

Project-based Learning Task Design: Designing Mathematical Literacy Learning Program for High School in Tanjungpinang, Riau Islands

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Abstract. This design-based research focuses on designing a project-based learning activities carried out in one semester for the Mathematical Literacy course in 2023/2024 academic year in the Mathematics Education Study Program at Raja Ali Haji Maritime University. This one cycle research enables us to design, test, and revise our materials. The teaching experiment is conducted for pre-service teachers who enrol the course enhancing their mathematical literacy understanding by engaging in a project to design a program which integrates mathematical literacy into high school mathematics lesson in Tanjungpinang. The key feature of our design is making sense of phenomena of mathematical literacy and designing solutions to problems. The project task consists of four key activities: defining problems through literature analysis where pre-service students explore relevant literature of mathematical literacy and conduct field needs analysis which includes interview with mathematics teacher, classroom observations, and administering mathematical literacy test to students; designing the project administering the field analysis, finishing the project through active discussion with lecturer and peers, and conducting evaluation. This project task results observation instruments, picture of mathematical literacy of high school students' in high schools in Tanjungpinang, and a learning design to integrate mathematical literacy for mathematics lesson.

1 Introduction

As Indonesia increasingly participate in the global economy and society, it is essential for the government and educational institutions to prioritize the development of 21st-century skills particularly among young generations. Mathematical literacy is related to skills such as critical thinking, analytical reasoning, and data interpretation, which are highly valued in the globalized world. According to the OECD, mathematical literacy is defined as individual's capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to know the role that

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mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective 21st Century citizens [1]. Consequently, mathematical literacy is crucial to be developed especially for students through education, equipping them to understand and critically engage with the quantitative aspects of everyday life. It is then important for schools today in mathematics lesson to emphasize applying mathematics to real-world contexts, enabling students to understand the relevance of mathematics to daily life.

Besides that, Indonesia's participation in international assessments like PISA (Programme for International Students Assessment) highlights the need for preparing mathematical literacy among students for competitiveness and alignment with global educational standards. However, the performance of Indonesian students in PISA indicates significant challenges in mathematics. Whereas mathematics PISA evaluates students' ability in mathematical reasoning and problem-solving. It focuses on how well students can relate real-world contexts to mathematics concepts and apply these connections to solve problems. In the 2022 PISA assessment which mathematics is the major domain of assessment, Indonesian students scored significantly below the OECD average in mathematics. Almost no students reached Level 5 or 6, and only about 18% of Indonesian students achieving at least a Level 2 proficiency [2] [3] [4]. This level represents the ability to apply basic mathematical concepts to solve simple problems in real-world situations. Since Indonesia participated in PISA in 2003 to the latest in 2022, the results in the mathematics assessments have not shown consistent improvement over the years, generally a decline, where a significant drop is in 2022 showing only slight improve from the first time of participation in 2003 [4] [5]. This results over the years reflect ongoing challenges and a significant need for improvement in education system for mathematical literacy, particularly in addressing learning loss following the COVID-19 pandemic.

The data of Indonesia's performance in mathematics reflects broader educational challenges, such as teacher training quality. Research indicates that teachers do not feel confident in their mastery of mathematical concepts, which impacts their effectiveness in the classroom [2] [6]. Furthermore, teaching practices often emphasizes rote memorization rather than foster reasoning and problem-solving skills, which are the framework of mathematical literacy in PISA. Government interventions, such as the School Literacy Movement (Gerakan Literasi Sekolah-GLS), initiated in 2016 to foster culture of reading and literacy in schools, where numeracy as a part of literacy, had not given the expected outcomes in mathematics performance in PISA.

While enhancing students' mathematical literacy is crucial as the need of global skills and to improve educational outcomes in future international assessments, many research highlight and suggest strengthening teacher training and professional development. Nonetheless, there is limited focus on preparing pre-service mathematics teachers to understand and apply mathematical literacy concepts. Establishing foundation during teacher preparation programs can ensure that future teachers enter the classroom equipped with the skills and confidence necessary to teach mathematics in ways that promotes problem-solving, critical thinking, and real-world applications.

In the Mathematical Literacy course in mathematics education study program of Raja Ali Haji Maritime University (UMRAH), pre-service teachers are aimed to understand what mathematical literacy is, why mathematical literacy is needed, and how mathematical literacy refers to PISA and AKM (Indonesia's national assessments that align with PISA frameworks), as well as being aware of the condition of Indonesian students' mathematical literacy. Additionally, this course provides opportunities for pre-service teachers to develop 21-st century competencies, including think analytically, solve problems, collaborate and be creative through activities to solve and analyze mathematical literacy problems, and design

creative learning activities that provide solutions to problems in schools related to mathematical literacy.

Therefore, this course employs Project-Based Learning (PjBL) as a central method, giving pre-service teachers the opportunity to apply theoretical concepts in practical settings. Through PjBL, the pre-service teachers gain experience in designing contextualized mathematics concepts. This research aims to describe how PjBL design and implementation for the Mathematical Literacy course to prepare pre-service teachers support mathematical literacy development in their future classrooms.

2 Method

This research uses design-based research method [7] giving descriptive analysis of designing and revising the tasks of project-based learning (PjBL) approach in the Mathematical Literacy course, implementing, and evaluation. Subject research includes pre-service mathematics teachers who enroll in the Mathematical Literacy course academic year 2023/2024 at FKIP Raja Ali Haji Maritime Education (UMRAH), in Tanjungpinang, Riau Islands. The subjects are selected based on their enrolment in the course, ensuring they are at an appropriate stage in their teacher training program to engage with PjBL tasks. The one-cycle stages involved in this research are the preparation phase, design experiment, and retrospective analysis. Data is collected through a combination of methods: observations are conducted to monitor interactions during PjBL sessions, semi-structured interviews to gather pre-service teachers' perspective on their experiences with PjBL, and field notes for reflective journals throughout the course. All this data is descriptively analysed and used to get information for redesigning PjBL tasks. During the preparation phase, review of literature on PjBL is carried out; our conjecture through lesson plan and students' PjBL guideline are developed. This includes project framework, sequence of project activities, and assessments. The design experiment phase involves teaching experiment in one semester. In the retrospective analysis phase, the PjBL design is evaluated by comparing it with the actual classroom learning process.

3 Results and Discussion

3.1 Preparation phase

In this phase we design the structure of the Project-based Learning (PjBL) model for the Mathematical Literacy course. This includes literature review on PjBL, the development of project framework to decide the type of projects and the sequence of learning activities, and the development of learning instruments.

3.1.1 Literature Review on PjBL

PjBL is an instructional approach that encourages students to engage in meaningful projects related to real-world contexts. PjBL puts emphasise on assigning tasks, particularly in the form of projects that can lead students to experience an inquiry process [8]. Rooted in constructivist theories: Dewey and Vygotsky, PjBL emphasizes active learning, collaboration, and problem-solving. Students take an active role in exploring complex questions and developing solutions, which can improve critical thinking and deepen content understanding [9] [10].

The Indonesian Ministry of Education, Culture, Research, and Technology advocates for PjBL in universities as part of a broader effort to align education with 21st-century skills and

promote interactive, holistic, integrative, scientific, contextual, collaborative, and student-centred learning [11]. This shift is seen within the framework of the Merdeka Belajar (or Emancipated Learning) reform, which emphasizes autonomy, character building, and practical skills. PjBL allows students to experience real-world problem-solving, promoting critical thinking, creativity, collaboration, and communication. By involving students in complex, authentic projects, PjBL encourages active learning and helps develop students' independence and social responsibility. This learning model aligns with the ministry's response to global education trends, aiming to help students apply knowledge practically while enhancing their skills and cognitive development.

The Ministry of Education, Culture, Research, and Technology [12] adopt PjBL framework from The George Lucas Educational Foundation which includes six stages :

1. Start with the essential question : initiate the project by asking open-ended questions
2. Design a plan for the project : collaborate with students to set project goals,
3. Create a schedule : organize and manage the schedule,
4. Monitor the students and the progress of the project : provide feedback from teachers and peers on both the process and the final product,
5. Assess the outcome
6. Evaluate the experience

3.1.2 Development of Project Framework

The development of the project framework for the Mathematical Literacy course is aligned with the course learning outcomes (CLOs), which are : 1) understanding the basic concepts of mathematical literacy ; 2) understanding the domain of mathematical literacy and its evaluation ; 3) solving school mathematics literacy questions; 4) analyzing problems in schools related to mathematical literacy; and 5) designing school mathematics literacy learning that supports the development of students' mathematical literacy.

To achieve the CLOs, the course is designed with PjBL model [8] where along the stages of the project, pre-service teachers progressively build knowledge, starting with an understanding of basic concepts and moving toward complex applications in real classroom settings. This setting gives chance for pre-service teachers master both the theoretical and practical aspects of mathematical literacy.

The course project framework is structured to engage pre-service teachers in authentic, hands-on tasks that reflect the practical challenges of teaching mathematical literacy in schools following the 6 stages of PjBL of The George Lucas Educational Foundation [8]. The project outcome intended in this course is that pre-service teachers can design a mathematical literacy learning program based on challenges they find in schools through observation and giving test. This enables pre-service teachers design and evaluate mathematical literacy tasks to enhance students' mathematical literacy.

Therefore, the project task design begins with Step 1: **Starting with the essential question**, where the pre-service teachers are introduced a phenomenon: reports and literatures about current issues of mathematical literacy, especially Indonesian students low score in mathematics PISA (Programme for International Student Assessment). In this step, the pre-service teachers are driven with problems to be explained, experienced, and solved. During the exploration understanding this phenomenon, the pre-service teachers must collect information. We design learning activities, weekly, that they explore mathematical literacy domain in PISA, examples of mathematical literacy practices in schools especially from practices of the School Literacy Movement (Gerakan Literasi Sekolah-GLS), program of Indonesia government [13]; and then explore assessment of mathematical literacy with PISA domain and National Assessment. By this process, they continuously develop understanding of concepts of mathematical literacy referring to PISA.

In Step 2: **Designing a plan for the project**, where pre-service teachers collaborate in team to outline the tasks for the final project of designing mathematical literacy learning program based on actual school condition. The tasks include strategies needed to address the question of how to design a mathematical literacy program. The pre-service teachers need to seek for actual data from real classroom practices in high schools in Tanjungpinang, Riau Islands for their initial point to start design the program. Therefore, we include learning activities where they practice observation and experience giving mathematical literacy test.

In Step 3: Creating a schedule, involves setting a timeline for each phase of the project and including checkpoints and deadlines to keep students on track and manage the project's progression effectively over the semester. As pre-service teachers work through their project.

In Step 4: Monitoring, we set progress presentation where peers and lecturer can give feedback and guidance about their work to stay aligned with the learning objectives. We provide guideline to them what to focus on observation and test result. This happens in several meetings, where we discuss the results from each team's observation, test results, and continue follow up this field analysis result to draft a design program.

In Step 5: Assessing the Outcome focuses on evaluating the final project based on predefined criteria that reflect the Course Learning Outcomes (CLOs). Finally, **in Step 6: Evaluating the Experience**, provides an opportunity for reflection. Pre-service teachers analyse their learning process, identify successes and challenges, and consider how they would apply what they've learned in future teaching scenarios.

3.1.3 Development of Learning Instruments

The learning instruments are designed to achieve the CLOs and align with PjBL stages used in this course. The learning instruments consist of some materials that support each stage of the PjBL process which include lesson plan, project guideline, and assessment rubric.

The lesson plan provides a scaffolded approach outlining the objectives, activities, and expected outcomes of each lesson. The framework of PjBL in lesson plan ensures the pre-service teachers progressively comprehend understanding of mathematical literacy. At the beginning, we design the outline of the course (see Figure 1) and then transform it into UMRAH lesson plan format (see Figure 2). We outline the activities into 3 main activities align with PjBL stages: exploring the foundational elements of mathematical literacy (meeting 2 to meeting 3); exploring its domain and evaluation methods (meeting 4 to meeting 6). These two main activities are at stage 1 in PjBL; and applying this understanding in practical scenarios (meeting 7 to meeting 15) for stage 2-6 of PjBL.

Course Overview**Literasi Matematika, 2 SKS**

Meeting 1	<u>Pendahuluan, penelusuran literatur tentang literasi matematika</u>
Meeting 2	<u>Memahami konsep dasar literasi matematika</u> <u>Kerja Kelompok</u> - Penelusuran dan Eksplorasi literatur, dan diskusi tentang konsep literasi matematika, dan asesmen literasi matematika di sekolah dan internasional - Presentasi hasil kerja kelompok dan diskusi <u>Tugas Mandiri</u> - Membuat essay pemahaman tentang literasi matematika
Meeting 3	<u>Praktik Pembelajaran Literasi Matematika di sekolah</u> <u>Praktik baik strategi literasi matematika di sekolah (Gerakan Literasi Numerasi di Sekolah)</u> https://ditsmp.kemdikbud.go.id/modul-literasi-numerasi/ https://repositori.kemdikbud.go.id/22599/1/Panduan_Penguatan_Literasi_dan_Numerasi_di_Sekolah_bf1426239f.pdf <u>Tugas Mandiri</u> - Membuat personal essay tentang pembelajaran literasi matematika
Meeting 4	<u>Asesmen Literasi Matematika: Soal PISA konten literasi matematika</u> <u>Tugas Kelompok</u> - Penelusuran dan eksplorasi literatur tentang PISA (apa itu PISA, framework PISA, domain PISA): Domain PISA: Content, Context, Level Competency, Type of Questions. - Deskripsi domain PISA di atas, berikan contoh masing-masing 2 soal pada setiap konten. - Setiap soal harus terdiri dari beragam konteks, level, dan tipe soal/trubrik penskoran. - Membuat essay pemahaman tentang tes PISA
Meeting 5	<u>Asesmen Literasi Matematika: Asesmen Kompetensi Minimum (AKM) Kelas, komponen numerasi (konten: bilangan, pengukuran dan geometri, data dan uncertainty, aljabar; proses: pemahaman, aplikasi, penalaran; konteks: personal, sosiokultural, saintifik)</u> https://pusmendik.kemdikbud.go.id/akmkelas/ https://pusmendik.kemdikbud.go.id/an/page/news_detail/asesmen-kompetensi-minimum https://pusmendik.kemdikbud.go.id/an/asesmen_kompetensi_minimum/view/literasi-matematika <u>Tugas Kelompok</u> - Penelusuran dan eksplorasi literatur tentang AKM - Membuat essay pemahaman tentang AKM numerasi

Meeting 6	<u>Latihan soal-soal tes literasi numerasi PISA dan AKM</u> <u>Tugas Mandiri</u>
Meeting 7	<u>Kerja Kelompok</u> - Mengobservasi video pembelajaran - Merefleksikan apa saja yang hal-hal yang perlu disoroti dalam video pembelajaran - Mengembangkan instrument observasi berdasarkan fokus-fokus tertentu - Presentasi hasil kerja kelompok dan diskusi, pembagian kelompok fokus observasi <u>Tugas Kelompok</u> - Mempersiapkan seluruh tahapan observasi
Meeting 8	<u>Kerja Kelompok</u> - Praktik observasi di sekolah <u>Tugas Kelompok</u> - Laporan hasil observasi
Meeting 9	<u>Kerja Kelompok</u> - Mempersiapkan seluruh tahapan pelaksanaan AKM
Meeting 10	<u>Kerja Kelompok</u> - Melaksanakan kegiatan test AKM konten numerasi <u>Tugas Kelompok</u> - Laporan hasil tes AKM
Meeting 11	<u>Kerja Kelompok</u> - Analisis data temuan - Menarik kesimpulan tentang kebutuhan praktik pembelajaran literasi matematika <u>Tugas Kelompok</u> - Membuat perbaikan Laporan hasil observasi dan hasil AKM
Meeting 12	<u>Presentasi Kelompok</u> - Refleksi temuan dari praktik observasi dan praktik tes AKM numerasi - Memetakan temuan - Merumuskan program pembelajaran literasi matematika untuk menjawab kebutuhan sekolah - Kelompok saling memberikan masukan untuk praktik program pembelajaran
Meeting 13	<u>Kerja Kelompok</u> <u>Merancang dan menentukan program pembelajaran literasi matematika</u>
Meeting 14	<u>Presentasi kelompok, revisi rancangan program</u>
Meeting 15	<u>Presentasi kelompok, revisi rancangan program</u>

Fig. 1. Course overview of Mathematical Literacy course.

7-8	SUB CPMK 6	1. Mengembangkan instrument observasi 2. Melakukan observasi sekolah	observasi	Bentuk: Student Centered Learning berkelompok Metode: Project-Based Learning dengan sintaks	Luring			Kriteria 1. Keaktifan berdiskusi menganalisis masalah dengan benar. 2. Mempresentasikan analisis dengan lancar 3. Tugas kelompok	@2 x 50'
Rencana Pembelajaran Semester (RPS) Mata Kuliah <u>Literasi Matematis</u>									9

MG KE -	KEMAMPUAN AKHIR YANG DIHARAPKAN (SUB CPMK)	INDIKATOR PENCAPAIAN	MATERI PERKULIAHAN/ POKOK BAHASAN	MODEL PEMBELAJARAN/ SINTAKS	KEGIATAN PEMBELAJARAN			KRITERIA PENILAIAN	WAKTU
					Luring	Daring	Blended		
				1. Persiapan mendasar. 2. Mendesain rencana proyek dan menyusun jadwal. 3. Mengetik proyek dan monitoring progres. 4. Menilai hasil proyek. 5. Mengevaluasi proyek. Kegiatan: 1. Dosen memberikan video tentang pembelajaran di sekolah. Selanjutnya, mahasiswa berdiskusi untuk memberikan informasi apa yang dapat diamati, aspek apa saja yang dapat dicermati dari video tersebut. Dosen dan mahasiswa mendiskusikan apa saja yang seharusnya menjadi poin observasi proses pembelajaran (sintaks 1). 2. Mahasiswa berkelompok, mengembangkan instrument observasi proses pembelajaran.				Bentuk • Diskusi • Observasi • Penugasan	
Rencana Pembelajaran Semester (RPS) Mata Kuliah <u>Literasi Matematis</u>									10

MG KE -	KEMAMPUAN AKHIR YANG DIHARAPKAN (SUB CPMK)	INDIKATOR PENCAPAIAN	MATERI PERKULIAHAN/ POKOK BAHASAN	MODEL PEMBELAJARAN/ SINTAKS	KEGIATAN PEMBELAJARAN			KRITERIA PENILAIAN	WAKTU
					Luring	Daring	Blended		
				meliputi aspek: perangkat pembelajaran, seperti kurikulum, silabus, Rencana Pelaksanaan Pembelajaran (RPP), metode pembelajaran, dan strategi pembelajaran, media dan sumber pembelajaran, metode penilaian (sintaks 2) 3. Melakukan observasi sekolah secara berkelompok (sintaks 2 & 3) 4. Membuat laporan hasil observasi.					
9-10	SUB CPMK 7	1. Mempersiapkan seluruh tahapan pelaksanaan AKM Melakukan observasi sekolah	Melakukan tes literasi matematika di sekolah	Bentuk: Student Centered Learning berkelompok Metode: Project-Based Learning Kegiatan: 1. Mempersiapkan seluruh tahapan pelaksanaan AKM (sintaks 2 & 3) 2. Melaksanakan kegiatan test AKM konten numerasi (sintaks 2 & 3)	Luring			Kriteria 1. Keaktifan berdiskusi menganalisis masalah dengan benar. 2. Mempresentasikan analisis dengan lancar 3. Tugas kelompok Bentuk • Diskusi • Observasi • Penugasan	@2 x 50'
Rencana Pembelajaran Semester (RPS) Mata Kuliah <u>Literasi Matematis</u>									11

MG KE -	KEMAMPUAN AKHIR YANG DIHARAPKAN (SUB CPMK)	INDIKATOR PENCAPAIAN	MATERI PERKULIAHAN/ POKOK BAHASAN	MODEL PEMBELAJARAN/ SINTAKS	KEGIATAN PEMBELAJARAN			KRITERIA PENILAIAN	WAKTU
					Luring	Daring	Blended		
				3. Membuat laporan hasil tes					

Fig. 2. Lesson plan of Mathematical Literacy course.

On the other hand, the project guidelines serve as a framework for pre-service teachers to understand the expectations of each project stage. The guideline is provided for each meeting including references to readings and instructions that support their project work (see figure 3 and figure 4 for the examples of the guideline).

Kegiatan Kelompok Literasi Matematika Pertemuan 2

Stimulus:

1. Baca beberapa artikel/makalah tentang tuntutan numerasi/literasi matematika di abad ke-21, berikut referensi

<https://link.springer.com/article/10.1007/s10763-017-9814-6>

Afrivanti, I., Wardono, W., & Kartono, K. (2018, February). Pengembangan literasi matematika mengacu PISA melalui pembelajaran abad ke-21 berbasis teknologi. In *PRISMA, Prosiding Seminar Nasional Matematika* (Vol. 1, pp. 608-617).

<https://jurnaldikbud.kemdikbud.go.id/index.php/jpnk/article/view/158/145>

Kerja Kelompok:

Berdasarkan bacaan tersebut, diskusikanlah bersama kelompok tentang isu pembelajaran abad 21 dan konsep literasi matematika.

Anda dapat menggunakan pertanyaan-pertanyaan berikut sebagai petunjuk:

- a. Apa itu kemampuan literasi matematika?
- b. Seberapa penting menurut Anda literasi matematika di abad 21?
- c. Apakah saat ini di abad 21, literasi matematika lebih penting atau kurang penting, jelaskan mengapa Anda berpikir demikian? Apakah warga negara atau pekerja lebih membutuhkan kemampuan literasi matematika daripada masa lalu? apakah perkembangan teknologi saat ini berarti membutuhkan lebih sedikit matematika?
- d. Menurut Anda, bagaimana dengan pengembangan kemampuan literasi matematika di sekolah, apakah sekolah mengakomodir pembelajaran untuk mengembangkan kemampuan literasi matematika?
- e. Bagaimana Anda dapat melakukan pembelajaran yang lebih baik? apakah ada tantangannya?
- f. Bagaimana pemerintah merespons pentingnya kemampuan literasi matematika? apakah ada kebijakan-kebijakan baru dari kementerian Pendidikan?
- g. Bagaimana menurut Anda untuk dapat mengajak siswa memahami pentingnya kemampuan literasi matematika?

Fig. 3. Guideline for meeting 2

Kegiatan Kelompok Literasi Matematika Pertemuan 7**Stimulus:**

Tontonlah video kegiatan pembelajaran berikut bersama anggota kelompok. Selama menonton, perhatikan situasi dan amati momen-momen penting selama kegiatan berlangsung.

<https://www.youtube.com/watch?v=WVlHPLvBIOW>

<https://guru.kemdikbud.go.id/bukti-karya/video/174324>

Kerja Kelompok:

Berdasarkan 2 video tersebut, diskusikanlah bersama kelompok pertanyaan-pertanyaan berikut

- a. Dari skala 1-5, bagaimana pendapat Anda secara keseluruhan menonton video kegiatan pembelajaran tersebut? (Perhatikan yang dinilai adalah kegiatan pembelajaran, bukan kualitas video)
 Skor 1. Sangat Menarik
 Skor 2. Menarik
 Skor 3. Netral
 Skor 4. Kurang Menarik
 Skor 5. Sangat Tidak Menarik
Skor:
Penjelasan:
- b. Hal-hal apa saja yang menurut Anda penting untuk diperhatikan/disoroti yang menjadi bagian dari kegiatan pembelajaran tersebut?
Jawaban:
- c. Uraikan temuan-temuan penting yang Anda soroti tersebut!
Penjelasan:
- d. Apakah Anda menemukan permasalahan, tantangan, atau situasi yang seharusnya dapat diperbaiki dari hal yang Anda soroti tersebut? (Anda dapat menyoroti berbagai aspek misalnya: praktek mengajar tidak sesuai dengan perencanaan awal, kegiatan yang diarahkan kurikulum tidak seharusnya seperti itu, siswa diberikan kesempatan untuk menerapkan matematika untuk memecahkan masalah, dsb).
Penjelasan:
- e. Sebutkan dan uraikan apa yang ingin Anda perbaiki dari permasalahan tersebut!
Penjelasan:
- f. Hal-hal yang Anda amati dari video kegiatan pembelajaran ini merupakan salah satu sumber data yang dapat Anda kumpulkan untuk observasi sekolah, yaitu proses pembelajaran. Sebutkan dan uraikan aspek apa saja yang dapat digunakan untuk mengobservasi proses pembelajaran!
Penjelasan:
- g. Selain dari proses pembelajaran, sebutkan sumber data lain yang menurut Anda penting untuk dicari tahu dan diamati di sekolah!
Penjelasan:
- h. Anda telah melakukan pengamatan kegiatan pembelajaran matematika dengan video. Video kegiatan pembelajaran tersebut dapat Anda ulang-ulangi lagi untuk memperhatikan lebih seksama fenomena apa yang terjadi. Namun, pada kenyataannya ketika Anda turun ke lapangan, Anda akan memerlukan waktu, tenaga, dan biaya untuk melakukan observasi hal yang sama secara berulang. Sehingga, sebelum turun lapangan, Anda sudah harus jelas fokus dan data apa yang ingin disoroti. Untuk mempermudah Anda melakukan pengamatan nyata di sekolah, Anda memerlukan alat bantu yakni sebuah instrument observasi. Instrumen observasi berfungsi memberikan tuntunan atau pedoman agar data yang didapat ketika turun lapangan lebih sistematis dan terarah. Dari kegiatan a-g, Anda memperoleh kisi-kisi aspek apa saja yang dapat dijadikan data ketika observasi. Kembangkanlah bersama kelompok sebuah instrument observasi yang dapat Anda gunakan untuk mengobservasi sekolah khususnya permasalahan terkait pembelajaran numerasi yang sudah ada di sekolah.
Jawaban:

Fig. 4. Guideline for meeting 7

To evaluate both the process and outcome of the project, assessment rubric is created to assess the final project. The rubric includes criteria (see Figure 5) to asses pre-service teachers’ ability to design mathematical literacy program for school they observe.

Rubrik Penilaian Produk:

No	Penilaian Produk Proiek	1	2	3	4	5
	Orisinalitas					
1	Produk dikembangkan sendiri oleh tim					
2	Produk belum pernah diumumkan dan digunakan di tempat lain					
	Kesesuaian Produk dengan Pembelajaran Numerasi					
3	Produk tepat bermanfaat untuk menyelesaikan permasalahan yang dikemukakan di bab analisis					
4	Produk mendukung pembelajaran untuk penguatan numerasi					
	Kelayakan Isi Produk					
5	Keluasan materi/konsep					
6	Kedalaman materi/konsep					
7	Keruntutan materi/konsep					
8	Interaktivitas (guru dengan siswa dan antar siswa)					
	Kreativitas					
9	Produk memanfaatkan teknologi					
10	Teknologi yang digunakan user friendly					
11	Tampilan menarik					

Fig. 5. Assessment rubric for project product

3.2 Design experiment and retrospective analysis

In this phase, we describe how the PjBL is implemented in the course setting and do the retrospective analysis for revision of our design. This includes pre-service teachers engagement and participation, adjustments made comparing lesson plan and actual implementation.

During the design experiment, pre-service teachers progress through the six stages of the PjBL model: starting with the essential question, designing a plan for the project, creating a schedule, monitoring progress, assessing outcomes, and evaluating the experience. The design experiement is done in one semester. The pre-service teachers are grouped in team of 3 members.

3.2.1 Start with the essential question

In this stage, we design activities where pre-service teachers explore fundamental concepts of mathematical literacy and Indonesia current issue of mathematical literacy in meeting 1 to meeting 3 and then explore domain and evaluation methods in meeting 4 to meeting 6. Specifically, in meeting 1 and 2, pre-service teachers are proposed a research result which provides both literature review of concept of mathematical literacy and Indonesia mathematics PISA results [14] [15]. In meeting 3, the pre-service teachers start exploring the examples of classroom practice of mathematics lesson focusing numeracy (term used in Minimum Competency Assessment-AKM). Hereafter, in meeting 4 to meeting 6, the preservice teachers explore mathematical literacy based on PISA framework and AKM which is aligned with PISA: the mathematical process, content domain, context, and skill levels.

Based on our observation, separating understanding concept of mathematical literacy and domain and evaluation methods is not effective in achieving understanding for the pre-service teachers. Many of them struggle to connect the theoretical aspects of mathematical literacy, such as the core concepts and the assessment, with the practical application in classroom settings. As a result, we observe some disconnect between their understanding of the foundational concepts and their ability to critically engage with the evaluation methods. Moreover, practicing mathematical literacy in just one meeting is not enough to allow pre-service teachers to fully grasp experiencing solving mathematical literacy problems.

Therefore, we find that merging the exploration of concepts with domain and evaluation methods, practicing solving problems, into a single integrated activity might provide a more holistic understanding and then continue to introduce them to real-life classroom scenarios where mathematical literacy concepts are applied would help bridge the gap between theory and practice. For practice phase, we suggest extending to several sessions to give pre-service teachers more time to experiment solving various and more assessment items of mathematical literacy. Also, for refinement, we need to provide more update of mathematical literacy framework and assessment items that are used in PISA 2022 to the course.

3.2.2 Create a schedule

In this stage, pre-service teachers guided by the lecturer create a schedule to manage the development and completion of their final project, which involves designing a mathematical literacy learning program as real classroom needs. The structure is spanned from meeting 7 to meeting 15. The pre-service teachers at the beginning in meeting 7 engage in a practice video observation, where they discuss and reflect some aspects they need to observe especially on classroom mathematical literacy. This initial practice outcome is then developed into observation instrument to prepare them for the actual school observation in meeting 8, where they visit a high school in Tanjungpinang, Riau Islands, to observe classroom practice and identify challenges related to mathematical literacy. This observation provides critical insights into how mathematical literacy concepts are addressed in mathematics lesson, enabling the pre-service teachers to identify specific areas for improvement. In meeting 9, the pre-service teachers in team prepare assessment test items from PISA and AKM to evaluate students' mathematical literacy.

Following data collection from observation and test, meeting 11 and meeting 12 focus on data analysis, where pre-service teachers are guided to analyze the observation and test results to identify patterns, strengths, and areas needing improvement in students' mathematical literacy (see Figure 6 and Figure 7). This analysis helps them gain a deeper understanding of the types of mathematical challenges students face, which will inform their project design and which PISA domain they need to focus on. During meeting 13 to 15, the

pre-service teachers work in team to develop a comprehensive mathematical literacy program.

Petunjuk penugasan:

Kirim dalam bentuk word file dengan nama: Kelompok X_Laporan Observasi

1. Cover (judul laporan dan identitas)
2. Daftar Isi
3. Hasil Observasi:
 - sub bab 1. Metode observasi: tujuan observasi, Teknik observasi, deskripsi subjek, lokasi observasi, waktu observasi.
 - sub bab 2. Hasil observasi:
 - a. uraian singkat tujuan observasi, dilanjutkan penjelasan apa saja poin-poin yang diamati dari observasi, dan bagaimana keterlaksanaan observasi;
 - b. deskripsikan temuan2 yang didapati dari observasi. Perhatikan poin temuan yang disoroti adalah terkait Literasi Matematika. Sebelum membuat paparan deskripsi, ada baiknya brainstorm ide/poin-poin yang ingin disampaikan/poin-poin hasil observasi. Lalu uraikan/kembangkan poin-poin tersebut menjadi paragraf. Mulai paparan dengan menjelaskan SK, KD, Tujuan pembelajaran saat pelaksanaan observasi KBM (kegiatan belajar mengajar) (jika ada dokumen yang ingin dilampirkan seperti RPP guru, dll silahkan sebutkan di teks dilampirkan pada lampiran keberapa). Lalu dilanjutkan Adapun hasil observasi adalah terkait
4. Penutup: a. Kesimpulan dan b. Saran
5. Lampiran:
 1. Lembar Observasi
 2. Isian lembar Obervasi
 3. Lembar Wawancara (jika ada)
 4. Isian lembar wawancara (jika ada)
 5. Bukti melakukan observasi dan atau wawancara (foto)
 6. Bukti melakukan observasi dan atau wawancara (link video drive)
 7. Lampiran-lampiran lain

Fig. 6. Observation report guide

Petunjuk penugasan:
Kirim dalam bentuk word file dengan nama: Kelompok X_Laporan Tes Literasi Matematika

- 1. Cover (judul laporan dan identitas)
- 2. Daftar Isi
- 3. Hasil Tes:
 - sub bab 1. Metode: tujuan tes, Teknik tes, deskripsi subjek, lokasi dan waktu pelaksanaan tes. Disini juga jelaskan bagaimana tim peneliti merancang tes, dokumen apa sj yang dirancang (sebutkan di lampiran berapa)
 - sub bab 2. Hasil dan pembahasan tes:
 - a. uraian hasil tes: Berikan uraian pengolahan data dan paparkan data akhir dengan membuat tabel

No. Soal	Bentuk Soal	Kompetensi Litmat yang dinilai	Jumlah Siswa yang mengerjakan	Jumlah siswa yang menjawab benar	Persentase siswa yang menjawab benar

- b. pembahasan hasil tes: deskripsikan temuan2 yang diamati dari tes literasi matematika. Sebelum membuat paparan deskripsi, ada baiknya brainstorm ide/poin-poin yang ingin disampaikan/poin-poin hasil tes. Style pemaparan dapat dari mana saja, misal dengan memaparkan temuan disoroti dari hasil tes **berdasarkan level soal**. Disini paparkan mulai dari kebanyakan siswa dapat menjawab soal level berapa sampai yang tersedikit, diikuti dengan pembahasan proses berpikir siswa dalam menjawab soal yang disertai dengan bukti jawaban siswa yang mewakili penjelasan Anda. Dapat juga menyoroti berdasarkan **konten**. Disini paparkan konten apa yang banyak mendapatkan jawaban sesuai yang diharapkan, sampai ke konten matematika yang dianggap sulit bagi siswa dilihat dari tes tersebut. Semakin kaya aspek temuan2 yang dibahas semakin bagus.
- 4. Penutup: a. Kesimpulan dan b. Saran
- 5. Lampiran:
 - 1. Lembar Tes
 - 2. Rubrik Tes
 - 3. Bukti melakukan tes dan atau wawancara (foto)
 - 4. Bukti melakukan tes dan atau wawancara (link video drive)
 - 5. Lampiran-lampiran lain

Fig. 7. Test report guide

Based on our observation and discussion with pre-service teachers, this scenario is effective enough for them to conduct field analysis prior to designing a mathematical literacy lesson. The pre-service teachers engage in active discussion how to translate the field observation and analyse test data. However, our issue is task arrangement. We find that separating the observation and test phases by scheduling them as distinct tasks is not optimal. Ideally, the process of observing classroom practices and analysing test results should be intertwined, as they offer complementary perspectives on students’ mathematical literacy.

3.2.3 Monitor the students and the progress of the project, assess the outcome, and evaluate the experience

In this stage, we focus on monitoring both the progress of the pre-service teachers' projects and their engagement with the learning process. Throughout the semester, we ensure that teams are on track with their project timelines, receiving the necessary support, and addressing any challenges that arise. We make sure their understanding of mathematical literacy concepts especially on implementing the domain of mathematical literacy in their design.

As the projects progress, pre-service teachers are encouraged to assess their own work and other team's, evaluate and make adjustments where needed. This involves both self-assessment and peer review. In the assessment process, we focus on the alignment of their program with the PISA or AKM frameworks, as well as the appropriateness of their proposed program in addressing the identified gaps in students' mathematical literacy.

Toward the end of the project, a final evaluation is conducted, involving discussion of the pre-service teachers experience along the learning process in this course. From 10 teams, we have 10 mathematical literacy program that can be implemented in real classroom setting.

4 Conclusion

In this study, we implement and evaluate a Project-based Learning (PjBL) task design of Mathematical Literacy course for pre-service mathematics teachers. The aim is to provide these prospective teachers with a comprehensive understanding of mathematical literacy, particularly as it relates to the PISA and AKM assessments.

Throughout the course, we identified both strengths and challenges. The PjBL effectively engage pre-service teachers in collaborative problem-solving and critical reflection on their learning process. However, challenges emerge in terms of the sequencing of tasks—particularly at the initial stage of PjBL start with question, and the separation of observation and test data analysis—which hindered a more integrated understanding of classroom practices and assessment methods. Based on our observations, we suggest merging these activities to create a more holistic and continuous learning experience.

The course design allows the pre-service teachers experience developing observation instruments, preparing test instruments, and execute them to the school. Therefore, we get picture of how mathematical literacy is usually conducted at school and how mathematical literacy of students in Tanjungpinang. The data analysis from this is used by the pre-service teachers to design mathematical literacy program.

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