

To accommodate the explanation of the situation above, this can be dealt with by overhauling the teaching materials used by overhauling the composition of the material, both the order of the material and the material delivery model in the teaching materials. Good teaching materials are also able to guide students to recall the concepts or principles of a material that has been learned (Tianisa & Suparman, 2018). In addition, it is also based on six

andragogy assumptions that are applied to instructional technology: learner's need to know, learner's self-concept, the role of learner's experience, learner's readiness to learn, and learner's motivation to learn.

The teaching materials to be developed in this study is module of SLE and matrices. Module is a way of organizing subject matter that pays attention to educational functions where the strategy of organizing learning materials consists of three stages of the thinking process: concept formation, concept interpretation and concept application (Sulistiyorini & Argarini, 2019). Concept formation in this module is realized by presenting definitions, properties and principles related to SLE and matrices. Interpretation of concepts in this module is realized in illustrations that support concepts, such as the relevance of the elimination method in high school with OBE on an enlarged matrix. The application of concepts in this module is realized by the existence of sample problems, practice problems and problems by applying the concepts of SLE and matrices.

Then to support the understanding of concepts and increase student motivation in learning SLE and matrix material can use teaching materials integrated with prezi media. Prezi is an application that combines creative thinking with modern technology facilities (Špernjak, 2014). Prezi has various advantages over presentation applications such as PowerPoint. Learners with learning that applies Prezi have the ability to remember and understand better than learning that applies PowerPoint (Akgün et al., 2016).

In addition to presentations, Prezi can also be used as a tool to explore and share ideas on a virtual canvas. Prezi excels because the program uses the Zooming User Interface (ZUI), which allows Prezi users to zoom in and out of their presentation media. The uniqueness of presenting with Prezi is that there is no need to move from one slide to another. It is enough with one big canvas that can be inserted with images, videos, data, etc. and simply shifted, so that our presentation place is like seeing a graffiti painting display on a wide wall. Thus, for presentations with Prezi there is no need for many slides, just one slide (Sulistiyorini & Argarini, 2019). Concept interpretation integrated with Prezi learning media is expected to help students understand the concept of SLE.

Research conducted by (Rohiman & Anggoro, 2019) and (Rosmiati & Siregar, 2021) suggest that the quality of using prezi learning media in learning mathematics is very good so it is recommended for use in learning mathematics. Likewise, the results of research

by (Setiyani et al., 2021) that the development of interactive media assisted by prezi media can support students' mathematical understanding abilities. The similar finding yet discovered by (Atika, 2021)) that there was a good effect in using the Problem Based Learning model using Prezi media.

METHODS

The research belongs to Research & Development research, which is research oriented to research, design, produce, test, the validity of the products produced (Sugiyono, 2019). The development model used in this study is the model developed by M. Alessi and Stanley R. Trollip, which consists of the stages of planning, design, and development. The (Alessi & Trollip, 2001) development model has three stages, namely planning, design, and development. The three stages have components at each stage. These components are standards, continuous evaluation and project management. The development model can be a reference in producing effective products because the stages are quite simple and at each stage there are components that are explained in detail in following Picture 1, 2, and 3. The subjects of the research were preservice mathematics teacher who held elementary linear algebra course in Universitas Timor at cohort 2019/2020, 2020/2021, 2021/2022, dan 2022/2023.

PLANNING

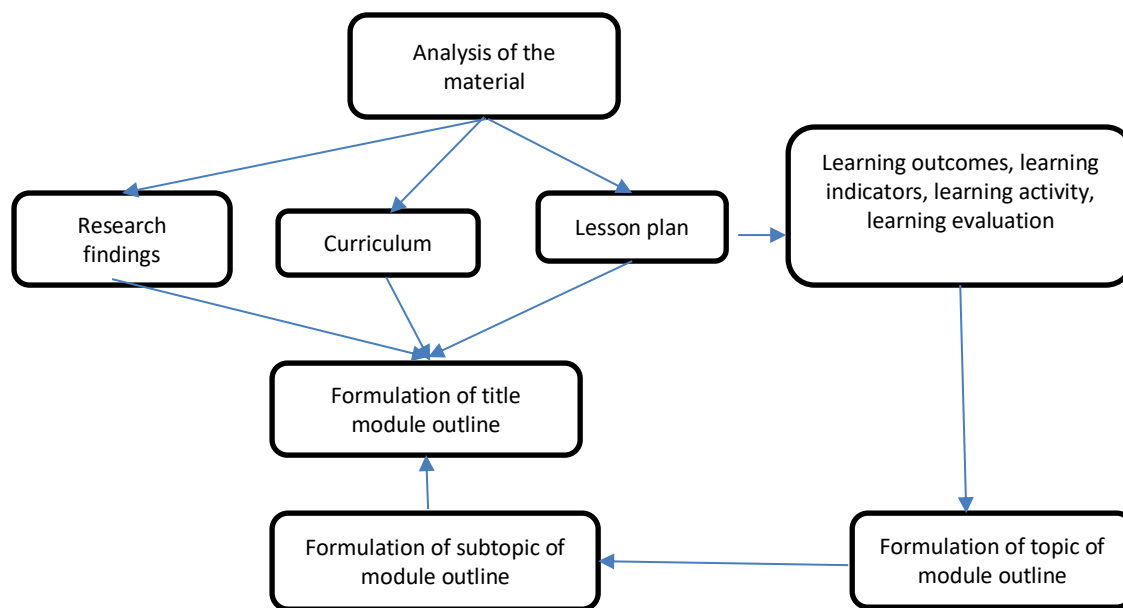


Figure 1. Research Procedure on Planning Stage

DESIGN

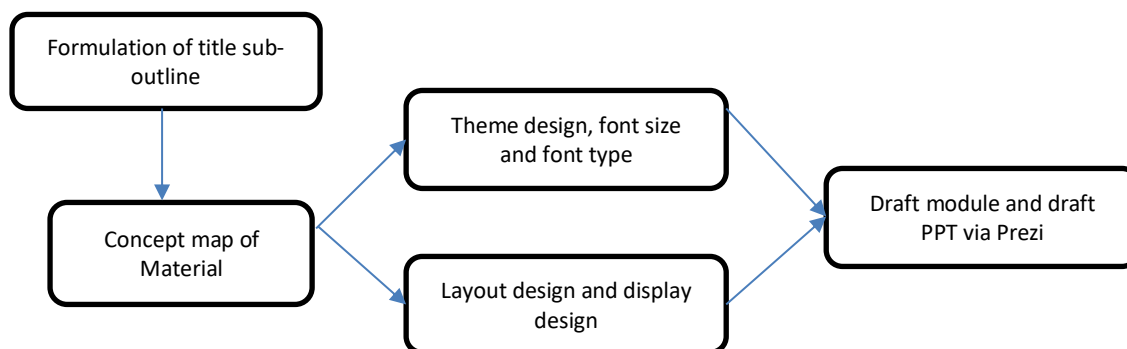


Figure 2. Research Procedure on Design Stage

DEVELOPMENT

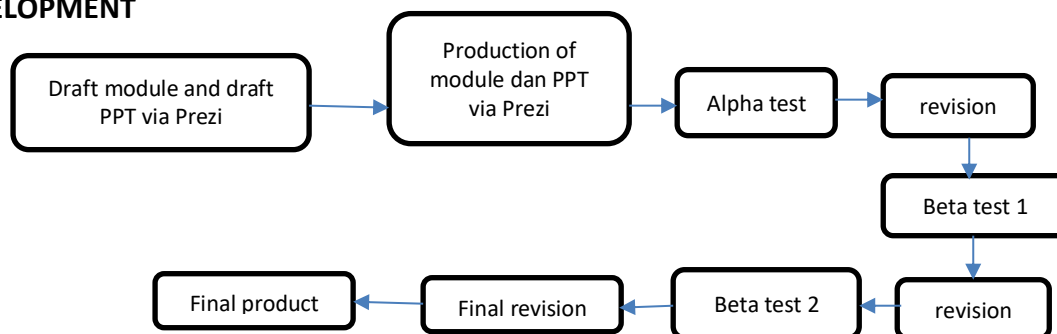


Figure 3. Research Procedure on Development Stage

The instrument in measuring the validity, practicality, and effectiveness of the module integrated to prezi, the following instrument blueprint are presented based on the aspects measured in table 1. Then followed by the test instrument blueprint in table 2.

Table 1. Indicators of the Aspects of Validity, Practicality, and Effectiveness of Modules Integrated Prezi Media

Aspect	Instrument	Indicators
Validity	Validation sheet of expert of material	<i>self-instruction</i> <i>self-contained</i> <i>Stand-Alone</i> <i>Adaptive</i> <i>User friendly</i>
	Validation sheet of expert of media	Size of the module Design of module cover Design of module content Exploration of Learning Media Prezi Utilization of Learning Media Prezi
Practicality	Student response questionnaire	Learning Display Utilization of Learning Media Prezi
Efectivity	Test	Students' ability to understand the concept of SLE after using the module

Table 2. The blueprint instrument test in SLE

Outcome indicators	Amount
a. To solve SLE with a single solution using the Gauss-Jordan elimination method	1
b. To represent the reduced matrix into the SLE solution	
a. To solve SLE with multiple solution using the Gauss-Jordan elimination method	1
b. To represent the reduced matrix into the SLE solution	
c. To solve SLE with no solution using the Gauss-Jordan elimination method	1
a. To represent the reduced matrix into the SLE solution	

RESULTS AND DISCUSSION

Planning

The purpose of developing this module is to minimize the learning obstacles experienced by students in learning matrix and SLE because it is arranged based on student learning trajectories (Siahaan, Fitriani, & Rosa Da Lima Leli, 2023) and (Siahaan, Fitriani, & Manek, 2023) The establishment of matrix and SLE content material is the result of previous research conducted by researchers (Siahaan, Fitriani, & Rosa Da Lima Leli, 2023). While the product target is students are able to finding the solution of an SLE with the Gauss-Jordan elimination method which through by the score test of SLE concept comprehension is classified belongs to good category which is score interval is in 70,00-84,99.

This stage conducted to identifying the character of students who will use this product. The initial data of identification is achieved according to the findings of (Siahaan, Fitriani, & Rosa Da Lima Leli, 2023). The identification results are students experienced difficulties in implementing ERO if fractional numbers are encountered, students experienced difficulty

analyzing multiple solutions on SLE and converting them into parameters, limited understanding in recognizing the reduced row echelon matrix (RREM), and students have not been able to classify which RREM SLE has multiple solutions and has no solution.

At this stage yet perform the material analysis, material delivery model, and product display began to be designed. In the material analysis, two activities will be retrieved, the first is identifying the contents of matrix and SLE content material in Elementary Linear Algebra teaching materials carried out by literature review and the second is by analyzing the contents of SLE and matrix material against the material delivery model. In the material analysis, the sequence is changed from SLE material to matrix material to matrix material followed by SLE material. For the material delivery model, the interactive lecture method will be used by utilizing prezi learning media integrated in the developed product. For the appearance of the product, the module is designed as simple as possible and the professional appearance does not involve many colors.

This stage includes all sources to support or to assist the process of product development; in the material presented, the learning process, and module delivery techniques. The sources are reference books, research articles, web links, and lesson plan in module development, images from the internet that support case study examples, and slide templates for prezi learning media. The reference books used are: Elementary Linear Algebra: Application version by Howard Anton dan C. Rorres, Aljabar Linier Elementer I by Pamuntjak R.J dan Warsito, Aljabar Linear by Wono Setya Budhi, Aljabar Linier untuk Pemula by Meiva Marthaulina Lestari Siahaan dan Fitriani yet the web link used is <https://www.10mathproblems.com>.

Design

At this stage, all texts and images that have been compiled are then printed and on prezi learning media published in the cloud and shared in the form of links to produce powerpoints (ppt) file using prezi media integrated with modules. The components of the module include cover, preface, instructions for using the module, learning objectives in each chapter in the module, material description, summary, practice questions, and bibliography. This learning module consists of three chapters: matrices, elementary row operations (ERO), and systems of linear equations (SLE).

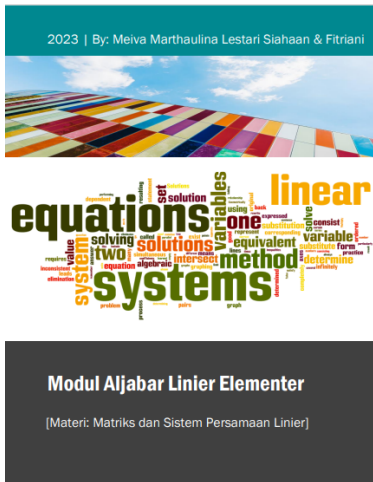


Figure 4. Module Cover

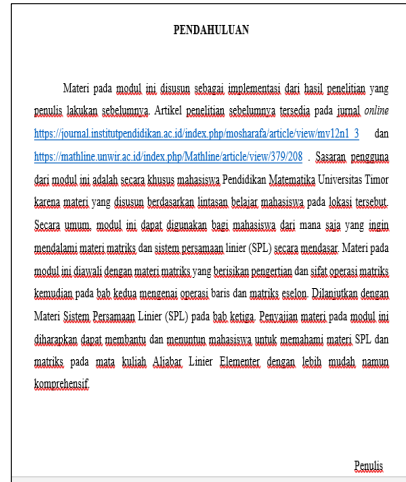


Figure 5. Introduction part in module

DAFTAR ISI	
Pendahuluan	i
Daftar Isi	ii
Petunjuk Penggunaan Modul	iii
BAB 1 MATRIKS	
1.1 Dasar-Dasar Matriks	1
Rangkuman	9
Latihan	10
1.2 Sifat Operasi Matriks	12
Rangkuman	18
Latihan	19
Daftar Pustaka	20
BAB 2 OPERASI BARIS	
2.1 Operasi Baris Elementer	21
Rangkuman	24
Latihan	25
2.2 Eliminasi Gauss dan Eliminasi Gauss-Jordan	26
Rangkuman	28
Latihan	29
2.3 Matriks Eselon, Matriks Eselon Tereduksi, dan Matriks Elementer	30
Rangkuman	33
Latihan	34
Daftar Pustaka	35
BAB 3 SISTEM PERSAMAAN LINIER	

Figure 6. Table of Contents

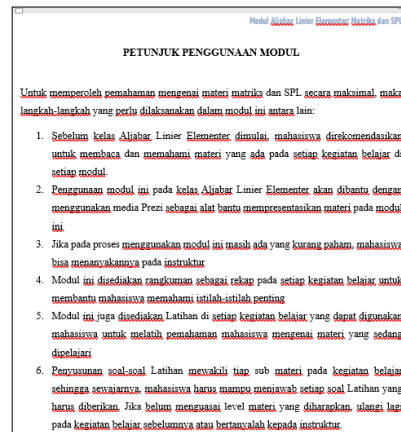


Figure 7. Module Instructions

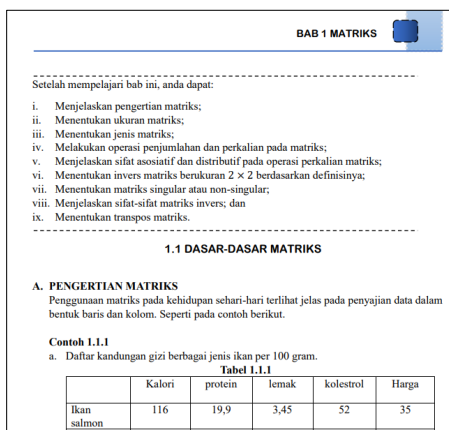


Figure 8. First page view of each chapter



Figure 9. Display of material content with images

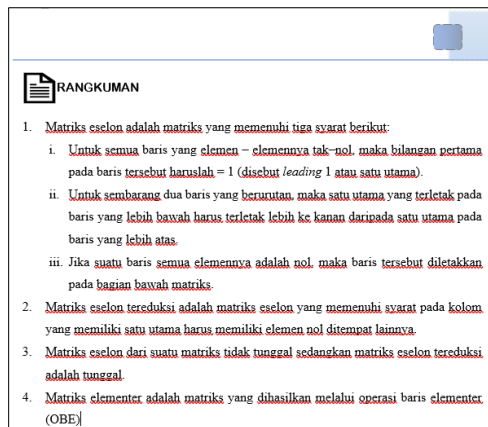


Figure 10. Summary view of each chapter

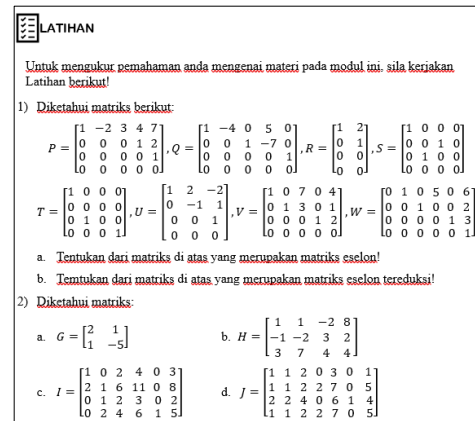


Figure 11. Display of exercise for each chapter

As for the PPT prez learning media, in terms of appearance, several options from the prez cloud are provided. Then the content is a reference to the developed module which is designed concisely and simplified yet assists students in comprehending the module.

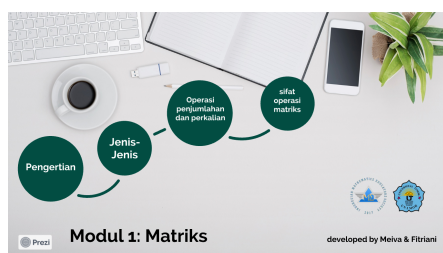


Figure 12. The frontpage slideshow of module 1

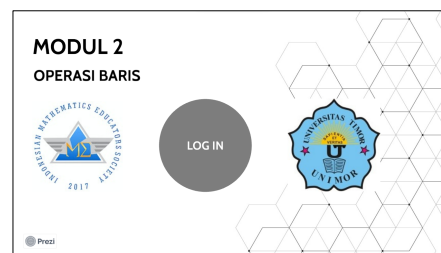


Figure 13. The frontpage slideshow of module 2



Figure 14. The display of media integrated into the module

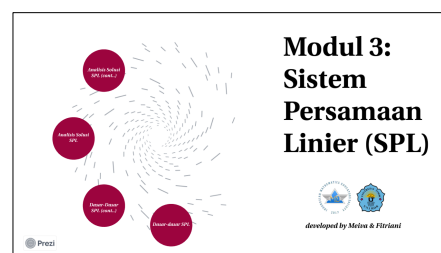


Figure 15. The frontpage slideshow of module 3

Development

Alpha test

The alpha test was performed by 2 experts in content experts and media experts. The alpha test was conducted using a questionnaire that had been validated by the instrument

validator. Respected validation result from two content experts and two media experts is explained as follows.

a. Validation of content experts

Content expert validation was conducted by two lecturers in the Department of Mathematics who taught elementary linear algebra courses and also conducted research related to algebra.

Table 3. Recapitulation of content expert assessments

Aspects	Content expert		Amount	Score average
	I	II		
self-instruction	4	3,6	7,6	3,8
self-contained	4	4	8	4
stand-alone	3,5	4	7,5	3,75
adaptive	4	4	8	4
user friendly	4	4	8	4
Total of amount			39,1	19,55
Average of total of amount				3,91
Category				Very feasible

b. Validation of media experts

Media expert validation was conducted by two lecturers in the Department of Mathematics Education who taught learning media courses yet conducted research related to learning media.

Table 4. Recapitulation of media expert assessments

Aspects	Media expert		Amount	Score average
	I	II		
Size of the module	4	4	8	4
Design of module cover	4	3,75	7,75	3,875
Design of module content	3,875	3,25	7,125	3,56
Exploration of Learning Media Prezi	3	4	7	3,5
Utilization of Learning Media Prezi	3,67	3,67	7,34	3,67
Total of amount			37,215	18,605
Average of total of amount				3,721
Category				Very feasible

Beta test 1

In beta test 1 or small group test, it was conducted on eight students who had taken elementary linear algebra courses. These students are cohort 2019-2022 of 2 people in each of cohort. The purpose of this small group test is to determine the response of students as users before being tested in large groups. Students were asked to use module and learning

media, then at the end of the meeting they filled out response questionnaires regarding learning aspects, display aspects, and aspects of prezi media utilization.

Table 5. Assessment of student response in small group test

Aspects	Score average
Learning	3,68
Display	3,70
Utilization of Learning Media Prezi	3,78
Total score	11,16
Average of total score	3,72
Category	Very feasible

To assess students' comprehension after utilizing the prezi learning media integrated module, three SLE problems were given, each of which represented a type of SLE solution. Table 6 are the results of the evaluation of the subject's understanding after using the module in the small group class.

Beta test 2

In beta test 2 or large group test, conducted on 70 students in Department of Mathematics Education Cohort 2023 who were taking elementary linear algebra courses. Student's response questionnaires result on table 7. Students were provided SLE problems to evaluate the students' comprehension after using prezi learning media integrated module. The SLE problems representing three kinds of SLE solution. The table 8 is the results of the evaluation of the subject's comprehension after using the module in the large-scale class.

Table 6. Test score of matrix and SLE in small group test

No	Subject	Score
1	S1	66,67
2	S2	83,33
3	S3	90
4	S4	100
5	S5	100
6	S6	93,33
7	S7	93,33
8	S8	100
Average of score		90,83
Category		Very good

Table 7. Assessment of student response in beta test 2

Aspects	Score average
Learning	3,54
Display	3,50
Utilization of Learning Media Prezi	3,42
Total score	10,46
Average of total score	3,49
Category	Very feasible

Table 8. Classification of Test Score of Matrix and SLE Comprehension

No	Category	Number of students
1	Excellent	42
2	Good	18
3	Moderate	10
	Average of score	81,11
	Category	Good

Product Validity Analysis

The results of the validators' assessment showed that the matrix and SLE modules integrated with prezi learning media received a score of 3.91 from both material experts and a score of 3.721 from both media experts. Both of these numbers indicate very feasible criteria. This means that the matrix and SLE module products are suitable for testing by paying attention to several revisions.

Some of the comments and suggestions are provided by the two material experts: 1) authors need to put relevant pictures on the case study examples, 2) need to discuss determinant content material before inverse content material, 3) need to add sample problems in some sub-chapters, and 4) need to use a consistent designation for the identity matrix or unit matrix. The module has been revised according to the suggestions and comments from both material experts.

Whereas, some comments and suggestions are provided by the two material experts: 1) authors need to make the numbering system in the module must be consistent, 2) need to look into content of the introduction section, it is more appropriate to be a preface, if it remains as an introductory part of the module, it is necessary to describe the content and user or target so that the module's utility appears, 3) need to use the necessary colors so that the module is more attractive as a whole, 4) need to use colorful images, for example in case study section. The module has been revised according to the suggestions and comments from

both media experts. Based on the results of the product validity assessment and the revision process, the matrix and SLE module integrated with prezi learning media are declared valid.

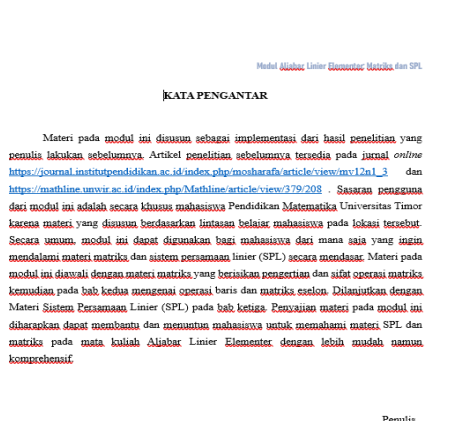


Figure 16. Changes from Introduction to Preface

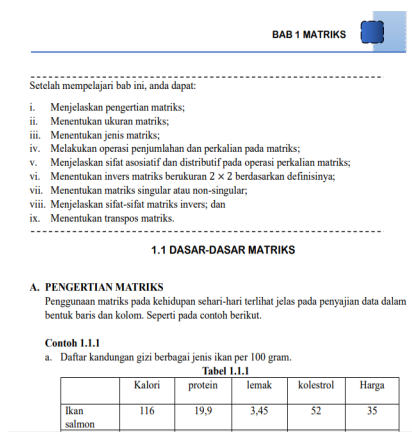


Figure 18. Numbering system after revision

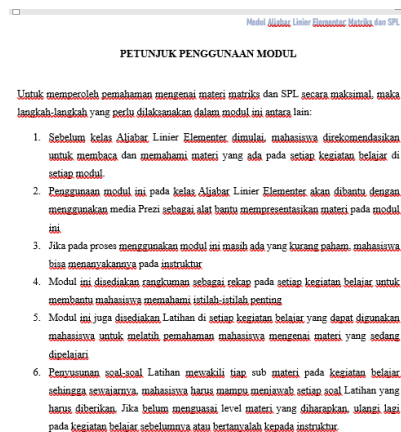


Figure 17. Add determinant topic before inverse topic

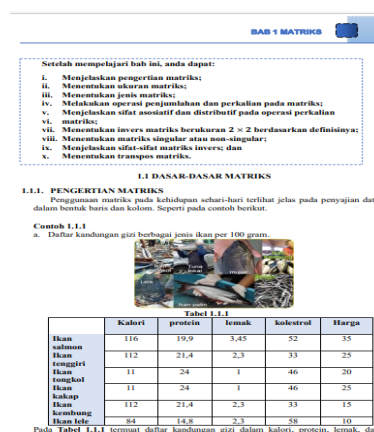


Figure 19. Case study after revision

Product Practical Analysis

The practicality test is analyzed from the student response questionnaire in beta test 1 and beta test 2 which each assesses the aspects of learning, displaying, and utilizing prezi media. In the learning aspect for the beta test 1 and beta test 2, each received a score of 3.68 and 3.54 which were included in the very feasible category. Subject responses in this aspect are related to the clarity of the title and objectives in the module, the ease of material to learn, the suitability of learning objectives with the material, the accuracy of exercise questions to measure student understanding, and the sequence of material in the module. The subject's response in this aspect shows that students are helped in understanding the material because the module fulfills the learning aspect points and supports students to apply independent learning using the module.

In the display aspect for the beta test 1 and beta test 2 each received a score of 3.70 and 3.50 which were included in the very feasible category. The subject's response in the display aspect is related to the instructions for using the module, the sentences used in the module, and the proportion of colors in the module. Student responses related to this aspect are that the developed module has clear instructions for using the module so that it can guide students to use it. Also sentences that are in accordance with the level of thinking of students, as well as the right proportion of module colors so as to motivate students in using the module.

In the aspect of utilizing prezi media for beta test 1 and beta test 2, each received a score of 3.78 and 3.42 which were included in the very feasible category. Subject responses in this aspect are related to the ease of accessing prezi media, the language used in the media, and the visual appeal of the media. Students' responses were that the prezi media integrated in the module helped students in understanding the highlights of matrix and SLE topics so as to form a concept map in their thinking process. The prezi media presented also uses language that is easy-understandable and has contrasting colors so that it has an attraction for those who access the media. So overall, the matrix and SLE module product integrated with prezi media is practical.

Product Effectivity Analysis

Some of the advantages of this product so that it proves effective in supporting students' understanding of matrix and SLE material are first, the composition of the material is arranged based on the student's learning trajectory. Previously students were firstly presented with SLE topic then followed by matrices, this became a factor inhibiting student learning. Students unable to understand what an echelon matrix and a reduced echelon matrix are and some even need a deeper understanding of matrix operations so that in the context of this learning obstacle, students need to understand matrix material first then followed by elementary row operations and continued with SLE and solution analysis. Second, to make it easier for students to understand matrix material, the introduction to matrix material is presented by providing concrete examples or related to everyday life or general knowledge such as the nutritional content in various types of fish which are presented in tabular form and then interpreted in matrices. This thing able to increase student motivation in learning content that is related to life issues (Jenaman et al., 2022) Third, the material in

the module is presented with integrated prezi media in the form of attractive powerpoints so that it can attract students' attention and make students focus on listening to student explanations.

CONCLUSION

Based on the findings of this research, it can be concluded that the development study of matrix and SLE modules integrated with learning media produces modules that are valid, practical, and effective. It is said to be valid seen from the assessment of material experts who scored 3.91 and the assessment of media experts who scored 3.721 with a very feasible category. It is said to be practical seen from the results of the student response questionnaire on beta test 1 which scored 3.72 and beta test 2 which scored 3.49, both of which are included in the very feasible category. Furthermore, the module is declared effective seen from the results of student understanding tests on matrices and SLE in beta test 1 and beta test 2 which get an average score of 90.83 and 81.11 respectively. Both test averages meet the effective expectations in this study in the minimum is in good category.

ACKNOWLEDGMENTS

Authors would like to extend the gratitude to Indonesian Mathematical Educators Society (I-MES) for funding this research according to scheme "Riset Kolaborasi Dosen Pemula (RKDP)" by contract number 042 / RKDP / I-MES / Set / V / 2023.

REFERENCES

- Akgün, Ö. E., Babur, A., & Albayrak, E. (2016). Effects of Lectures with PowerPoint or Prezi Presentations on Cognitive Load, Recall, and Conceptual Learning. *International Online Journal of Educational Sciences*, 8(3). <https://doi.org/10.15345/iojes.2016.03.001>
- Alessi, S. M., & Trollip, S. R. (2001). *Multimedia for Learning: Methods and Development 3rd Ed* (Vol. 3). A Pearson Education Company.
- Atika, A. R. (2021). The Influence Problem-Based Learning Model with Scientific Approach by Using Media Prezi on Learning Outcomes. *International Conference on Educational Studies in Mathematics*, 121–125.
- Jenaman, R. E., Wibawa, K. A., & Wulandari, I. G. A. P. A. (2022). Developing a Realistic Mathematics Education Based Learning Module on Sets Subject in Junior High School. *Proceedings of the Eight Southeast Asia Design Research (SEA-DR) & The Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*, 273–280.

- Ningrum, Y., Kusmayadi, T. A., & Fitriana, L. (2019). The Validity of Algebraic Module with Living Values Education for Junior High School. *Journal of Physics: Conference Series*, 1306(1). <https://doi.org/10.1088/1742-6596/1306/1/012038>
- Rohiman, & Anggoro, S. B. (2019). *Penggunaan Prezi untuk Media Pembelajaran Matematika Materi Fungsi*. 2(1), 23–32. <http://ejournal.radenintan.ac.id/index.php/desimal/index>
- Rosmiati, U., & Siregar, N. (2021). Promoting Prezi-PowerPoint presentation in mathematics learning: The development of interactive multimedia by using ADDIE model. *Journal of Physics: Conference Series*, 1957(1). <https://doi.org/10.1088/1742-6596/1957/1/012007>
- Setiyani, S., Hapsari, T., Ferdianto, F., Sagita, L., & Irawanti, A. C. (2021). Pengembangan Media Interaktif Berbantuan Prezi Terhadap Kemampuan Pemahaman Matematis Topik Sistem Persamaan Linier Dua Variabel. *Jurnal Ilmiah Soulmath: Jurnal Edukasi Pendidikan Matematika*, 9(1), 11–24. <https://doi.org/10.25139/smj.v9i1.3325>
- Siahaan, M. M. L., Fitriani, F., & Manek, P. (2023). Hypothetical Learning Trajectory: To Determine The Solution of Linear Equation System in Elementary Row Operation. *Mathline: Jurnal Matematika Dan Pendidikan Matematika*, 8(1), 246–255. <https://doi.org/10.31943/mathline.v8i1.379>
- Siahaan, M. M. L., Fitriani, & Rosa Da Lima Leli, A. (2023). A Study of Learning Obstacles: Determining Solutions of a System of Linear Equation Using Gauss-Jordan Method. *Mosharafa: Jurnal Pendidikan Matematika*, 12(1), 25–34. <http://journal.institutpendidikan.ac.id/index.php/mosharafa>
- Smith, L., & Powell, J. (2011). An Alternative Method to Gauss-Jordan Elimination: Minimizing Fraction Arithmetic. *The Mathematics Educator*, 20(2), 44–50.
- Špernjak, A. (2014). The Eurasia Proceedings of Educational & Social Sciences (EPESS) The Eurasia Proceedings of Educational IS PREZI MORE USEFULLNESS EDUCATION TOOL THAN POWERPOINT? *Science & Technology*, 1. www.isres.org
- Sugiyono. (2019). *Metode penelitian dan pengembangan (research and development/R&D)* (4th ed.). Alfabeta.
- Sulistiyorini, Y., & Argarini, D. F. (2019). Pengembangan Modul Analisis Vektor Terintegrasi Media Pembelajaran Prezi. *Laplace: Jurnal Pendidikan Matematika*, 2(1), 32–47. <https://doi.org/10.31537/laplace.v2i1.193>
- Tianisa, W. T., & Suparman. (2018). Development of Mathematical Module Based on Guided Discovery to Develop Critical Thinking Ability and Learning Independence. *International Summit on Science Technology and Humanity (ISETH 2018)*, 183–192.