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DEVELOPMENT OF LMS PHYTAGORAS BASED SEFPAWS AS CAPABILITY BOOSTER MATHEMATICAL NUMERACY

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Abstract

The problems in this research are the students' lack of arithmetic skills, the insufficient writing of textbooks for each course, and the lack of activities in using the Pythagoras LMS. Integrated Hybrid Learning Development Research aims to develop Integrated Hybrid Learning, Active, Simple, and Collaborative, abbreviated as LMS Phytagoras, based on SEFPAWS (Study, Explore, Formulate, Present, Apply, Wordly, Spiritual) as a means to strengthen numeracy skills with valid and effective criteria. The subjects of this study were third-semester students of Mathematics Education at Wiralodra University, specifically in the selected topics course of secondary mathematics education. The type of research utilized in this study is Research and Development (R&D). The design model used is the ADDIE type. The data collection instruments include validation sheets, tests, and questionnaires. During the validation process, LMS Phytagoras was validated by three expert validators with medium validity criteria. This study indicates that the developed product contributes to strengthening students' mathematical numeracy skills and underscores the urgency of developing more valid and sustainable assessment instruments to systematically monitor the development of these competencies.

Keywords: Development; LMS Phytagoras; SEFPAWS; Mathematical Numeracy.

Abstrak

Masalah pada penelitian ini yaitu kurangnya kemampuan berhitung pada mahasiswa, kurangnya penulisan buku teks untuk setiap mata kuliah, kurangnya aktivitas dalam menggunakan LMS Phytagoras. Penelitian pengembangan pembelajaran hibrid TERPADU bertujuan untuk mengembangkan pembelajaran hibrid TERPADU aktif, Sederhana, dan kolaboratif yang disingkat LMS Phytagoras berbasis TERPADU (Telaah, Eksplorasi, Rumuskan, Presentasikan, Aplikasikan, Duniawi, dan Ukhrowi) sebagai sarana penguatan keterampilan berhitung dengan kriteria valid dan efektif. Subjek penelitian ini adalah mahasiswa Pendidikan Matematika semester III Universitas Wiralodra, khususnya pada mata kuliah pendidikan matematika menengah. Jenis penelitian yang digunakan dalam penelitian ini adalah Research and Development (R&D). Model desain yang digunakan adalah tipe ADDIE. Instrumen pengumpulan data meliputi lembar validasi, tes, dan angket. Pada proses validasi, LMS Phytagoras divalidasi oleh tiga orang validator ahli dengan kriteria validitas sedang. Penelitian ini mengindikasikan bahwa produk yang dikembangkan berkontribusi terhadap penguatan kapasitas numerasi matematis mahasiswa dan menegaskan urgensi pengembangan instrumen asesmen yang lebih valid dan berkelanjutan untuk memantau perkembangan kompetensi tersebut secara sistematis.

***Kata kunci**: Pengembangan;* LMS Phytagoras*;* SEFPAWS, Numerasi.

INTRODUCTION

In the current technological era, learning in higher education is increasingly expected to be ICT-based to support accessibility, interactivity, and effectiveness of instruction. One of the most prominent needs in this context is the availability of electronic teaching materials that can be integrated into digital learning environments such as Learning Management Systems (Kazaine, 2016; Mahdavi & Khoobkar,

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2012). Various empirical studies indicate that electronic teaching materials are practical and effective in facilitating learning in the modern era, as they offer flexibility, multimodal representation, and student-centered engagement (Bu, 2024; Firdaus et al., 2024; Harahap et al., 2023). In addition, gamification based electronic teaching platforms have also been shown to enhance motivation and participation in learning activities (Azmi & Singh, 2015).

Several studies have developed LMS based teaching materials aimed at improving learning outcomes in specific subject areas (Kurata et al., 2018; Madyatmadja, 2023). Likewise, there has been research and development of electronic teaching materials based on Problem Based Learning (PBL) that promote inquiry, critical thinking, and collaborative problem solving (Geofrey, 2023; Jha et al., 2024). These studies affirm that both LMS and PBL present pedagogical advantages when applied properly in higher education settings (Epler & Jacobs, 2022; Müller & Wulf, 2024). However, despite the growing body of research on digital learning, there remains limited studies focusing on the development of LMS integrated, PBL based electronic teaching materials specifically designed to enhance mathematical numeracy competencies.

More importantly, none of the existing studies have developed LMS Phytagoras-based SEFPAWS teaching materials, particularly for the targeted mathematical content area, nor examined their potential to improve students' mathematical numeracy. This gap is critical, as mathematical numeracy represents a fundamental competence necessary for reasoning, problem solving, and academic performance across disciplines. Addressing numeracy through LMS based instruction is therefore essential, yet research on this integration remains scarce.

Field data highlight the urgency of this issue. Empirical findings indicate that 100% of students own smartphones with internet access, providing a solid infrastructure to support digital learning. Despite this high accessibility, students' understanding of mathema-tical concepts remains low, suggesting that the potential of ICT tools has not been maximally harnessed to support conceptual learning. This paradox implies that current instructional strate-gies and learning resources are insuffi-cient in scaffolding students' mathe-matical reasoning and numeracy skills.

Based on the aforementioned conditions, it is necessary to develop LMS Phytagoras Based SEFPAWS as a capability booster for mathematical numeracy, with the expectation that it can make the learning process more practical, interactive, and effective. The development of such an LMS is anticipated to not only utilize existing technological resources but also address the persistent problem of low mathematical concept comprehension through innovative, structured, and student centered learning design.

This data shows that numeracy skills are still low and need to be enhanced. Numeracy skills play an important role in achieving the goals of mathematics learning. Numeracy is the ability to use, understand, and analyze mathematics in real contexts and to solve problems related to everyday life. The Impact of Covid-19 Pandemic on Higher Education in Indonesia the Covid-19 pandemic has exacerbated the crisis in higher education in Indonesia, where lectures have shifted to online learning. Based on analyses validated by external research, it has been found that in terms of literacy, students have

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lost approximately 6 months of learning in one academic year, while in numeracy, they have lost 5 months. This phenomenon is referred to as learning loss, necessitating a curriculum solution tailored to each university's needs to catch up on the missed learning.

The MBKM program enhances lecturers' pedagogical competence and produces graduates with technical expertise and soft skills aligned with Industry 4.0 demands. However, its implementation is challenged by students' low numeracy skills, requiring more effective learning materials and instructional strategies to support learning outcomes. Therefore, the researcher will conduct a study titled "Development of LMS Phytagoras Based SEFPAWS as Capability Booster Mathematic Numeracy." Mathematical literacy and numeracy mathematical skills that can be utilized to solve contextual problems are mathematical numeracy skills (Bolondi et al., 2018; Hoogland et al., 2018; Iswara et al., 2022). The definition of mathematical numeracy is the knowledge of performing calculations or the skill of applying mathematical operations in sequence, using numbers embedded in printed material, up to the ability to confidently handle mathematical needs in adult life (Bolstad, 2020).

Research on numeracy highlights the need for systematic support through digital learning strategies and resources to enhance students' mathematical reasoning skills. Adelia and Putri (2024) emphasize that numeracy development should be facilitated through contextual learning design and technology-based assessments to improve students' ability to solve authentic problems. Similarly, Adelia et al., (2024) found that mathematics teachers still struggle to integrate numeracy perspectives into daily teaching practices, suggesting the need for more structured instructional tools that effectively support numeracy development.

The literature also shows that Learning Management Systems (LMS) have strong potential to improve learning quality. Kurata et al., (2018) found that LMS usage enhance engage-ment and learnability among engineering students, while Madyatmadja, (2023) reported that LMS provides significant flexibility and accessibility for university students in Indonesia. However, the effectiveness of LMS depends heavily on the quality of instructional material. Mahdavi & Khoobkar (2010, 2012) argue that content in LMS should incorporate interactivity, scaffolding, and instructional design principles to support deep conceptual understanding.

Research on electronic teaching materials also indicates positive effects on mathematics learning outcomes. Harahap et al., (2023) showed that e-learning in statistics courses improves students' academic performance, while Bu (2024) found that electronic teaching materials are empirically effective in enhancing learner engagement from both teacher and student perspectives. Similarly, Firdaus et al., (2024) confirmed that digital resources significanly improve mathematics learning quality.

Furthermore, literature on numeracy underscores its urgency in contemporary education. Geiger et al., (2015) describe numeracy as a multidimensional competence involving reasoning, application, and decision-making in authentic 21st-century contexts. Tout & Gal, (2015) further highlight numeracy as a critical life skill in the era of data literacy, while Gal et al., (2020) point out that vulnerable populations are often left behind in numeracy competence, requiring effective pedagogical inter-

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ventions. Previous studies show strong efforts to enhance numeracy through digital and innovative learning tools. Cahyadi et al., (2023) developed a numeracy-oriented self-learning application, while Fanggidae et al., (2024) highlighted numeracy as a growing focus in mathematics education research. Putri et al., (2022) demonstrated that culturally grounded LSLC-based materials can strengthen numeracy. In addition, (Zaenal et al., 2022, 2024) reported that e-learning and mobile learning platforms effectively improve students' numeracy skills. Mulyana et al., (2021) This study demonstrated the effectiveness of learning using MATH-UNWIR in enhancing mathematical connection skills and online learning. In the current situation, lecturers are required to be innovative in Previous studies on students' spatial thinking in geometry have predominantly focused on identi-fying performance levels, common errors, and cognitive strategies used to solve spatial tasks. Most of this research emphasizes general cognitive aspects without integrating affective variables, such as resilience, that may influence students' persistence and problem-solving behavior. Additionally, existing instruments tend to measure spatial thinking as a single construct, lacking a multidimensional assessment approach that captures both cognitive performance and affective disposition.

In contrast, the present study aims to explore the relationship between spatial geometry thinking and students' affective resilience, providing a more holistic understanding of students' abilities. This research introduces an assessment framework that combines performance-based spatial tasks with affective measures, offering a novel perspective on how emotional and motivational factors interact with cognitive skills in geometry learning. Thus, the study fills a gap by examining spatial thinking not only as a cognitive skill but also in conjunction with resilience as a key determinant of student success.

METHODS

This study is a Research and Development (R&D) project employing the model ADDIE to develop the SEFPAWS-Based LMS Phytagoras for the course "Selected Topics in Basic Education Mathematics" to enhance students' mathematical numeracy. The product integrates six SEFPAWS stages (Study, Explore, Formulate, Present, Apply, Worldly, Spiritual) as a framework for numeracy development in higher education. The LMS development follows the ADDIE phases: Analysis, Design, Development, Implementation, and Evaluation**.** The stages of ADDIE development are illustrated in Figure 2.

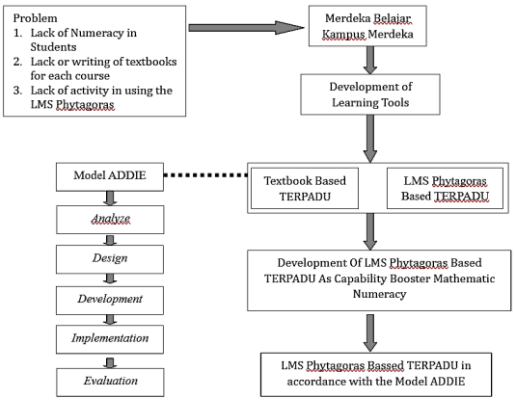

Figure 1. Framework for the development research of an LMS Phytagoras Based SEFPAWS as Capability Booster Mathematic Numeracy

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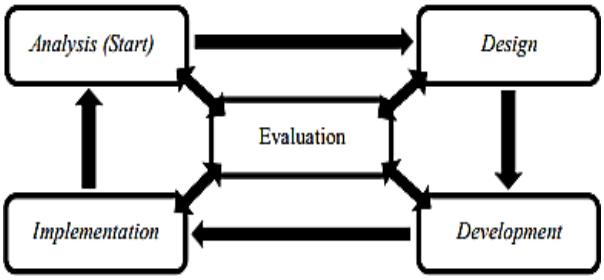

Figure 2. ADDIE Development Design (Aldoobie, 2015)

Tabel 1. Research Activities at each stage of the ADDIE Model

No	Stage	Activities
1	Analysis	- Explore the numeracy skills of students - Analysis of the LMS Phytagoras for the learning of the selected course of Basic Education Mathematics - SEFPAWS Learning for Basic Education Mathematics
2	Design	- Planning LMS Phytagoras diagram - Planning LMS Phytagoras storyboard - Planning Learning Object Materials (LOM) such as: RPS, Learning Video, PowerPoint Materials, Teaching Materials
3	Development	- Developing LOM on the LMS Phytagoras - Content of LOM according to learning objectives - Validating LOM and LMS Phytagoras
4	Implementation	- Conducting a LMS Phytagoras test - Conduct SEFPAWS learning using LMS Phytagoras - Evaluate numerical ability through LMS Phytagoras
5	Evaluation	- Analyzing the strengths and weaknesses of the LMS Phytagoras - Collecting data on student perceptions

The development of the LMS Phytagoras was validated by 3 professors. In this research, the population determined is the response of professors and students of the Mathematics Education Program at Universitas Wiralodra for the even semester of the 2023/2024 academic year. The sample selection in this research is third-year students because the teaching materials are part of the MBKM curriculum, namely the selection of basic mathematics education materials. Charts and tables must be centered. Large charts and tables can be stretched in both columns. Each table or image that includes a width of more than 1 column must be positioned at the top or at the bottom of the page. Graphs are allowed to be colored. Images may not use dots because there is a possibility that they cannot be printed in the original. Use solid coloring that contrasts well with high resolution for display on a computer screen, as well as for prints that are black and white.

Meanwhile, the techniques used are questionnaires, interviews and tests. The research instrument is a supporting tool used to obtain data in the research conducted. The research instruments used in the development of LMS Phytagoras are as follows: (1) Validation Sheet: useful to know the quality and eligibility of the design of the product developed, namely

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LMS Phytagoras. In this research, validation is carried out by three experts, including 3 professors from subject matter, media, and language experts; (2) Tes: used to test the effectiveness of the implementation of the LMS Phytagoras. The test is given to students in the form of a pretest and a posttest to see the effective-ness of the LMS Phytagoras after the learning process. (3) Survey form used to test the evaluation of the use of the LMS Phytagoras. The survey form is given to teachers and students to see the responses related to the LMS Phytagoras in question. The following will explain how to analyze data based on the techniques used.

1. Logbook Analysis

In this logbook analysis, the model used refers to the Miles and Huberman model. This model consists of three sequences: data reduction, data presentation, and conclusion Sugiyono (2020). In the data reduction phase, the obtained data will be transcribed and then reduced by focusing on the main points through determining themes and data patterns, and eliminating unne-cessary data. In the data presentation phase, the data resulting from the reduction phase is presented in the form of a narrative as a brief des-cription, and at the conclusion stage, the narrated data will be summa-rized and verified.

2. Analysis Validation

Validation sheet used by three experts in subject matter, media, and language. The validated instruments are RPS, Slide Power Point, Learning Video, Textbook, and LMS Phytagoras. After the experts conduct a check of the instruments, they provide an evaluation according to the Likert scale with five options.

Table 2. Likert Scale with Five Response Alternatives

Scale	Description
5	Very good
4	Good
3	Just okay
2	Not good
1	Very poor

Source: Sugiyono (2020)

After filling out the validation sheet, the next step is to perform calculations using Aiken's Validity *V* (Aiken, 1985) with the formula 1 (Aiken, 1985):

$$V = \sum \frac{s}{[n(c-1)]} \ldots. (1)$$

In the equation, *V* indicates the validation value, *s* the difference between the expert and the lowest score, *n* the number of experts (evaluators), and c the highest value on the scale. LMS Pythagoras will be considered as a valid medium assuming that it meets the validation criteria with the criteria of validity level in the results of the study can be seen in Table 3.

Tabel 3. Validation Level Criteria

Score range (V)	Level of validity
V ≤ 0,4	Validity low
0,4 – 0,8	Validity moderate
V ≥ 0,8	High validity

Source: Aiken (1985)

3. Analysis of the Test

Test data on the ability of numeracy in this research were analyzed to determine the effectiveness and improvement of numeracy skills among students during the learning of selected mathematical capital of basic education using the LMS Phytagoras. The comparison test

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between pretest and postest was conducted to understand the comparison of numeracy abilities before and after using the LMS Phytagoras developed or can be called pretest with numeracy abilities after using the LMS Phytagoras. The data that have been collected are pretest and post test scores using LMS Phytagoras based SEFPAWS as a capability booster mathematic numeracy, which will be analyzed using SPPS V.20 with a significance of 95%. This comparison uses N-Gain score or commonly known as the normality gain test. The categories of interpretation of the effectiveness of N-Gain. Based on Table 4.

Table 4. N-Gain score criteria

Percentage (%)	Interpretation
Gain > 0.7	High
0.7 ≥ Gain ≥ 0.3	Medium
Gain < 0.3	Lower

Source: Hake in Mulyana et al., (2021)

4. Survey Response of Students

analysis of survey response of students. The data from the survey response of students is analyzed by calculating the percentage of each respondent's score. formula 2.

$$R = \frac{x}{n} \times 100\% \quad \ldots (2)$$

From the above formula, it can be explained that R is the average percentage of the chosen answer, The variable x is the percentage of each question, and n is the number of question items. After the calculation of the average percentage is complete, This is converted according to the following criteria (Table 5).

Table 5. Criteria for Evaluating the Student Response Survey

Score Interval	Category
80% – 100%	Positive
0% – 79,9%	Negative

RESULTS AND DISCUSSION

In this study, the development of LMS Phytagoras is analyzed using the ADDIE model, where all phases of development are interrelated and have an impact on each other. Change in one stage affects the others, therefore it needs to be done synergistically (Aldoobie, 2015).

1. Analysis

At the analysis stage, the problem is identified from the needs of students. According to Cheung (2016), educators need to make education have a goal and determine what is needed to achieve the stated goals. The analysis stage consists of many activities, the first is to study the most important aspects of the ability of numerators. Table 6 provides a detailed analysis of the use of LMS Phytagoras in the recovery of the Capita Selekta Mathematics Basic Education.

Table 6. Analysis of LMS Phytagoras needs in teaching

No	Competency	Student Activities	Features required in LMS Phytagoras
1	Flexible and interactive access to learning materials (understanding)	Can access learning materials anytime and anywhere	Availability of interactive and collaborative LMS features
2	Monitoring attendance (understanding)	Filling in attendance and providing further	Absence feature availability

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No	Competency	Student Activities	Features required in LMS Phytagoras
		assistance	
3	Monitoring progress and Automatic Evaluation (implementation)	Instant feedback availability	Availability of tools for monitoring learning progress
4	Development of teaching skills (implementing)	Obtaining real-time feedback	Availability of uploading materials, learning videos, discussions, easily giving assignments and managing exams
5	Additional learning resources (implementing)	Can access additional learning resources such as power point	Availability of Learning Object Material (LOM) in the LMS
6	Collaboration between courses (cross-disciplinary)	Helping students understand the relationships various scientific disciplines	Availability of collaboration between subjects that are related to learning materials
7	Class recording (understanding)	Allowing students to access back the class material	Availability of class recordings for understanding difficult concepts and preparing for exams or assignments.

Next activities in the analysis phase are the SEFPAWS learning study (Study, Explore, Formulate, Present, Apply, Wordly, Spiritual) for learning using LMS. A literature study is conducted at this stage to learn about the SEFPAWS learning syntax in LMS and its advantages in learning activities.

2. Design

After collecting references and conducting LMS needs analysis, we designed the LMS Phytagoras that consists of home, pre-test, learning materials, learning process, and post-test in the design phase. Pretest and posttest in the form of essays to know the initial knowledge and its improvement. SEFPAWS learning syntax (Study, Explore, Formulate, Present, Apply, Wordly, Spiritual) is integrated into the learning process by applying the following steps: (1) Study, which means studying Learning Object Material (LOM) such as, media powerpoint, learning video, (2) Explore, which means exploring the LOM into students' answers from the research process, (3) Formulate, which means formulating students' worksheets in the form of group discussions, (4) Present, which means presenting the results of group discussions obtained from the formulation process, (5) Apply, which means applying the learning obtained in answering the questions given as an assessment in the form of assignments, (6) Wordly and Spiritual, which means connecting learning with daily life. The SEFPAWS Learning Model is SEFPAWS with the LMS Phytagoras because it is considered to have the appropriate characteristics to achieve learning objectives. The characteristics of the SEFPAWS Learning are student-centered learning, using daily life problems as learning material, as well as requiring the latest information through independent learning, the instructor only as a facilitator, and student

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learning is carried out in groups (Ceker & Ozdamli, 2016).

Figure 3. depicts the system flow diagram designed to visualize the SEFPAWS design of the LMS Phytagoras with blended learning.

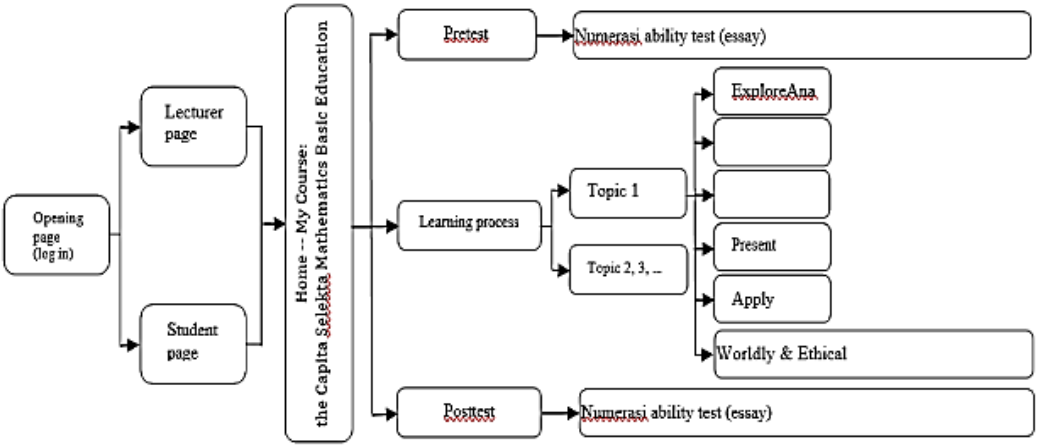
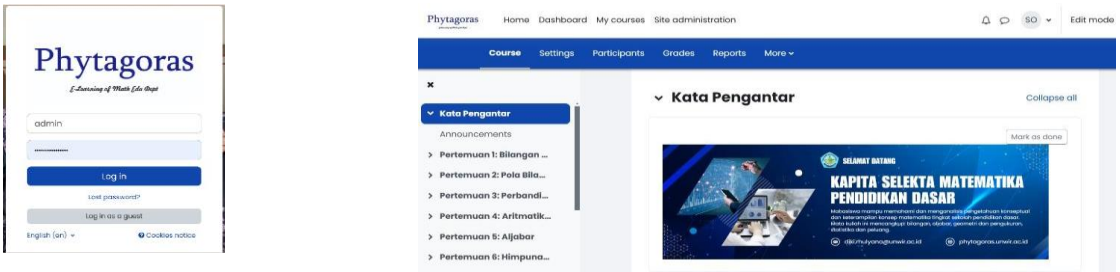


Figure 3. Diagram of the LMS Phytagoras in selected basic mathematics education chapters

After creating the flowchart, the next step is to design the storyboard, which is illustrated and displayed sequentially to visualize the specific LMS Phytagoras. During the design phase, the scenario activities are added to the concept of the teacher's needs to determine the internal functions of the LMS Phytagoras, which can influence the teacher's current activities. Next, in creating the storyboard, designers create scenario designs to determine the representation of objects and task actions to help teachers understand and interpret the proposed functions. The storyboard used presents the design and functions of each part of the LMS Phytagoras. An example of the display for each page is shown in Figure 4.



(a) (b)

Figure 4. Example storyboard created to develop LMS Phytagoras:
(a) Example of the page design developed in LMS Phytagoras, and
(b) Example description of the page and function for each icon on LMS Phytagoras

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3. Development

The need for teaching materials and LMS Phytagoras in accordance with current mathematics learning which prioritizes numerational abilities. This LMS Phytagoras and teaching material is adjusted to the new curriculum, MBKM. For this reason, designing LMS Phytagoras as needed is something that needs to be followed up. At the design stage or design of LMS Phytagoras based SEFPAWS to improve the ability of numeration of tertiary levels, especially in semester III of the Mathematics Education Study Program that is designed and designed as a solution with the implementation of the MBKM curriculum. The design process begins with collecting literature to choose an innovative and attractive strategy from various literature. Furthermore, it is described the main points of the material to be in accordance with the level of achievement and depth of competencies that will be taught to students. The main points of the material are numbers, algebra, geometry, statistics, and opportunities. The next stage is the development stage, where at this stage the LMS Phytagoras is made thoroughly so as to produce LOM products including RPS, Slide Power Point, Learning Videos, and Textbooks. During the LMS development stage, revision was carried out. After LOM and LMS are complete, it will be validated by three validators.

Here is presented data about the content validity, presentation validity, and graphic validity for "LMS Phytagoras based SEFPAWS as Capability Booster Mathematic Numeracy". The validation team consists of three experts on subject matter, media, and language. Will be presented a table of the average results of the three experts' content validity using Aiken V technique.

Table 7. Results of Content Validity Validation

No	Criteria	V	Description
1	RPS	0,93	High validity
2	Media Power Point	0,79	Validity moderate
3	Media Video Learning	0,76	Validity moderate
4	Textbook	0,74	Validity moderate
5	LMS Phytagoras	0,75	Validity moderate
Rata-rata		**0,79**	**Validity moderate**

The Table 7 presents the validity results of five instructional components, namely the lesson plan, PowerPoint media, video learning media, textbook, and the LMS Phytagoras. The highest validity score is obtained by the lesson plan (0.93), categorized as high validity, while the other components fall within the range of 0.74–0.79, categorized as moderate validity. Overall, the average validity score is 0.79, indicating that the instructional materials are reasonably valid and can be implemented with minor revisions. Next, the table of the average validation results of three experts for the eligibility of presentation will be presented.

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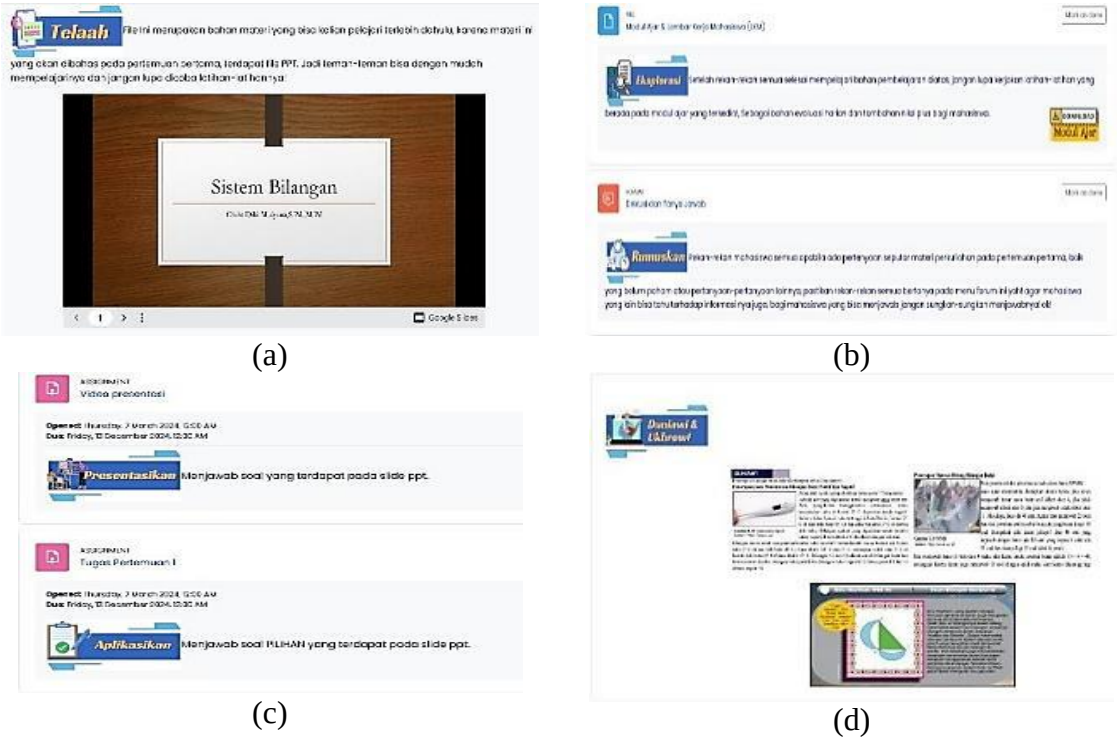
Table 8. Validation Results of LMS Phytagoras Eligibility

No	Criteria	*V*	Ket
1	Frame, Object and video on the LMS Phytagoras	0,67	Good
2	Integreted learning presented on the LMS Phytagoras	0,83	Very good
3	Selection of the language used is good and correct	0,83	Very good
4	The main topics are presented logicall and systematically	0,75	Very good
5	Scope of learning material contect is in line with the material to be explained	0,58	Good
6	More interactive learning	0,83	Very good
Average expert validation		**0,75**	**Very good**

Validation of the expert against the LMS Phytagoras resulted in a value *V* of 0.75 for four items with very good description and two items with good description. The minimum criteria for the value *V*, as shown in table 8, have been met. Therefore, it can be concluded that the LMS Phytagoras has met the validity criteria and is ready for implementation. The following is the result of the development of the LMS Pythagoras based SEFPAWS as Capability Booster Mathematic Numeracy after being validated by experts.



(a) (b) (c) (d)

Figure 5. LMS Phytagoras based SEFPAWS: (a) review: there are loms such as power points and learning videos; (b) exploration and formulating: there are LOMs like textbooks and LKM; (c) Present: Video Presentation Discussion Results and Applications: Exercise Questions; (d) Worldly and Spiritual: Trouble related to everyday life

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4. Implementation

In the implementation phase, the SEFPAWS learning activities using the LMS Phytagoras are carried out by using pre-test, post-test one group design, as shown in formula.

$$O_1 \; X \; O_2$$

O_1 = pre-test numeracy ability
O_2 = post-test numeracy ability
X = SEFPAWS learning using LMS Phytagoras

Implementation stage, LMS Phytagoras is used by 7 mathematics education students to allocate time during the pre-test and post-test and after the lecturer opens the system. The participants conduct sequential processes for each stage, with repetition or jumping from one stage to another. The learning process automatically moves to the next stage when time has run out.

Shapiro Wilk is used to determine the results of the normality test of preetest and posttest numeration capabilities, as shown in Table 9.

Table 9. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Before being provided with learning using LMS Phytagoras	.287	7	.085	.842	7	.104
After being provided with learning using LMS Phytagoras	.308	7	.044	.863	7	.162

a. Lilliefors Significance Correction

Based on the Shapiro-Wilk normality test, the data before the learning was given using the LMS Phytagoras with sig 0.104 > 0.05, and the data after the learning was given using the LMS Phytagoras with sig 0.162 > 0.05, then both data have a normal distribution. The distribution of the numeracy skills produced is normal, allowing for the continuation of the paired sample t-test for the implementation phase of the LMS Pythagoras in the selected mathematics lessons of the basic education curriculum, as recorded in Table 10.

Tabel 10. Numeracy scores with Paired Samples Test

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Before and after given learning using LMS Phytagoras	-15.142	7.668	2.898	-22.235	-8.050	-5.224	6	.002

The analysis indicates a significant improvement in numeracy skills following the use of the LMS Phytagoras. The mean value of -15.142 shows that post-test scores were higher than pre-test scores. Score variation among participants was moderate, as reflected by the standard deviation of

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7.668, with reasonable estimation accuracy shown by a standard error of 2.898. The 95% confidence interval, ranging from -22.235 to -8.050, confirms that this improvement was consistent and statistically significant. These results suggest that the LMS Phytagoras was effective in enhancing students' numeracy skills**.**students' mathematical numeracy skills.

Effectiveness of implementing LMS Phytagoras in improving numerical ability as analyzed using N-Gain, as shown in Table 11.

Tabel 11. Descriptive Statistics of the N-Gain Score calculation

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	7	.19	.83	.4521	.26830
Valid N (listwise)	7				

Based on the calculation results of the N-Gain score test in table 5, it shows that the average N-Gain score is 0.4521 or 45.21%, which falls within the moderate category. Therefore, it can be concluded that the use of the LMS Phytagoras is effective in the medium category for improving numerical ability in the elective math education course.

5. Evaluation

At the evaluation stage, tests were conducted on the advantages of the LMS Phytagoras in the teaching of elective math education and student perception. The following are some advantages of the LMS Phytagoras in teaching:

1. Create innovative and high-quality education and achieve better learning outcomes.
2. Materials are easily accessible, clear, and well-structured, making them highly helpful for repeated access.
3. More engaging, simple, and user-friendly interface.
4. Learning activities can be conducted anywhere without being limited by the classroom space.
5. Create a more interactive and enjoyable learning atmosphere.
6. Involve students in expressing their opinions through group and class discussions.
7. Assist teachers in evaluating the learning process and results.
8. Collecting assignments is easier.

We also identify the following problems:

1. Akses to the LMS Phytagoras is sometimes disrupted by weak network conditions and interference, making it difficult to access materials.
2. No notifications are received for tasks submitted to the LMS Phytagoras.
3. There is a limit on file upload size, so the file size must be reduced.

The questionnaire on student response consists of a number of statements related to the LMS Phytagoras, as well as changes in students' knowledge and skills. Student responses are very important in the evaluation process because they feel the implemented program directly. The main response of the students is that the LMS Phytagoras and the learning process need to be improved to ensure that users are satisfied when using the LMS. The results of the student responses are shown in Figure 6.

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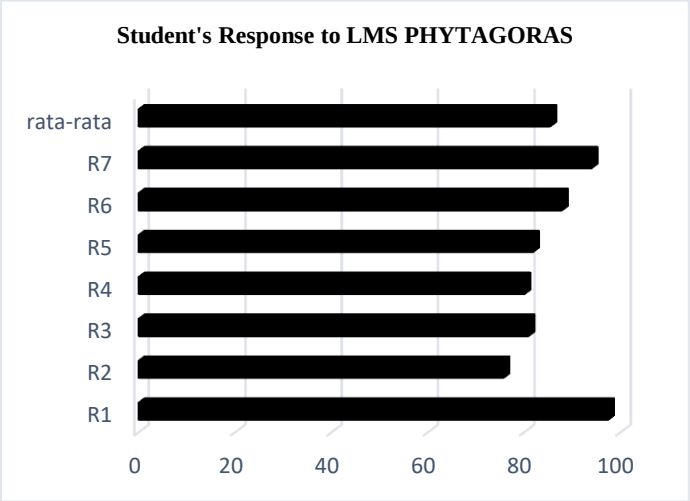

Figure 6. Students' Responses to the Use of LMS Phytagoras

Based on Figure 6, the average response of students to the LMS Phytagoras is that 85% fall into the positive category. There are 2 students in the negative response category, while 5 students fall into the positive category. The research conducted this time resulted in a LMS Phytagoras with based SEFPAWS as capability booster mathematic numeracy skills, which was developed through the ADDIE development model. As explained in the data analysis technique Under the condition of validity, the obtained test results are as follows: RPS value of 93%, Media Power Point value of 79%, Learning Video Media value of 76%, Textbook value of 74%, and LMS Phytagoras obtained a value of 75%. From the three results, if averaged, it results in a value of 79% or reaching the criteria of “very good” with a few revisions. As for the LMS survey questionnaire Phytagoras maximum score obtained was 83%.

According to the LMS Phytagoras criteria: (1) the learning adaptation to the LMS Phytagoras, (2) the selection of good and accurate language, and (3) more interactive learning. From these results, it can be concluded that the development of LMS Phytagoras based on integration as a tool to enhance mathematical numeracy skills meets the valid criteria. Along with the statement in the introduction that it is necessary as a supporting tool to explain concepts better. The LOM developed this time also functions as a supporting tool for the delivery of material concepts from teachers to students. According to the obtained results that all the criteria meet the valid criteria.After LMS Phytagoras is revised based on expert advice, the implementation phase can be carried out, namely by using the developed LMS Phytagoras in mathematics learning. After the learning is carried out, the evaluation phase is obtained through the provision of test questions. The results of the post-test obtained that the lowest score is 65 and the highest is 95. From the above post-test results, it is found that 7 students are proficient in learning that uses "LMS Phytagoras based on integration as a tool to enhance mathematical numeracy skills", or in classical terms, achieving an 86% success rate. Therefore, the effective criteria are

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exceeded. In line with the research of Mulyana et al., (2021), the quality of teaching tools can be seen from the aspect of effectiveness.

The effectiveness of the LMS Phytagoras designed and developed obtained effective results. This can be used to achieve the numeracy skills related to mathematical numeracy.The obtained test results have the lowest value of 50 and the highest value of 73. For the post-test, the lowest value obtained is 65 and the highest is 95. Subsequently, normality test and N-Gain using SPSS V.20, followed by the evaluation of student responses to the learning using LMS Phytagoras in the subject of Basic Education Mathematics Selective Course.

The findings of this study indicate that the development of an LMS supported by systematic instructional design and problem-based activities can enhance students' mathematical numeracy skills. This improvement occurs because the LMS provides structured materials and tasks that promote conceptual exploration, problem-solving, and contextual application, which strengthen mathematical understanding and performance.

These results are consistent with prior research showing that numeracy development requires contextual and active learning strategies (Adelia et al., 2024; Geiger et al., 2015). Problem-based learning has also been found to improve critical thinking and reasoning (Schmidt et al., 2009), while LMS platforms contribute to learning autonomy and academic achievement (Kurata et al., 2018; Madyatmadja, 2023). Furthermore, electronic teaching materials have been reported to enhance mathematics learning quality (Firdaus et al., 2024; Harahap et al., 2023). Overall, the current findings align with previous studies and reinforce the pedagogical need for digital and problem-based approaches in higher education, without showing significant conflict with existing evidence.

The observed improvements are causally linked to structured instructional design, problem-based activities, interactive digital resources, and collaborative learning features embedded in the LMS. Despite its strengths in producing a structured and contextually relevant learning product, the study has limitations, including restricted testing contexts, limited comparison across LMS platforms, and insufficient analysis of user analytics.

The research offers practical and theoretical contributions, providing empirical evidence that LMS-based learning can strengthen numeracy, supporting the literature on digital pedagogy in mathematics education, and informing future instructional design and technology-based policy initiatives.

CONCLUSIONS AND SUGGESTIONS

This study aimed to develop and evaluate the effectiveness of a Learning Management System (LMS)-based learning approach integrated with problem-based learning to enhance students' numeracy skills. The results indicate that a systematically designed LMS can significantly improve students' conceptual understanding, problem-solving skills, and overall numeracy performance.

These improvements were supported by structured electronic learning materials, contextual tasks, and interactive features that promoted active engagement and meaningful learning. A key finding of the study is that integrating LMS with problem-based learning contributes positively to the quality of

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mathematics instruction and supports the development of 21st-century numeracy competencies.

The main contribution of this research lies in providing empirical evidence on the effectiveness of combining LMS and problem-based learning in mathematics education, along with proposing a transferable model for developing electronic ins-tructional materials. These findings highlight the importance of techno-logical innovation and instructional design in enhancing numeracy outcomes in higher education.

Nevertheless, this study has certain limitations in terms of the number of participants, the duration of the intervention, and the scope of the variables observed. Therefore, future research is recommended to involve larger and more diverse samples, implement interventions over a longer period, and compare the effectiveness across different LMS platforms or pedagogical models.

Further studies may also investigate the impact of LMS integration on other affective or cognitive aspects, such as motivation, resilience, or self-regulated learning. Such investigations could provide deeper insights and strengthen the generalizability of the findings obtained in this study.

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