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The development of Outcome-Based Education OBE)-Oriented Teaching materials through problem-based and project-based learning for the elementary science education course

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Article info	Abstract
Keywords: The development of teaching materials, outcome-based education (OBE), problem-based and project-based learning for the elementary science education course.	This study aims to develop new teaching resources for elementary school science education courses that emphasize outcome-based education (OBE) and integrate project-based learning (PjBL) and problem-based learning (PBL) methodologies. This development addresses the need to enhance the quality of OBE-based learning materials, highlighting that traditional teaching resources often fail to meet student expectations. This research focuses on the development and validation phases; its limitation is that it does not include effectiveness testing. Employing the Research and Development (R&D) approach guided by the Borg and Gall framework, the study progressed through structured phases: prototype creation, initial testing, refinement, field implementation, and finalization of the product. Participants in this research included subject matter experts, instructional design specialists, media experts, course instructors, and students from the Elementary School Teacher Education (PGSD) program. Validation results indicated that the developed materials achieved an average feasibility score of 89.81%, placing them within the "highly valid" category. The use of these teaching materials is anticipated to foster students' critical thinking, analytical reasoning, and collaboration skills, aligning with OBE learning outcomes and the objectives of the Merdeka Belajar Kampus Merdeka (MBKM) initiative. The study suggests that future research should further investigate the impact and effectiveness of these materials across broader educational settings.

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1. Introduction

Colleges and universities worldwide strive for global excellence by providing students with the best possible education(Cresencio, 2023). The higher education curriculum in Indonesia has adopted the Outcome-Based Education (OBE) approach as stipulated in the National Standards for Higher Education. For this approach to be implemented and achieve learning achievement indicators, lecturers are required to design and implement the learning process using relevant methods and approaches oriented towards student-centered learning. However, in practice, there are often significant learning gaps in higher education's instructional strategies. According to Chan & Fong (2018), Outcomes-Based Education (OBE) learning and its integration into relevant learning

models can be adopted for learning in higher education. This approach aims to ensure the achievement of Graduate Learning Outcomes (CPL) and Course Learning Outcomes (CPMK). Therefore, careful analysis and design of appropriate learning models are needed. According to Asbari & Nurhayati (2024), students' learning needs in a course are determined by three main domains: cognitive, affective, and psychomotor aspects. These three aspects are integrated into learning methods that emphasize developing them.

Project-based learning in science education really helps students expand their understanding of science concepts (DongJin & Mohamad Ashari, 2024). Critical and analytical thinking skills are essential competencies students need to succeed in the future workforce. The Problem-Based Learning (PBL) learning model is expected to serve as a facilitator in developing these skills by encouraging students to identify an event as a problem to be analyzed for its root cause before formulating a solution. According to Handoyo et al. (2024), PBL aligns with the OBE concept and is a relevant learning model. This approach emphasizes the importance of a deep understanding of the problem rather than merely seeking practical, immediate solutions.

Learning strategies that integrate a collaborative approach between theoretical and practical aspects are highly relevant to the Outcome-Based Education (OBE) indicators in the Merdeka Belajar Kampus Merdeka (MBKM) curriculum framework. One approach suitable for implementing this strategy is Project-Based Learning (PjBL). Of course, the OBE approach, when integrated into the PBL and PjBL models, can meet the anticipated learning objectives if carefully implemented to align with the educational context and objectives (Erdiana & Yasin, 2025). This learning model provides educators with the space to design a learning process that focuses on implementing complex projects, starting from investigative questions and real-world problems. Teaching materials based on OBE must be designed to align with predetermined learning objectives. According to Zheng et al. (2024), teaching materials developed using PjBL can provide a more concrete learning experience for students and encourage them to be more creative.

The combination of these two models is often referred to as Problem and Project-Based Learning (PPjBL). This creates a holistic learning environment with several advantages, such as:

1.1 Increasing cognitive Depth and Relevance, this model transforms through problem-based learning (PBL) into practical applications. The goal is for students not only to analyze problems but also to synthesize knowledge to design, test, and produce solutions relevant to real contexts, thereby strengthening their conceptual understanding.

1.2 Developing comprehensive 21st-century skills, this integration simultaneously fosters critical thinking skills in the PBL phase, collaboration and communication in the PjBL phase, and project creation. Students are trained to work in long-term teams, manage resources, and present validated results.

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1.3 By aligning motivation with authentic problems, students are motivated because they see that their academic efforts will culminate in a deliverable or product that can be demonstrated or implemented.

Through this approach, students are directed to be actively involved in designing solutions, identifying and formulating problems, making strategic decisions, and conducting independent investigations. In addition, PjBL encourages the development of independence, critical thinking, and collaborative skills that align with the expected learning outcomes in OBE and the spirit of MBKM. Therefore, the implementation of the PBL learning model must be systematically structured in each course to ensure optimal achievement of graduate learning outcomes (CPL) and alignment with the targets set in the curriculum. The Independent Learning Campus Merdeka Curriculum (MBKM) encourages the implementation of active learning methods such as PBL and PjBL to achieve outcome-based learning. (Safitri et al., 2024). stated that the implementation of this approach can increase students' learning independence and deepen their understanding of science concepts through real projects.

Natural Science (IPA) learning is one of the subjects with a close relationship to students' daily lives and the wider community. The term "IPA" is generally used in the context of basic education, particularly at the Elementary School (SD) level and even at the college level (Azmi et al., 2025). The ability to learn science subjects can be likened to the "heart" of all science learning activities.

In addition to science process skills, there are also several abstract thinking skills closely related to mental activity, such as the ability to think broadly and propose innovative ideas. These skills are essential for teachers to teach science effectively. Students not only learn the material in line with the learning outcomes outlined in the syllabus, but also develop critical and analytical thinking skills that are essential in higher education (Salamah & Fauziah, 2025).

By creating innovative teaching resources, this study aims to address this gap in light of these challenges. We employ an Outcome-Based Education (OBE) strategy that integrates with Problem-Based Learning (PBL) and Project-Based Learning (PjBL) models, focusing on achieving specific outcomes. It is anticipated that this integration will shift the paradigm of learning from simple memorization to meaningful, demanding experiences.

In particular, this study aims to address some important research questions: 1) How are PBL and PjBL (PPjBL) incorporated into the process of creating OBE-based instructional materials for science classes in elementary schools? 2) Based on evaluations by professionals and experts, how viable and valid are the created instructional materials?.

2. Literature review

Outcome-Based Education (OBE) is an educational approach that emphasizes the achievement of specific, measurable learning outcomes. In the context of elementary science education, OBE encourages the development of students' critical thinking, problem-solving, and collaboration skills. This model is highly relevant to the demands of 21st-century education, where students are expected to apply their knowledge in real-life situations. However, in practice, significant learning gaps often exist in university teaching methods. For example, textbooks for elementary school science education courses are still traditional and rely heavily on theoretical approaches. As a result, students lose their intrinsic motivation to learn. In agreement with Mahadi et al.'s (2020) viewpoint, he stated that the OBE approach can be used to achieve measurable learning outcomes in science classes.

Outcome-Based Education(OBE) is an approach that emphasizes the sustainability of interactive, innovative, and effective learning activities. OBE affects all aspects of education, from curriculum design and setting learning objectives to teaching strategies, learning method design, assessment methods, and the creation of an educational environment. As explained in the book Outcome-Based Education, the basis for implementing OBE lies in the development of a curriculum that is in accordance with the industrial era 4.0, where education is closely related to the use of science and technology as well as national regulations and standards related to national-level accreditation or certification (Lubis et al., 2024).

Problem-Based Learning (PBL) is a student-centered learning approach that begins with real-world problems for students to solve. In elementary science classes, PBL is efficacious in improving students' scientific attitudes and learning outcomes. (Desiyanti & Nugroho, 2024) Found that the implementation of PBL significantly influenced the scientific attitudes and academic achievement of fifth-grade students. (Hidayah et al., 2024) found that applying PBL in science education can significantly improve elementary school students' critical thinking competencies, as PBL requires them to seek evidence-based solutions using scientific data.

Project-Based Learning (PjBL) involves students in real-world projects relevant to their environment. In science education, PjBL is efficacious in improving students' scientific knowledge and literacy. (Wahini & Ganing, 2023) Reported that the PjBL model significantly improved science knowledge competency among fifth-grade students. In addition, Nais et al. (2023) found through a systematic literature review that PjBL helps develop students' scientific literacy. (Mitchell & Tilley, 2024), PjBL was effective in improving higher-order thinking skills by providing students with practical learning opportunities and direct experiences.

Project-Based Learning (PjBL) is an integrated learning strategy that engages students in ongoing, collaborative investigations. In this model, students actively participate in the inquiry process, both individually and in groups, which enhances their research and problem-solving skills. Students are responsible for designing solutions, making decisions, and executing investigations through meaningful projects. PjBL emphasizes hands-on experiences to help students confront and understand key concepts and principles firsthand. Meanwhile, the Problem-Based Learning (PBL) model, rooted in constructivist Theory, engages students actively in contextual problem-solving. Students formulate questions, collect and organize data, analyze information, and construct arguments both independently and collaboratively as they build a deeper understanding of scientific concepts through real-world challenges.

The integration of Outcome-Based Education (OBE), Problem-Based Learning (PBL), and Project-Based Learning (PjBL) is not just a pedagogical trend, but an essential framework for transforming learning into a meaningful, relevant, and measurable experience. OBE ensures that each learning unit, including course materials, directly contributes to the achievement of Graduate Learning Outcomes (CPL) through the PBL model, and PjBL serves as an ideal mechanism for achieving these goals. Based on Lesilolo's (2023) findings, which showed that PBL-based materials successfully improved critical thinking skills, the teaching materials developed in this study adopt a contextual approach. Specifically, the teaching materials we developed adopt a contextual approach. This approach is the essence of PBL itself, transforming authentic, real-world problems into challenging, relevant learning units. By applying this contextual principle, the teaching materials are designed not only to transfer information but also to place students in problem-solving scenarios that require in-depth analysis, synthesis of information, and evaluation of arguments, thereby directly stimulating and developing critical thinking skills, which is the main objective of this research.

Project-Based Learning (PjBL) is a structured yet dynamic teaching approach that requires students to analyze problems, manage tasks, and complete work within a specified time. The PjBL process comprises three key stages: planning, implementation, and evaluation.

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This model encourages students to identify problems, interact with new information, and build personal understanding through active exploration. This model offers several benefits: it increases students' motivation by actively engaging them in meaningful projects and creates a more enjoyable learning environment compared to traditional methods. PjBL also strengthens problem-solving skills because students face complex real-life challenges. In addition, PjBL encourages teamwork and communication, improves time and resource management, and builds communication skills through collaborative activities. Importantly, PjBL provides authentic learning experiences grounded in real-world contexts, fostering a positive atmosphere for both students and educators. Despite its many advantages, PjBL also has several limitations. This model requires significant time and resources, depends on skilled and dedicated teachers, and relies on adequate facilities and materials.

Additionally, this model may not be effective for students who lack persistence or basic skills, and some students may struggle to fully engage in group collaboration (Safitri et al., 2024). However, the PjBL model is recognized as a superior approach to training 21st-century skills; its implementation is not without challenges, particularly the need for significant time, logistical support, and an administrative workload for lecturers and students. This teaching material provides a highly structured, systematic, and comprehensive guidance (scaffolding) for lecturers and students. The structure of this teaching material guide explicitly breaks down complex project stages into manageable steps, minimizing ambiguity, streamlining time allocation, and ensuring that the PjBL process can be implemented effectively.

3. Method

Research and development (R&D) is the category under which this study falls. R&D's primary goal is to create new teaching materials based on Outcome-Based Education (OBE) that incorporate Problem-Based Learning (PBL) and Project-Based Learning (PBL) models, and to determine whether the product meets specific needs in the context of science instruction in elementary schools. The chosen R&D model is a simplified version of the Borg and Gall model, tailored for the development of instructional materials.

This study was conducted by the Elementary School Teacher Education Study Program (PGSD) at FKIP UIR. The research participants were divided into two main groups: Validators and Prospective Users (Trial). This sample was chosen based on representative characteristics. Specifically, (1) learning experts verified the suitability of the model (OBE-PPjBL) and pedagogical elements, (2) material experts verified elementary school science and science content, and (3) media/design experts verified the appearance, attractiveness, and organization of the course materials. Expert Validators (Expert Test) provided a comprehensive assessment of the product's viability and quality. (4) A validator lecturer teaches the course. Using a purposive sampling technique, 30 students were chosen for the trial based on two criteria: (a) members of the Class of 2024, and (b) students who have taken or are enrolled in the Elementary School Science Learning Course.

The development process starts with the (1) Needs Assessment stage: (a) Curriculum and Material Analysis, which involves comparing the OBE-based PGSD curriculum with the Elementary School Science/Science curriculum in order to determine the gap (gap analysis) between the expected Graduate Learning Outcomes (CPL) and the available teaching resources, (b) Examining students and key concepts, identifying the initial characteristics of students (target users), and verifying their initial understanding of the course's primary ideas for science instruction in elementary school. (2) At the product design stage: (a) a clear connection (constructive alignment) is established between the curriculum based on OBE and the instructional materials that will be developed, (b) Design of instructional materials, Teaching materials, concept maps, and learning exercises focused on problem solving (Problem) and project creation (project) are systematically included in this flow. It is created using the PBL and PjBL (PPjBL) models in conjunction with an OBE-based framework of educational resources. (3) Expert Validation and Revision Stage: (a) Preparing the first draft for the creation of an early prototype of instructional materials, (b) Validity Test: The educational materials are verified by PGSD Lecturer Validators and Expert Validators (Materials, Learning, and Media), (c) Trial Stage: The updated teaching materials were distributed to 30 students from the 2024 intake, and information was obtained from their answers to a questionnaire.

The following are the research tools: (a) a validation sheet, which is a Likert scale questionnaire used to evaluate the media/design, content, and construction (model) of the teaching materials; and (b) student questionnaire responses, which are used to evaluate the usefulness, appeal, and responses of the teaching materials. Although qualitative analysis is the main focus of this development research's data analysis method, specifically qualitative analysis, (a) evaluating expert validator interviews and feedback and recommendations (qualitative data) from the Validation Sheet, and (b) using this qualitative data as a basis for adjusting instructional materials and ensuring that the final product has high feasibility (high validity) and comprehensiveness. The results of the expert's or Validator's assessment are obtained from a Likert-scale questionnaire (1-4). The Likert score is then calculated using the average score on the statement items, which are provided as a range of responses. No descriptor is shown by a value of 1, one descriptor is shown by a value of 2, two descriptors are shown by a value of 3, and all three descriptors are shown by a value of 4. In the meantime, the validator uses a straightforward percentage calculation to determine the Validation Criteria. A score between 70.00% and 85.00% is considered suitable, meaning it may be used but requires some minor adjustments. A score of 85.00% to 100% is considered Very Suitable, meaning it can be used without revision. (3) Because it requires substantial adjustment, a score between 50.00% and 70.00% is deemed Less Suitable and should not be used. (4) 01.00% to 50.00% is inappropriate or should not be used.

The data analysis technique used in this study was [insert technique name]. Analyzing the Sains or IPA SD school's curriculum and student needs is the first step. They then examine the mahasiswa's attributes, including their comprehension of the core ideas. Then, determining the parallels between the curriculum based on OBE and the current teaching resources. The next step is to design OBE-based teaching materials integrated with the PBL and PjBL (PPjBL) models, with the flow comprising materials, concept maps, and educational activities focused on problems and projects—research instruments, such as questionnaire responses, validation sheets, and tests. Drafting the instructional materials is the next step. Consult with professionals in science education, curriculum, and media to validate the content and construction. Changes are made in response to the validator's feedback. The following steps involve observing the learning process, gathering information, and documenting student reactions throughout the trial.

Data analysis techniques were employed using qualitative methods, specifically analyzing data from validation sheets and interviews. Input and suggestions from expert validators were processed to revise the teaching materials, aiming to obtain more in-depth and comprehensive feedback.

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4. Results

Data collection for this study was conducted from October 11, 2024, to January 18, 2025, at the PGSD Education Study Program, FKIP UIR, involving 30 student samples. The results of validation by material experts on the development of OBE-based teaching materials through the problem and project-based learning model for elementary school science courses include three aspects, namely the feasibility of content with a value of 82.33%, the feasibility of presentation with a value of 83.33%, and language with a value of 85.45%. Based on the Assessment, the average value reached 83.37%, falling within a valid or feasible category. The results of the Validator's Assessment are shown in Figure 1.

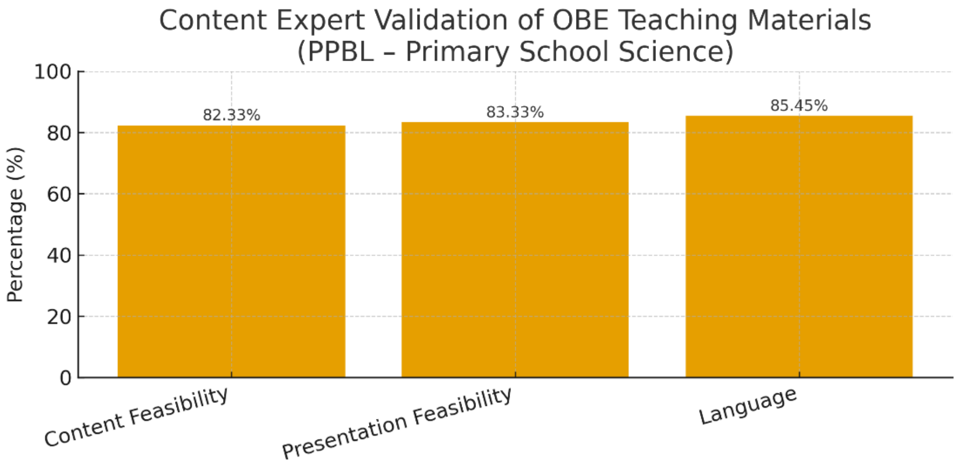

Figure 1. Researcher's data graph on the expert material validator's assessment

Material experts assessed the training materials' language, presentation, and content for viability and assigned them an average score of 83.37% in the "valid" or "viable" category. The scientific accuracy and relevance of the developed teaching materials to the curriculum's demands and Graduate Learning Outcomes (CPL) facilitate students' transition from the problem-solving stage to the project implementation stage. They also visually support the PBL and PjBL (PPjBL) models' flow and are simple to follow. The language used in the module is considered standard, intelligible, and suitable for the cognitive abilities of PGSD students.

The results of the validation of teaching materials by learning experts on OBE-based teaching materials through the problem and project-based learning model for elementary school science courses, namely the Validator's Assessment includes six aspects, the format of teaching materials with a value of 91.67%, presentation with a value of 95.83%, language with a value of 98%, graphics with a value of 95%, quality of teaching materials with a value of 91.67%, and benefits with a value of 97. Based on the assessment, the average value was 94.86%, indicating very valid or very feasible. The results of the validator's assessment are presented in Figure 2.

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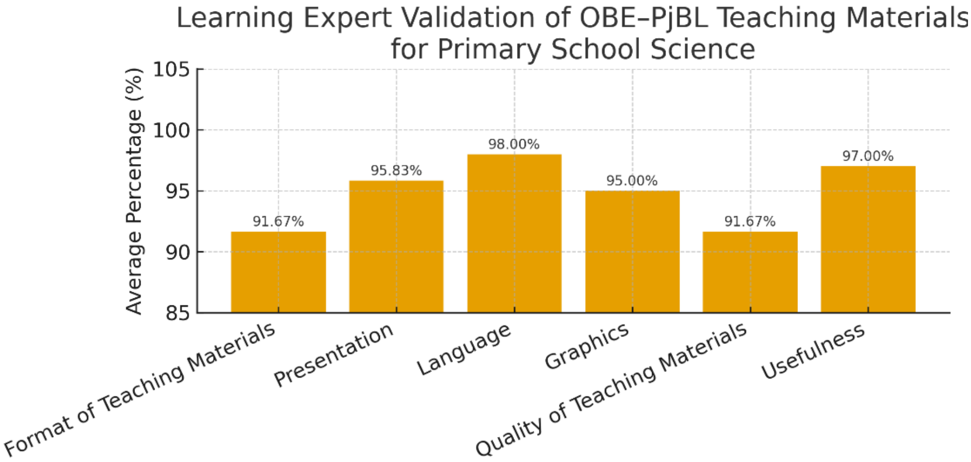

Figure 2. Researcher's data graph on the learning expert validator's assessment

The results of the validation of teaching materials by media experts on OBE-based teaching materials through the problem and project-based learning model for elementary school science courses, namely the expert validator's assessment, include three aspects namely display quality with a value of 85.45%, content suitability, with a value of 85.50%, and benefits with a value of 88.75%. Based on the Assessment, the average value reached 86.56%, falling within the valid or feasible category. The results of the validator's assessment are presented in Figure 3.

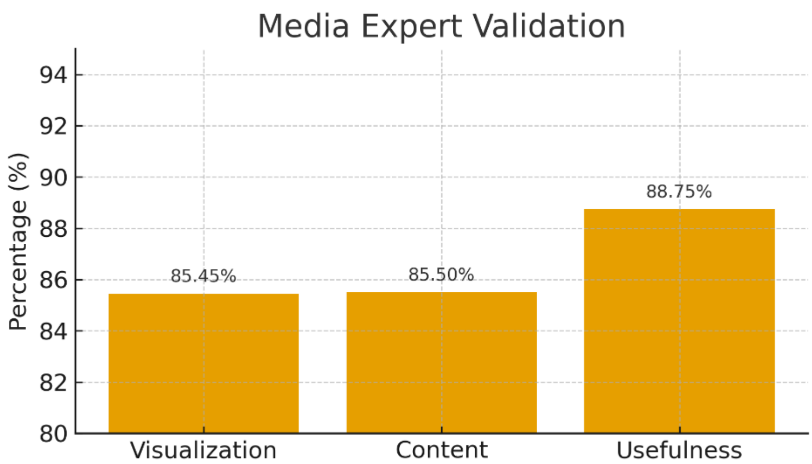

Figure 3. Researcher's data graph on media expert validator's assessment

The results of validation by the lecturer in charge of the course on OBE-based teaching materials through the problem and project-based learning model for elementary school science learning courses, namely the assessment of the expert learning validator covers four aspects, the suitability of learning achievements/objectives with a value of 91.67%, material/content content 95.83%, language 92.81%, usefulness with a value of 95.60%. Based on the assessment, the average value was 93.97%, indicating that it was very valid or very feasible. The results of the validator assessment are presented in Figure 4.

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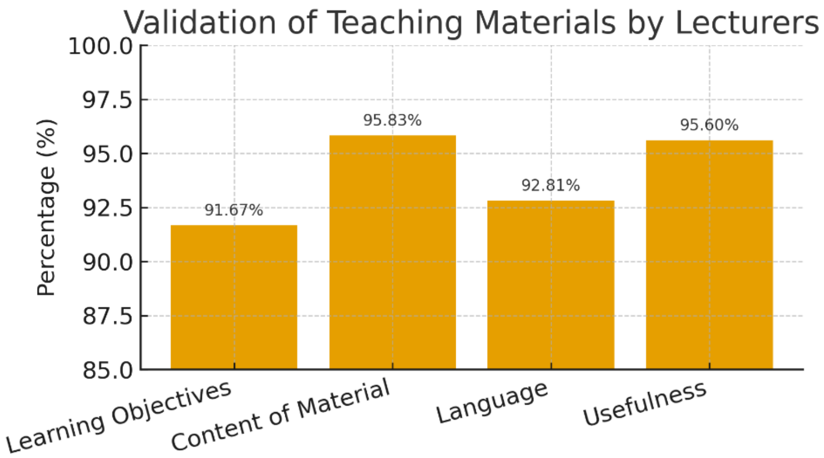

Figure 4. Graph of researcher data on the assessment of course lecturers

After the trial, 30 students from the Elementary School Teacher Education Study Program (PGSD) participated in interviews on the readability and utility of the instructional materials developed. According to the interview results, the students thought the step-by-step guide, which included group roles and a practical explanation of the teaching materials, was beneficial in making complex science concepts easier for them to understand. They went on to say that the arrangement of the images, their color palette, and aesthetic appeal were all pleasing and in line with the scientific concept.

5. Discussion

The integration of problem- and project-based learning (PBL) into the development of Outcome-Based Education (OBE)-based teaching materials for science subjects at the elementary school level is a comprehensive and structured pedagogical strategy. This approach is systematically designed to create learning experiences that not only meet curriculum demands but also prepare students with the essential skills needed to face future challenges. The implementation of the Outcome-Based Education (OBE) system is designed as a strategic approach in higher education to optimize the student learning experience and provide more accurate measures of competency. By developing learning models into measurable teaching processes, such as the PPjBL model, the implementation of OBE directly contributes to achieving predetermined learning outcomes. This not only enriches the learning experience through relevant activities but also increases the validity of evaluations of students' mastery of required competencies.

The integration of the problem- and Project-Based Learning (PBL) model within the Outcome-Based Education (OBE) framework has been shown to enhance not only students' understanding of science concepts but also the development of 21st-century skills, such as critical thinking, creativity, communication, and collaboration. Previous studies highlight that PjBL enriches scientific literacy and provides more meaningful learning experiences through contextual and real-world activities (Amelia & Santoso, 2021; McKinney, 2023). Furthermore, implementing PPjBL under the OBE system aligns with findings that project-based learning strengthens learning outcomes while fostering students' social competencies through collaboration (Nurhidayah et al., 2021; Zhao & Wang, 2022). Through this integration, the gap between Theory and practice is minimized, ensuring that elementary science education remains relevant to global challenges.

This research serves as the initial step in a research and development (R&D) cycle to create a new product. Through this approach, we not only focus on results but also systematically document each stage of the development process. In this initial stage, the research provides a comprehensive outline of how innovative teaching materials are designed, constructed, and validated by experts, offering a deep and structured understanding of the methodology employed.

The feasibility and validity of the developed teaching materials are crucial to ensuring their quality. Validity is evaluated by experts, who ensure that the content and teaching methods align with educational theories, are consistent with the OBE curriculum framework, and can be implemented through the PPjBL approach. Furthermore, feasibility is assessed by practitioners in the field, who ensure the materials are efficient, easy to use, and engaging for students. Thus, this problem formulation serves as a bridge between Theory and practice, ensuring that the resulting product is not only conceptually sound but also functional and well-received by users.

Based on the results of the recapitulation assessment of the validation value for the feasibility of developing OBE-based teaching materials through the Problem and Project-Based Learning model for elementary school science learning courses, the findings are detailed in Table 1 as follows.

Table 1. Summary of the feasibility assessment of teaching material development, problem, and project-based learning model for elementary school science courses

No	Validator assessment and response	Average percentage	Category
1	Subject Matter Expert	83.87%	Valid
2	Learning Expert	94.86%	Very Valid
3	Media Expert	86.56%	Valid
4	Course Lecturer Assessment	93.97%	Very Valid
	Average Assessment Results	**89.81%**	**Very Valid**

Material experts assessed the training materials' language, presentation, and content for viability and assigned them an average score of 83.37% in the "valid" or "viable" category. The scientific accuracy and relevance of the developed teaching materials to the curriculum's demands and Graduate Learning Outcomes (CPL) facilitate students' transition from the problem-solving stage to the project implementation stage. They also visually support the PBL and PjBL (PPjBL) models' flow and are simple to follow.

The Learning Expert's validation assessment was 94.86%, indicating a very high level of learning. The Learning Expert claimed that the pedagogical and instructional design of the teaching materials had been designed to meet the requirements of Outcomes-Based Education (OBE) and were aligned with the Graduate Learning Objectives (CPL). The PBL and PjBL (PPjBL) models had been integrated into the instructional design. This instructional design was developed rationally and based on a student-centered learning process. On the other hand, minimal graphics and visual design can enhance learning, help focus on visuals, and serve as valuable learning references.

	DOKUMEN: RENCANA PEMBELAJARAN SEMESTER (RPS)	KODE DOKUMEN:
RENCANA PEMBELAJARAN SEMESTER (RPS)		
TANGGAL PENYUSUNAN	28 Agustus 2023	
TANGGAL REVISI		

1	Program Studi	Pendidikan Guru Sekolah Dasar	
2	Nama Mata Kuliah	Pembelajaran IPA SD	
3	Kode Mata Kuliah	SD215141	
3	Semester	V	
4	Bobot (sks)	Teori : 1 sks	Praktik : 1 sks
5	Dosen Pengampu	Laili Rahmi S.Pd., M.Pd	
6	Capaian Pembelajaran Matakuliah	CPL_PRODI (Capaian Pembelajaran Lulusan Program Studi yang dibebankan pada mata kuliah)	
		CPL – S7	Menunjukkan sikap bertanggung jawab, jujur, berdasarkan iman dan taqwa di bidang keahlian Pendidikan Guru Sekolah Dasar.
		CPL – P3	Menguasai pengetahuan bidang studi IPA di sekolah dasar
		CPL – P4	Menguasai konsep pendekatan, strategi, model, metode, teknik, bahan ajar, media dan sumber belajar yang inovatif sebagai guru kelas di sekolah dasar
		CPL – KU1	Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam konteks pengembangan atau implementasi ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora yang sesuai dengan bidang keahlian pendidikan sekolah dasar pada mata pelajaran IPA
		CPL – KK3	Mampu menerapkan pengetahuan bidang studi di sekolah dasar pada bidang, IPA melalui perancangan dan pelaksanaan pembelajaran.

Figure 5. Semester learning plan (RPS) based on OBE

		pembelajaran IPA SD melalui perangkat pembelajaran, bahan ajar, media pembelajaran dan instrument penilaian yang menyelaraskan antara capaian matakuliah, aktivitas belajar, dan penilaian pembelajaran.
8	Bahan Kajian / Materi Pembelajaran	1. Hakikat Pembelajaran IPA SD 2. Tujuan dan Manfaat Pembelajran IPA SD 3. Teori-teori Pembelajran IPA SD 4. Pendekatan, Strategi, Model-model pada pembelajaran IPA SD. 5. Konsep materi IPA SD (Analisis Materi IPA SD kelas 1,2,3) 6. Konsep materi IPA SD (Analisis Materi IPA SD kelas 4,5,6) 7. Rencana perangkat pembelajaran dan Aplikasi (Modul pembelajaran IPA SD) 8. Media pembelajaran IPA SD (Bahan Ajar dan Media pembelajaran IPA SD) 9. Rancangan Assesment Pembelajaran IPA SD 10. Inovasi Pembelajran IPA literasi sains dan HOTS sesuai ketermpilan abad 21 di SD. 11. Simulasi Pembelajaran IPA SD.
9	Pustaka	**Utama dan Pendukung** 1. Atep Sujana, 2014. *Dasar-Dasar IPA: Konsep dan Aplikasi*, Bandung. UPP Press 2. Nelly Wedyawati, dkk. 2018, *Pembelajaran IPA SD*. Yogyakarta. Depublish 3. Yosaphaf Sumardi, *Konsep Pembelajaran IPA SD*, Bandung 4. Ika Candra Sayekti, dkk, 2020. *IPA Dasar*. Bandung, Rosdakarya 5. Zainul Alim. 2020. *IPA Dasar Untuk PGSD/PGMI*, Bandung, Rosdakarya 6. I Gusti Tri Agustina. 2020. *Konsep Dasar IPA Aspek Biologi*, Ombak 7. I Gusti Tri Agustina. 2020. *Konsep Dasar IPA Aspek Fisika dan kimia*, Ombak
10	Mata Kuliah Prasyarat	*Di isi mata kuliah yang harus lulus sebelum mengikuti mata kuliah ini.*

8. Rencana Kegiatan Perkuliahan

Figure 6. The circled parts are the items the validator commented on.

The average score of 86.56%, deemed appropriate or legitimate but suggesting a cover change, resulted from validation by media experts, who recommended replacing the cover with a more concrete image. The three main focuses of the validation evaluation were appropriateness, content, and visualization. The visualization's elements included layout, color scheme, font selection, and images.

Halaman	Tampilan	
	Cover depan Judul Gambar Penulis	Judul Gambar
i	Kata Pengantar	
ii	Daftar Isi	
iii-iv	Daftar Tabel Daftar Gambar	

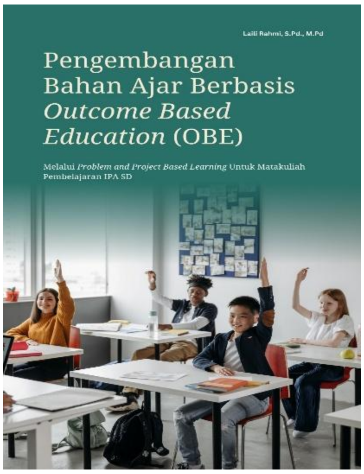

Figure 7. Initial teaching material storyboard structure design teaching material

Indikator	Deskriptor	Skor Penilaian	Koment
1. Tampilan Judul	1. Terdapat judul pada media pembelajaran 2. Judul singkat dan jelas 3. Judul mudah dipahami	A	Ganti cover
2. Jenis dan Ukuran teks	1. Jenis dan ukuran huruf tepat 2. Jarak antar baris sesuai 3. Konsisten dalam pemilihan huruf 4. Teks pada tampilan terbaca	3	
3. Kualitas gambar	1. Gambar terlihat jelas 2. Letak posisi gambar tepat 3. Ukuran gambar sesuai dan mendukung materi pembelajaran	A	
4. Komposisi warna	1. Warna sesuai dengan *background* 2. Warna pada bingkai dan teks sesuai	3	
5. Jenis dan ukuran teks	1. Jenis ukuran huruf tepat 2. Jarak antar baris sesuai 3. Konsisten dalam pemilihan huruf 4. Teks pada tampilan terbaca	3	
6. Kualitas gambar	1. Gambar terlihat jelas 2. Letak posisi gambar tepat 3. Ukuran gambar sesuai dan mendukung materi pembelajaran	A	

Indicator	Descriptor	Score	Comment
1. Title Display	1. A title is present on the instructi 2. The title is concise and clear. 3. The title is easy to understand.	A	Change the cover
2. Type and Size of Text	1. The font type and size are appropriate. 2. The line spacing is appropriate. 3. There is consistency in the choic	3	
3. Image Quality	1. The images appear clear. 2. The placement of the images is 3. The image size is appropriate ar	A	
4. Colour Composition	1. The colours are compatible with 2. The colours of the frame and tex	3	
5. Type and Size of Text	1. The font type and size are appropriate. 2. The line spacing is appropriate. 3. There is consistency in the choic	3	
6. Image Quality	1. The images appear clear. 2. The placement of the images is 3. The image size is appropriate ar	A	

Figure 8. Value of one of the validators by media experts

After the trial, 30 students from the Elementary School Teacher Education Study Program (PGSD) participated in interviews on the readability and utility of the instructional materials developed. According to the interview results, the students thought the step-by-step guide, which included group roles and a practical explanation of the teaching materials, was beneficial in making complex science concepts easier for them to understand. They went on to say that the arrangement of the images, their color palette, and aesthetic appeal were all pleasing and in line with the scientific concept.

Based on the Research and Development (R&D) research method employed, the development of this teaching material is implemented through several systematic stages, including the creation of prototypes, initial trials, revisions, field trials, finalization, and continuous evaluation.

5.1 Making prototypes of teaching materials

This stage includes developing an initial draft of a learning module prototype based on the previously developed conceptual design. This prototype is designed in an integrated manner, adopting Outcome-Based Education (OBE) principles and implementing Problem-Based Learning (PBL) and Project-Based Learning (PjBL) models. This integration aims to facilitate the development of 21st-century competencies in students. The main activity in this stage is developing an OBE-based Semester Learning Plan (SLP) that systematically maps learning outcomes to relevant activities, assessment methods, and resources. This step ensures that each learning component explicitly contributes to achieving the predetermined competencies.

This stage is a crucial phase in curriculum design, during which prototype learning modules are developed based on the conceptual design. This process involves integrating three key pedagogical frameworks to ensure the learning experience is relevant and practical. First, this module is designed in accordance with the Outcome-Based Education (OBE) principle. Kedua, untuk menunjang pencapaian hasil pembelajaran tersebut, modul mengimplementasikan model pembelajaran *Problem-Based Learning* (PBL) dan *project-based learning* (PJBL).

5.2 Initial trial

This stage involves a small group of students, approximately 30 people, as initial trial participants to observe how they respond to the developed teaching materials directly. This activity aims to identify the obstacles or difficulties students may encounter in understanding the content and structure of the teaching materials, and to obtain an initial assessment of the effectiveness of these materials in supporting the learning process.

Additionally, the involvement of the course's lecturers is a crucial component of this process. Lecturers play a crucial role in assessing the relevance of the content in teaching materials to the applicable curriculum, the suitability of the material to meet students' learning needs, and its contribution to achieving the learning outcomes targeted by the Outcome-Based Education (OBE) approach. Input from lecturers is strategic because it can direct developers of teaching materials to make revisions or adjustments that improve the quality and acceptability of the materials before they enter the field trial stage.

In other words, this stage is not only an initial evaluation but also a reflective process that brings together the perspectives of students as end users and lecturers as learning facilitators, enabling the refinement of teaching materials based on honest feedback from the learning environment. This process is an integral part of the Research and Development (R&D) methodology, which emphasizes systematic product development driven by real-world field needs.

5.3 Revision of teaching materials

Revisions are made after conducting initial trials to ensure the quality of the teaching materials is optimal. The adjustment process not only covers the content but also the visual appearance of the teaching materials, making them easier to understand and more engaging for students. In terms of content, the revision aims to clarify the concepts presented to make them easier to digest, as a clear understanding will increase the effectiveness of the learning process.

In addition, the revision also focuses on compiling more contextual materials, namely by linking learning to relevant situations or experiences in everyday life. This is important so that students not only understand the Theory presented, but can also apply it in real life. Thus, the teaching materials produced not only have high educational value but are also more easily accessed and accepted by students, which can ultimately increase their involvement in the learning process.

5.4 Field trial

After the revision, the updated teaching materials were tested in class, involving a larger number of participants and in a more representative learning situation. This trial aims to measure the extent to which the revised teaching materials are acceptable and effective in a broader learning context. During this evaluation process, various data collection methods were employed, including direct observation of student interactions with teaching materials, interviews with teachers and students, and tests administered after the learning process.

Observations were conducted to see firsthand how students interacted with the revised teaching materials, including how they absorbed them and whether they could trigger in-depth discussions. Interviews were also an important tool for exploring students' and teachers' perceptions of the effectiveness of the teaching materials and for identifying areas that still needed improvement. Meanwhile, tests administered after learning aimed to assess the extent of students' understanding of the material taught and to determine whether there was a significant increase in their understanding after using the new teaching materials.

By collecting various types of data, the evaluation is not only aimed at measuring the effectiveness of the material but also at obtaining more in-depth feedback from students and teachers. This feedback is crucial to ensuring that the teaching materials developed are genuinely aligned with students' needs and enhance the overall quality of learning. Based on the evaluation results, further improvements can be made to produce teaching materials of higher quality and greater alignment with the characteristics of the class students.

5.5 Finalization of teaching materials

After the field test phase, a final revision was made to perfect the teaching materials. The updated materials were then prepared for broader application, in both print and digital formats. At this stage, a usage guide was also prepared for lecturers and students, enabling them to make optimal use of the teaching materials. In addition, the format of the teaching materials was adjusted to be more practical and user-friendly, making it easier for users to access and apply learning materials in various conditions.

5.6 Continuous evaluation and improvement.

Evaluation is conducted periodically to monitor and assess the effectiveness of teaching materials in the field and ensure they have a positive impact on the learning process. This evaluation process involves collecting data from various sources, including feedback provided by lecturers and students, who are the primary parties interacting directly with the learning materials. This feedback is highly valuable because it can provide insight into the strengths and weaknesses of the teaching materials used in real-world classroom contexts.

Based on feedback from lecturers and students, an analysis is conducted to identify areas that require improvement or adjustment, ensuring that the teaching materials remain effective in meeting learning needs. Additionally, this feedback helps ensure that the material taught remains relevant and up to date with the latest developments in the field of science or the topic being discussed.

The purpose of this evaluation is to maintain the quality of teaching materials, ensuring they continue to support the ongoing learning process and adapt to changing needs and challenges in the field. By conducting continuous evaluation, it is hoped that teaching materials will not only remain relevant but also be more effective in improving student understanding and supporting the achievement of better learning objectives.

Consistent with this study's results, Romarate et al. (2023) emphasized that the development of OBE-based instructional materials is crucial in teacher education. Her findings confirmed that such materials are valid, practical, and effective, supporting the attainment of learning outcomes while accommodating flexible modes of instruction. Employing a research and development (R&D) approach, the materials were designed based on needs analysis, validated by experts, tested with students, and refined until proven valid, practical, and effective.

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The study further revealed that OBE-based instructional materials enhance students' understanding and engagement, support the achievement of predetermined learning outcomes, and allow for flexible learning modalities—whether online, offline, or hybrid—making them highly relevant to today's educational context.

6. Conclusion and implications

Based on the results of this study, it can be concluded that the OBE-based teaching materials developed through the PPjBL model for elementary science demonstrate high validity and feasibility. Material experts rated the content, language, and presentation at 83.37% (valid), learning experts at 94.86% (very appropriate), media experts at 86.56% (valid/appropriate), and the course lecturer at 93.97% (very valid). The module is scientifically accurate, aligned with the curriculum, Graduate Learning Outcomes (CPL), and OBE principles, and successfully integrates the PBL and PjBL (PPjBL) models into a coherent learning structure. Its layout, color scheme, and visual elements support the flow from problem-solving to project implementation. At the same time, the language is clear, standard, and appropriate to PGSD students' cognitive level, making the materials practical for use during actual lecture time and with available resources.

Positive end-user responses reinforce the implications of these findings. Posttest interviews with thirty PGSD students indicate that the module's clear instructions and practical examples enhance their understanding of complex scientific concepts and support their engagement in the PPjBL process. Students also appreciated the module's visual appeal, noting that the color scheme and image arrangement were both attractive and consistent with the scientific content. Overall, the teaching materials are academically sound, practical, and user-friendly, and are therefore suitable for broader implementation in PGSD science learning to strengthen the effectiveness of the PPjBL model and support the achievement of CPL and OBE-oriented outcomes.

References

Amelia, R., & Santoso, S. T. P. (2021). 21st Century Skills in Project-Based Learning Integrated STEM on Science Subject: A Systematic Literature Review. *Proceedings of the International Conference on Engineering, Technology and Social Science (ICONETOS 2020)*, *529*(Iconetos 2020), 583–590. https://doi.org/10.2991/assehr.k.210421.085

Asbari, M., & Nurhayati, W. (2024). Outcomes-Based Education in Indonesian Higher Education : Empowering Students' Learning Competencies. *INTERNATIONAL JOURNAL OF SOCIAL AND MANAGEMENT STUDIES (IJOSMAS)*, *05*(05), 1–6.

Asim, H. M., Vaz, A., Ahmed, A., & Sadiq, S. (2021). A Review on Outcome-Based Education and Factors That Impact Student Learning Outcomes in the Tertiary Education System. *International Education Studies*, *14*(2), 1. https://doi.org/10.5539/ies.v14n2p1

Asnidar, Safriana, Jalil, S. M., Sakdiah, H., & Zahara, S. R. (2024). Development of E-Modules on Problem-Based Learning to Enhance Students' Science Literacy. *Asian Journal of Science Education*, *6*(1), 134–144.

Azmi, I., Prasetya, D. S. B., & Sabrun. (2025). Profil Berpikir Kritis Siswa SMP pada Mata Pelajaran IPA. *Journal of Classroom Action Research*, *7*(1).

Chan, C. K. Y., & Fong, E. T. Y. (2018). Disciplinary differences and implications for the development of generic skills: a study of engineering and business students' perceptions of generic skills. *European Journal of Engineering Education*, *43*(6), 927–949. https://doi.org/10.1080/03043797.2018.1462766

Cresencio, M. (2023). Outcome-based education in open and distance learning. *Journal of Education and E-Learning Research*, *10*(4), 645–656.

Desiyanti, V., & Nugroho, I. A. (2024). The Influence of the Problem-Based Learning Model on the Scientific Attitudes and Science Learning Outcomes of Fifth Grade Elementary School Students. *Journal of Research in Science Education*, *10*(10).

Dewi, V. C., Kuswanti, N., & Projono, B. (2023). Implementation of the Problem-Based Learning Model based on Differentiated Learning to Improve Science Literacy Skills and Student Activities. *JEP (Jurnal Eksakta Pendidikan)*, *7*(2), 225–238.

DongJin, S., & Mohamad Ashari, Z. B. (2024). Project-based Learning in Early Science Education: A Systematic Review. *International Journal of Academic Research in Progressive Education and Development*, *13*(2), 706–721. https://doi.org/10.6007/ijarped/v13-i2/21365

Erdiana, N., & Yasin, B. (2025). Exploring Students' Perceptions of Project-based Learning in An Outcome-Based Education (OBE) Curriculum Framework. *Proceedings of International Conference on Education*, *3*(1), 15–20. https://doi.org/10.32672/pice.v3i1.3429

Handoyo, A. F., Sobandi, A., & Bimo, W. A. (2024). Trend and research focus on Problem-Based Learning and learning outcome in the world: A bibliometric analysis. *Inovasi Kurikulum*, *21*(2), 1289–1302.

Hidayah, N., Gunarhadi, & Karsono. (2024). Differentiated Learning with the Problem-Based Learning Model in Elementary School Science Learning: Literature Review. *Mini International Conference of Educational Research and Innovation (MICERI 2023)*, *7*(Miceri 2023), 217–228.

Kurniahtunnisa, & Wowor, E. C. (2023). Development of STEM - Project-Based Learning Devices to Train 4C Skills of Students. *Bioeduca: Journal of Biology Education*, *5*(1), 66–78.

Lesilolo, H. J. (2023). Development of Teaching Materials Based on Problem-Based Learning. *Journal of Research in Science Education*, *9*(6), 4320–4325.

Lubis, P. K. D., Yuni, R., & Matondang, K. A. (2024). Development of Project-Based Learning Model Through Outcome-Based Education (OBE) in the Creative Economy Course, Economic Education Study Program, State University of Medan. *Proceedings of the 6th International Conference on Innovation in Education, Science, and Culture, ICIESC 2024, 17 September 2024, Medan, Indonesia*. https://doi.org/10.4108/eai.17-9-2024.2353108

Mahadi, N., Woo, N. M. F., Baskaran, S., & Yaakop, A. Y. (2020). Determinant Factors for Employee Retention: Should I Stay? *International Journal of Academic Research in Business and Social Sciences*, *10*(4), 201–213. https://doi.org/10.6007/ijarbss/v10-i4/7120

McKinney, L. (2023). Effectiveness of Project-Based Learning in a Junior High Science Classroom. *Interdisciplinary Journal of Environmental and Science Education*, *19*(3), e2312. https://doi.org/10.29333/ijese/13678

Mitchell, J., & Tilley, E. (2024). The Role of Project-Based Learning at the Core of Curriculum Development. *Journal of Problem-Based Learning in Higher Education*, *12*(1), 1–17.

Nais, M. K., Kadarohman, A., Hana, M. N., Kusrijadi, A., Setiadi, R., Anwar, S., Rohman, I., Gumilar, G. G., & Gumilar, G. G. (2023). Designing Project-Based Learning Oriented to Scientific Literacy in Matter and Its Changes. *Jurnal Pengabdian Isola*, *2*(1), 30–37.

Nurhidayah, I. J., Wibowo, F. C., & Astra, I. M. (2021). Project-Based Learning (PjBL) Learning Model in Science Learning: Literature Review. *Journal of Physics: Conference Series*, *2019*(1). https://doi.org/10.1088/1742-6596/2019/1/012043

Romarate, M. A., Aquino, A. B., Punongbayan, E. J., Quizon, G. R., Balilla, L. A., & Ramos, N. P. (2023). Development of Outcomes-Based Instructional Materials in Professional Teacher

Education Courses for a Flexible Set-up. *Journal of Education and E-Learning Research*, *10*(1), 61–67. https://doi.org/10.20448/jeelr.v10i1.4378

Safitri, R., Alnedral, Gusril, Wahyuri, A. S., & Ockta, Y. (2024). The Impacts of the Project-Based Learning and Problem-Based Learning Models with Self-Confidence on Students' Learning Outcomes. *Indonesian Research Journal in Education*, *8*(1), 269–283.

Salamah, U., & Fauziah, A. N. M. (2025). Implementasi Inkuiri Terbimbing Untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik SMP Pada Materi IPA. *Edu-Sains*, *14*(1).

Wahini, N. M. P., & Ganing, N. N. (2023). The Project-Based Learning Model Improves Science Knowledge Competencies of Class V Elementary School Students. *MIMBAR PGSD Undiksha*, *11*(2), 256–263.

Zhao, Y., & Wang, L. (2022). A Case Study of Student Development Across Project-Based Learning Units in Middle School Chemistry. *Disciplinary and Interdisciplinary Science Education Research*, *4*(1). https://doi.org/10.1186/s43031-021-00045-8

Zheng, C., Yuan, K., Guo, B., Mogavi, R. H., Peng, Z., Ma, S., & Ma, X. (2024). Charting the Future of AI in Project-Based Learning : A Co-Design Exploration with Students. *Association for Computing Machinery. Conference '17, July 2017, Washington, DC, USA*.

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