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Instructional Alignment of PjBL in ECE: An Analysis of Learning Strategies, Methods, and Techniques

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ABSTRACT

This study was prompted by the discovery of instructional alignment gaps in the implementation of STEAM-based Project-Based Learning (STEAM-PjBL) in early childhood education (PAUD), particularly with regard to the alignment of objectives, strategies, methods, techniques, learning activities, and assessments. The study aims to analyse instructional alignment in STEAM implementation based on PjBL in PAUD, focusing on the relationship between learning strategies, methods, and techniques. The study used a qualitative approach with a case study design at TK ABA Ngampilan Yogyakarta, with one head teacher and three teachers selected through purposive sampling. Data was collected through observation, semi-structured interviews, and documentation, and analysed using Braun and Clarke's thematic analysis. The results of the study show that the implementation of STEAM-PjBL has demonstrated alignment between the learning objectives, activities, strategies, methods, techniques, and assessments through the active involvement of children in exploration, collaboration, experimentation, and reflection. However, challenges were still found in the form of extrinsic reward dominance, imbalanced participation in group work, insufficient reflective scaffolding, and discrepancies between written plans and the implementation of learning activities. This study emphasises the importance of strengthening teachers' pedagogical competencies in designing inclusive and meaningful STEAM-PjBL learning activities in early childhood education.

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1. INTRODUCTION

The transformation of education in the 21st century has shifted the learning paradigm (IIEP, 1996), and Early Childhood Education is no exception. The current purpose of learning is no longer understood as the transfer of knowledge from educators to learners, but rather as a process of meaning-

making through authentic experience (Adeyele, 2023), active exploration (NAECY, 2009), and social interaction (Aydın, 2025). To address the complexities of the 21st century, education must emphasize that learners possess critical thinking, creativity, collaboration, and communication skills (the 4Cs) (P21, 2019) as learning objectives (Trilling & Fadel, 2019).

STEAM (Science, Technology, Engineering, Art, and Mathematics) has begun to be adopted in early childhood education as an integrative approach that combines various disciplines (Chappell et al., 2025) and aims to foster creativity and problem-solving skills (Yakman, 2008) while also having a positive impact on academic achievement and attitudes (Amanova & Abildina, 2025; Jia et al., 2021). With STEAM in early childhood education, the learning experience will be child-centered through exploration, collaboration, and understanding of everyday phenomena. Children will build their conceptual understanding through direct experiences using their senses and meaningful play activities (Ata & Özlen, 2020).

The STEAM approach can be implemented using the Project-Based Learning (PjBL) model (Torres et al., 2024). In the PjBL model, teachers play a role in organizing learning through a project that begins with a question or problem. Children are also involved in designing, problem-solving, decision-making, conducting investigations, and are given the opportunity to complete their projects within a specific timeframe and present their project outcomes. The PjBL model enables educators to integrate various disciplines through contextual learning experiences that align with STEAM learning concepts (Thibaut, Ceuppens, et al., 2018; Thibaut, Knipprath, et al., 2018).

Although the STEAM-PjBL effectively synergizes in learning, in practice it is often not deeply integrated. PjBL is still understood as learning that is product-oriented, focusing on the final product (Wolk, 2022) rather than on the process of investigation, problem-solving, and developing concepts through learning experiences as the core of the activity (Sánchez-García & Reyes-de-Cózar, 2025). One example of implementing STEAM-PjBL in early childhood education is a book-reading activity that incorporates engineering and the engineering design process (Ata-Aktürk & Demircan, 2021).

Lowell & Rodriguez (2023) note that the conceptual framework of strategies, methods, and techniques has a hierarchical relationship in instructional design. Learning strategies emphasize the educator's role in organizing content, creating a conducive learning environment, and helping learners engage in independent learning (Killen, 2016; Zhang et al., 2024). The operational implementation of a intructional Strategy constitutes a method. A method is the procedure a teacher uses to conduct instruction in order to achieve learning objectives (Killen, 2016; Mitchell et al., 2024; Skutil et al., 2016). Meanwhile, the implementation of a learning method involves specific techniques that teachers employ to achieve learning objectives (Brown, 2001). Examples of such techniques include playing games, discussions, and storytelling (Riza, 2023).

An analytical perspective for determining whether instructional decisions are regularly translated into classroom practice is provided by this hierarchical distinction (Biggs, 1996; Biggs & Tang, 2011) state that the constructive alignment hypothesis, intentional coherence between teaching and learning activities, assessment, and intended learning outcomes, is necessary for effective instruction. According to a study (Stamov et al., 2021) instructional alignment should be investigated from the standpoint of curriculum design as well as how alignment is implemented and perceived in the classroom. Thus, throughout the implementation of STEAM-PjBL, the taxonomy put forth by Lowell & Rodriguez (2023) provides the analytical framework for analyzing instructional alignment between teachers' pedagogical objectives and classroom practices.

instructional design alignment focused on the effectiveness of children's learning outcomes, such as improvements in literacy and creativity (Chafidah et al., 2024). Therefore, a study is needed that specifically analyzes instructional alignment in PjBL-based STEAM implementation, particularly from the perspective of the relationship between learning strategies, methods, and techniques at the early childhood education level. This is crucial in the context of early childhood education because misaligned learning experiences can lead to suboptimal child development.

2. METHODS

This study employs a qualitative approach using a case study design to analyze instructional alignment in the implementation of Project-Based Learning (PjBL)-based STEAM in early childhood education. The case study design was chosen because this study focuses on an in-depth analysis of teaching practices within the context of a specific educational institution, thereby enabling the researcher to understand the phenomenon holistically and contextually. Through the case study, the researcher can comprehensively examine how the alignment between learning approaches, models, strategies, methods, and techniques

The research was conducted at TK ABA Ngampilan, Yogyakarta. The research participants consisted of one school principal and three teachers selected using purposive sampling, specifically educators directly involved in the planning and implementation of STEAM- and PjBL-based learning in the classroom. Data collection was conducted through observation, semi-structured interviews, and documentation. The research instruments were designed based on the components of instructional design, which include approaches, models, strategies, methods, and learning techniques. The focus of data collection was directed toward identifying the alignment between learning objectives, activities, and assessments in instructional practice.

Table 1. Interview and observation guidelines

Aspect	Indicator	Indicator Alignment	Observation Checklist	Interview Checklist
Approach	Philosophy & objectives	Alignment of objectives with activities	Observing the alignment of activities with objectives	How are activities aligned with learning objectives?
Strategies	Roles of teachers and children	Alignment of strategies with children's engagement	Observing the roles of teachers and children	How are children involved in planning, learning, and reflection?
Methods	Procedures & media	Alignment of methods with children's characteristics	Observing the use of methods	How are methods adapted based on children's characteristics?
Techniques	Implementation of learning activities	Alignment of techniques with children interaction and stimulation	Observing the teacher's techniques for giving instructions and guiding children in the classroom	How teaching techniques are used to support children's engagement and understanding

To enhance the validity of the data, this study employed a source triangulation technique, which involved comparing data from interviews, observations, and documentation, including teaching modules, photographs of children's activities and projects, research data, and documentation of the research process. The data analysis technique used thematic analysis developed by Braun and Clarke (2006), which comprises six stages: (1) familiarizing with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. The analysis was conducted iteratively to generate themes representing patterns of instructional alignment in the implementation of PjBL-based STEAM.

3. FINDINGS AND DISCUSSION

The results of the data analysis indicate that there are four main themes describing Instructional Alignment in the Implementation of STEAM-Based PjBL based on the taxonomy of strategies, methods, and techniques in early childhood education. These themes include: 1) Alignment of Learning Strategies in the Implementation of STEAM–PjBL; 2) Alignment of Learning Methods in the Implementation of STEAM–PjBL; 3) Alignment of Learning Techniques within the Project-Based Learning Framework; and 4) Alignment of Learning Objectives and Activities (Approach).

3.1. Alignment of Learning Strategies in the Implementation of STEAM–PjBL

During the implementation phase of the lesson, the strategies employed fostered the children's active engagement in the learning process. The activity began with a discussion between the teacher and the children based on a concept map that had been prepared in advance. During this phase, the children were given the opportunity to decide on a project idea, choose play activities, and form groups independently.

"The children decide for themselves what activities they want to play, which means they also get to choose their own groups."

In addition, teachers also provide learning support, which includes pre-play support through discussions about the projects to be created and the materials to be used; during-play support through prompting questions and offering appreciation for the children's work; and post-play support by encouraging children to reflect on their work and consider possibilities for future activities. Play activities at ABA Ngampilan Kindergarten are conducted in groups, giving children the opportunity to form their own groups independently.

"The children will decide for themselves what roles they'll take on in their groups." (Ms. T)

"If the group assignments are left up to the children… the project will be based on the discussions within each group." (Ms. IK)

Next, the children will describe their projects and the details of what they have created, and reflect on the activity by connecting their schoolwork to their daily lives. During this reflection phase, the teacher will offer collective praise and give rewards to the children. The teacher does this to provide positive reinforcement for the work they have produced. The reflection process does not only discuss the positive things the child has done, such as the results produced, but also addresses negative aspects, such as arguing or even fighting during playtime. This is intended to minimize or eliminate such negative behaviors in the future.

"At the end of the activity, the teacher also gave collective recognition to the entire group. (Ms. T)

"We give recognition. The reason for this recognition is so that the children will do even better next time. But we also need to ask about the negative aspects that emerged... So during the reflection activity, the focus is on reflecting on what has been done, what hasn't been done, the challenges, and the positive and negative things that occurred.

". (Ms. IK)

"Giving token rewards, such as handing out stars" (Ms. T)

Based on research data on instructional alignment in strategies implemented through the stages of understanding, planning, applying, and reflecting, it is evident that these align with the methods used, such as storytelling, field trips, and experiential learning in PjBL. This alignment demonstrates instructional alignment, meaning that there is integration between the teacher's activities and the structured learning stages. Instructional alignment between learning objectives and assessments is consistent with the concept proposed by Biggs and Pereira et al., namely that learning is designed so that all components from learning objectives and selected strategies to the assessments used are consistently integrated and support the expected learning objectives (Biggs, 1996; Pereira et al., 2024). From a constructive alignment perspective, effective learning occurs when learning objectives, learning activities, assessments, and Children's learning experiences are designed to be aligned and mutually supportive (Biggs, 1996; Biggs & Tang, 2011). In the context of STEAM-PjBL in early childhood

education, this alignment is evident through exploration, collaboration, experimentation, and reflection activities that are directed toward consistently supporting the achievement of learning objectives.

Based on the data from this study, the learning objectives focus on developing independence, collaboration, and reflection through PjBL activities. The assessment activities conducted by teachers in the classroom do not focus solely on outcomes. Instead, teachers provide ongoing feedback (formative assessment) by offering praise, star rewards, and engaging in joint reflection. These practices demonstrate alignment between learning activities and objectives and reinforce children's active engagement. However, the effectiveness of formative assessment depends on the nature of the feedback provided, as excessive reliance on external rewards may shift children's attention from the learning process to the reward itself. This is supported by research by Aust et al., (2024), which shows that formative assessment with feedback can improve children's perception of their competence, which impacts their intrinsic motivation to learn. Teachers who provide continuous feedback contribute to the development of young children's cognitive, social-emotional, and motivational aspects (Puad, 2025).

The constructive aspect deserves attention. First, rewards in the form of star stickers indicate an extrinsic focus. From a constructivist learning perspective, children's motivation to learn should stem from curiosity, the satisfaction of solving problems, and meaningful experiences during the learning process, rather than solely from external rewards. If teachers continue to rely on rewards, children will tend to focus on outcomes (Aisyah et al., 2025) rather than the learning process (Stoica, 2024; Sudaryanto & Amelia, 2025). Therefore, teachers should prioritize process-focused descriptive feedback that recognizes children's exploration, collaboration, creativity, and persistence rather than emphasizing physical token rewards (Granberg et al., 2021; Pat-El et al., 2024). For example, teachers can acknowledge how children generated creative ideas, collaborated effectively with peers, persisted when encountering challenges, or explored multiple solutions during project activities. Such descriptive feedback encourages children to value the learning process rather than merely pursuing external rewards, thereby fostering intrinsic motivation (Hattie & Timperley, 2013; Shute, 2013).

In addition to providing appropriate feedback, teachers should intentionally structure reflection activities within STEAM-PjBL, as part of Deep Learning pedagogy, to encourage children's active participation rather than teacher-dominated interactions (Hattie & Timperley, 2013; Shute, 2013). When teachers provide excessive guidance during reflection activities, opportunities for children to develop self-assessment and self-regulation may be reduced. In 21st-century learning, reflection extends beyond evaluation activities by functioning as a metacognitive process through which children monitor, regulate, and make sense of their own thinking and learning process (Silve et al., 2013).

In PjBL-based STEAM learning activities, teachers play a crucial role in the learning process. In this context, teachers are responsible for supporting, guiding, and motivating children to actively participate in order to deepen their understanding of the learning process. Additionally, teachers are responsible for ensuring the availability of tools and materials, posing thought-provoking questions, and supporting children's interactions throughout the activity.

"Once again, the teacher acts as a facilitator here. When organizing activities for the children, the teacher provides the necessary tools and materials, helps the children think critically, and ensures they can work in groups without conflicts arising during group work." (Ms. IK)

"(Their role) is as a motivator, as a facilitator, and also as an evaluator assessing whether the goals of play have been achieved. The teacher facilitates the children in play activities, then stimulates them, offers ideas, and provides inspiration." (Ms. S)

To build children's knowledge, teachers first provide examples and simulations before the children engage in play activities. This is evident in the various strategies employed, such as teachers demonstrating how to discuss, providing simulations, or showing the steps involved in group work at the beginning of the lesson.

"The teacher first demonstrates how to have a discussion." (Ms. T)

"There's a simulation, and then there's an example of how group work is done." (Ms. IK)

"At the beginning, the teacher provides an example." (Ms. S)

However, if a child is still struggling to process the material and information, the teacher will help the child find solutions to the difficulties they are experiencing through an individualized approach,

"... the teacher will approach the child to ask what they are going through and help find a solution" (Ms. T)
"if there are children who haven't been able to follow along or understand, then an individualized approach will be used later" (Ms. IK)

The teacher's role as a facilitator, motivator, and evaluator in STEAM-PjBL learning demonstrates an alignment between instructional strategies and the goal of developing 21st-century skills in children. Teachers not only provide tools and materials but also offer scaffolding through probing questions, guidance, and support throughout the play process. This support helps children develop critical thinking, collaboration, problem-solving, and independence through meaningful and contextual learning experiences (Bell, 2010).

The research findings indicate that the teacher's role as a facilitator in STEAM-PjBL learning reflects a constructivist approach that positions children as active agents in constructing knowledge through direct experience and social interaction (Bell, 2010). In this context, teachers play a role in providing learning support through probing questions, guidance, and scaffolding so that children can explore ideas, discuss, and solve problems both independently and collaboratively (Blumenfeld et al., 1991). These findings also indicate the presence of constructive alignment between learning objectives, play activities, and children's learning experiences within the STEAM-PjBL process.

Teachers, as facilitators in STEAM-PjBL learning, not only play a role in creating a conducive and participatory learning environment but also ensure that all Childrens have equal opportunities to engage in learning activities (Almulla, 2020). Based on the findings of this study, STEAM learning through Project-Based Learning (PBL) has provided children with opportunities to explore, collaborate, and express their ideas. However, project-based learning also presents significant challenges (Nayla & Zubaedah, 2024), one of which is ensuring the active participation of all children throughout the learning process. The research data indicates that teachers still need to actively monitor group dynamics to prevent conflicts and foster collaboration among children (Januardi et al., 2025; Li et al., 2026). This indicates that children's participation within the group is not always equal, as children with better social skills tend to dominate group activities, while those with weaker social skills may be less engaged in the project. If teachers do not monitor the situation appropriately, the concept of inclusive education cannot be implemented, resulting in unequal and uneven opportunities for children to participate (Balzan et al., 2025; Hastuti & Rusdiani, 2025).

3.2. Alignment of Teaching Methods and Techniques in the Implementation of STEAM–PjBL

Based on the research data, the implementation of STEAM-PjBL involves the stages of understanding, planning, applying, and reflecting. Each stage employs specific teaching methods and techniques. The variety of teaching methods used demonstrates alignment between the learning objectives, learning activities, and the learning experiences provided by the teacher. This alignment is a key element in project-based learning, as it not only focuses on project completion and learning objectives but also enhances Children engagement and fosters a deep, meaningful understanding of concepts (Blumenfeld et al., 1991; Sánchez-García & Reyes-de-Cózar, 2025).

3.2.1. Understanding Stage

The comprehension stage in the learning process is used to build children's initial understanding and serves as the first step in introducing learning topics in the classroom. At this stage, teachers utilize storytelling, field trips, and experiential learning by providing various stimuli through different media, such as storybooks, visual aids, and direct experiences in the children's immediate environment.

Through storytelling, children are encouraged to recognize foundational concepts through relevant stories, thereby helping them understand the topic in a more contextual way. Meanwhile, experiential learning is used to support children's prior knowledge through real-life experiences in

their surroundings. Field trips are organized to broaden or deepen children's understanding through visits to various locations.

"... I usually start the activity with literacy, which involves reading books to the children, and then the children are encouraged to ask questions and share their opinions" (Ms. ID)

"hands-on experiences or we can also bring in external resources" (Ms. IK)

"PjBL (project-based learning), which begins with understanding; children will learn about topics or subtopics through various learning resources" (Ms. T)

These methods are implemented through a variety of teaching techniques. In the storytelling method, teachers use techniques such as reading stories from books and telling stories using tools like videos, posters, or concrete props. On the other hand, the field trip method is implemented through visits to the children's surrounding environment, such as markets, post offices, or parks, to observe and interact directly with the material being studied. Meanwhile, the experiential learning method involves observing objects found around the school.

Although the analysis identified three methods of storytelling, field trips, and experiential learning, teachers did not explicitly mention the concept of experiential learning as one of the methods within the "understanding" stage of PjBL. This was evident in the interview results with all informants.

"Teachers first provide foundational knowledge through various learning resources, such as direct experiences (through the surrounding environment), storybooks, videos, images, or posters." (Ms. T)

"Videos, picture stories, posters, or complete teaching aids." (Ms. IK)

"In a lesson about rivers, the teacher utilized the school's surrounding environment because there is a river nearby. Before the visit, the teacher provided prompts so the children would know what to observe." (Ms. T)

During the comprehension stage, teachers use storytelling, field trips, and experiential learning to build children's prior knowledge through contextual learning experiences. The use of these methods demonstrates alignment between learning strategies and the STEAM-PjBL principles, which emphasize authentic and contextual experiences. The direct experiences (experiential learning) children engage in within their surroundings help them connect learning concepts to their daily lives through the process of observing and exploring (Kolb, 2015). The experiential learning method chosen by the teacher, when viewed from the perspective of learning alignment, supports the achievement of learning objectives because children are actively involved in constructing knowledge independently (Ramadhani et al., 2025). In the context of early childhood education, connecting learning concepts with real or authentic experiences encountered daily through exploration and observation plays a crucial role because children are directly involved in building knowledge, resulting in more optimal learning objectives compared to verbal explanations alone (Wahyuningsih & Küçükoğlu, 2025).

The use of storytelling in the comprehension stage serves not only as an early literacy activity but also as a means of stimulating children's thinking and communication skills (Farihah & Wiranti, 2023; Handayani et al., 2024). Through storytelling, children are encouraged to ask questions, express their opinions, and connect the story to their own experiences. Storytelling helps children develop an initial understanding of learning topics while increasing their engagement in the learning process (Isbell et al., 2004; Nicolopoulou et al., 2015).

Thus, alignment at the comprehension stage is evident in the consistency between the initial learning objectives and the use of storytelling, field trips, and experiential learning, which provide children with contextual learning experiences. This alignment helps children build prior knowledge through authentic experiences and enhances their active engagement in learning. These findings align with David A. Kolb's perspective, which emphasizes that knowledge is constructed through the transformation of direct experience. Research by Arina et al., (2024) also indicates that the implementation of Project-Based Learning for children aged 5–6 years can develop 21st-century skills, such as collaboration, communication, creativity, and problem-solving abilities, through children's active engagement in project-based learning processes.

However, implementation challenges remain evident in teachers' understanding of experiential learning, which has not yet been fully grasped as part of a planned instructional strategy

(Wahyuningsih & Küçükoğlü, 2025). This finding does not suggest that teachers lack the ability to implement experiential learning. Rather, it indicates that experiential learning is enacted intuitively and has not yet been explicitly conceptualized or planned as a distinct instructional strategy. On the other hand, Krajcik & Blumenfeld (2006) explains that the success of implementing Project-Based Learning is heavily influenced by teachers' ability to design learning experiences that are contextual, structured, and aligned with learning objectives.

These results imply that educators are already practically competent in using real-world classroom activities to achieve experiential learning. However, they still lack the pedagogical knowledge necessary to clearly identify, categorize, and purposefully arrange experiential learning as a unique teaching approach. Therefore, increasing teachers' pedagogical awareness and knowledge may enable them to design lessons more effectively, make more thoughtful instructional decisions, and achieve more instructional alignment throughout the implementation of STEAM-PjBL (Pratiwi, 2024; Ulferts, 2019).

3.2.2. Planning phase

At this stage, the teacher and children create a concept map related to the activity plan based on the story they have heard. In addition, at this stage, the children and teacher discuss play activities based on the concept map they created earlier. At this stage, the teacher and children discuss project ideas together, based on the children's interests.

"The play activities are determined by the children… the topics chosen here are based on the children's interests and also on what happens in their daily lives" (Ms. IK)

"We adjust it again to the children's interests… before we create or set up the play area, we discuss it with the children first" Ms. S

In this process, teachers use a collaborative discussion method implemented through brainstorming techniques. Through brainstorming, children can develop various ideas stemming from their existing knowledge or experiences.

"The results of the brainstorming session are written down according to the topics and subtopics. The children then review the activities by drawing what they observed" (Ms. T)

"On the first day, the activity focuses on understanding and planning before the children actually begin working on the project the following day… On subsequent days, play activities are carried out according to the children's plans" (Ms. T)

The planning stage in this study demonstrates that children are actively involved in determining ideas or concepts to develop a project based on their interests and experiences. This involvement became evident when the discussion method used brainstorming techniques to exchange ideas, express opinions, and make joint decisions regarding the project to be undertaken (Al-khatib, 2012). Thus, the teacher did not fully control the learning process. The children were directly involved in the process of collaborative meaning-making (Hmelo-Silver, 2004) during learning, and this environment can help them develop communication skills (Ginsburg-Block et al., 2006), social participation, and problem-solving abilities.

Children's participation when brainstorming techniques are used is not always consistent. Children's varying communication skills, ability to express opinions, and experiences can act as barriers. Teachers still need to provide scaffolding to ensure children have equal participation during discussion and decision-making activities so that no one dominates the class (Koyuncu et al., 2024; Sisilia & Sun, 2025). From a social constructivist perspective, the teacher's role in providing scaffolding aims to create a learning environment that fosters social interaction skills, enabling children to actively construct knowledge collaboratively (Wahyu et al., 2026).

Thus, alignment during the planning stage is evident through children's involvement in decision-making and the development of project ideas through discussion and brainstorming. These activities support the development of children's communication, collaboration, and problem-solving skills. However, teachers still need to provide scaffolding to ensure that children's participation is

equitable and not dominated by those with stronger communication skills (Kraatz et al., 2020; Rojas-Drummond & Mercer, 2003).

3.2.3. Application stage

Next is the application stage, which involves the children's activities within the project. At this stage, children are actively engaged in creating their work and collaborating within their groups. In practice, they discuss the steps to be taken, assign roles within the group, and exchange ideas to complete the project they are working on. Additionally, the teacher plays a role in providing guidance throughout the process, such as posing guiding questions, steering the discussion, and facilitating access to tools and materials.

"Then, moving into the application-based learning experience, the children will discuss what to create and then begin exploring how to make the project according to what they planned/discussed" (Ms. T)

At this stage, learning activities are conducted using experiments as the teaching method. This gives children the opportunity to be directly involved in the process of planning, implementing, and completing their work together with their groupmates. This method is also combined with demonstrations conducted by the teacher to provide initial examples of how to use tools, materials, and activity procedures.

"At the beginning, we provide some direct examples. So the teacher basically plays along with the children, helps clean up, and puts things back in their place like that…" (Ms. S)

"...by observing, trying things out directly, and experimenting, as well as asking questions of peers or the teacher" (Ms. T)

The techniques used to support optimal learning include the exploration technique, which provides children with the opportunity to try, observe, and manipulate various loose parts directly. Furthermore, guided demonstration techniques are carried out by the teacher by demonstrating the steps, how to use tools, or the activities the children will perform so that they have a clear example before practicing them independently. Additionally, group work techniques are used, allowing children to learn to collaborate, share roles, and interact with peers during the activity. The teacher also provides reinforcement and feedback as a form of guidance and direction regarding the children's learning process and outcomes.

Project implementation is also adapted to the developmental characteristics of children in each age group. In the older age group (Class B), project activities tend to be carried out continuously, whereas in the younger age group (Class A), projects are designed to be more flexible so that children can still switch activities according to their abilities.

"…Sustained PBjL is implemented in Class B. In the Class A age group, projects are not always sustained, so children can switch activities from day to day within a project-based play format" (Ms. T)

The application phase consists of the core activities of the project, which include exploration, experimentation, and project completion. When children use loose parts during experiments and group work, teachers provide them with opportunities to try, observe, manipulate materials, and solve problems (Aisyah et al., 2025). This also reflects the characteristics of inquiry-based learning (Kokotsaki et al., 2016). Children actively construct knowledge through direct experience, thereby developing their problem-solving skills (Mariana & Kristanto, 2023; Perignat & Katz-Buonincontro, 2019), critical thinking, creativity (Nurjanah, 2020), and active engagement (Sukardjo et al., 2023).

Teachers also consider the level of difficulty and the concepts of the projects developed by the children. Age is a key consideration because it influences developmental characteristics. For kindergarten programs, projects are conducted on a large scale and on an ongoing basis, whereas for preschool programs, projects are developed according to the children's abilities and attention spans (Fatimah et al., 2025; Souisa et al., 2024). This demonstrates the application of the DAP principle (NAECY, 2002). The alignment of activities with children's developmental stages influences their level of engagement, comfort in learning, and ability to participate optimally in the learning process (Bakoč et al., 2025; Sivertsen & Bjørgen, 2026).

However, the research data also revealed that teachers still provide demonstrations and examples at the beginning of activities. At the early childhood education level, providing examples is still permitted, particularly in understanding activity procedures, tool usage, or work patterns before engaging in independent exploration. The assistance provided by teachers must maintain a balance that does not restrict children's creativity and initiative. If scaffolding is implemented appropriately, it will support children's learning activities without diminishing opportunities for independent exploration (Pol et al., 2010; Wood et al., 1976).

Thus, alignment at the application stage is evident through the integration of exploration, experimentation, and group work activities with STEAM-PjBL learning objectives oriented toward inquiry-based learning and conceptual understanding. These activities provide children with opportunities to construct knowledge through direct experience. However, teachers must ensure that the scaffolding and demonstrations provided do not limit children's creativity and independent exploration throughout the project process.

3.2.4. Reflection phase

This process concludes with a reflection phase, during which children are given the opportunity to share their learning experiences, present their work, express their feelings, evaluate the process they have gone through, and plan future activities.

> *"The reflection session takes place in the afternoon; children are asked to describe what they have created and whether they would like to continue the activity the following day… The reflection phase is also used to plan future activities." (Ms. T)*

The method used during the reflection phase is the discussion method, aimed at allowing children to take turns sharing their experiences and opinions. In implementing the discussion method, the techniques used include question-and-answer, conversation, and the sharing circle technique. The question-and-answer and conversation techniques are conducted through prompt questions posed by the teacher to explore the children's experiences and reflect on their experiences related to the project activities that have been carried out. Meanwhile, the sharing circle is used by arranging childrens to sit in a circle so that every child has an equal opportunity to share their experiences in turn. In addition to individual reflection, group reflection is generally conducted according to project teams, although not all groups present at the same time.

> *"For presentations, they're usually done by team/group during reflection, though not all at the same time; presentations are also done individually by asking the child after they've finished playing or creating their work" (Ms. T)*
>
> *"During the reflection stage, where the child will present or describe the project they've created, the teacher will ask about the project's next steps, what's missing, and what needs to be added as evaluation questions" (Ms. S)*
>
> *"Since reflection happens at the end… So during the reflection activity, the focus is on reflecting on what has been done, what hasn't been done, the challenges, and the positive and negative aspects that occurred." Ms. IK*

The reflection stage at the end of the learning activity serves not only as an opportunity to present project outcomes in the form of a narrative but also allows the teacher to evaluate the child's experience throughout the process, identify challenges, and plan for future projects or activities. The techniques used in the reflection phase such as Q&A, conversation, and sharing circles give children the opportunity to express their understanding, experiences, and thoughts verbally. During reflection, children engage in dialogue that helps them make sense of things based on their experiences, communication, and social interactions throughout the learning process (Doyle et al., 2023). In STEAM-PjBL, reflection can help children develop metacognitive skills and self-regulated learning (Hmelo-Silver, 2004; Whitebread et al., 2009). These skills will make it easier for children to understand the thinking process, evaluate and monitor their thinking, and learn from their own experiences (Martha et al., 2023). During reflection, teachers are expected to provide scaffolding through instructions and

reflective questions appropriate to the children's developmental level to ensure the objectives of reflection are met.

Thus, alignment in the reflection stage is evident through the use of discussions, question-and-answer sessions, and sharing circles that support children's reflective, communication, and metacognitive skills (Whitebread et al., 2009). The reflection stage not only serves to evaluate project outcomes but also helps children understand the learning process they have undergone. The challenge of implementation lies in the teacher's ability to pose reflective questions appropriate to the children's developmental level, ensuring that reflection is not merely a formality at the end of the learning activity.

3.3. Alignment of Learning Objectives and Activities (Approach)

Based on the interview results, the informant explained that learning is conducted by integrating STEAM and PjBL concepts into learning activities. In practice, STEAM has been implemented conceptually, even though it is not explicitly stated in formal documents such as teaching modules. Nevertheless, elements related to STEAM are present through the activities and learning objectives that children engage in during the learning process.

> *"In practice, STEAM was already being applied conceptually long before it was formally recognized as an administrative term. Although it is not always explicitly stated that a particular activity involves science, technology, or mathematics, these components are evident in the learning objectives, the process, the children' work products, and their daily learning activities." (Ms. T)*

Teachers who have integrated the STEAM approach into PjBL without explicitly documenting it in planning documents, such as teaching modules, revealed a discrepancy between the intended curriculum and the enacted curriculum. Although classroom observations showed that STEAM principles were consistently implemented, the absence of explicit planning indicates that teachers relied primarily on professional experience rather than deliberately designed instructional alignment. Based on Biggs' Constructive Alignment theory Biggs (1996) dan Biggs & Tang (2011), alignment should originate from intentional instructional planning in which learning outcomes, teaching activities, and assessment are explicitly designed. Therefore, these findings suggest that teachers demonstrated enacted pedagogical alignment.

This discrepancy may also reflect differences in teachers' pedagogical capacity. Without written planning, teachers may interpret and implement the curriculum in different ways (Aslam et al., 2024; Phaeton, 2017). A teacher's mastery of curriculum understanding also influences learning implementation; written planning helps ensure that curriculum concepts, learning objectives, learning activities, and assessment are consistently aligned, thereby supporting more coherent instructional implementation (Tran & O'Connor, 2024).

It is generally acknowledged that teachers who do not prepare written teaching modules are not acting appropriately. If teachers wish to optimize the achievement of learning objectives, this is because, hierarchically, curriculum implementation begins with a curriculum that is planned, implemented, and achieved (Tatto & Hordern, 2017). This means that discrepancies between written teaching modules and their implementation impact the optimization of learning objectives due to a lack of alignment between objectives, activities, and assessment (Tatto & Bankov, 2018). This mismatch is also interpreted as "inconsistencies in curriculum delivery can lead to achievement gaps." When teachers do not follow written teaching modules, implementation can become inconsistent, resulting in learning gaps (Gizachew, 2025). The consequence of this situation can be learning activities that are not aligned with learning objectives.

This finding highlights a significant conundrum in STEAM-PjBL implementation. The intended curriculum is still not fully aligned since STEAM principles are not clearly stated in teaching modules, even while the implemented curriculum shows alignment through teachers' classroom practices. As a result, the problem found in this study should not be taken as proof that educators did not successfully include STEAM education. Instead, it shows that teachers effectively used STEAM principles in the classroom, although they mainly depended on professional experience rather than clear instructional

preparation. According to Biggs and Tang (2011), constructive alignment views this circumstance as reflecting implemented pedagogical practice rather than fully planned instructional alignment. In order to ensure greater alignment between the intended and enacted curriculum, teacher professional development should concentrate not only on improving classroom implementation but also on enhancing teachers' ability to translate pedagogical intentions into written teaching modules, learning objectives, learning activities, and assessments (Biggs & Tang, 2011; Tran & O'Connor, 2024).

The need for stronger instructional planning is also evident in teachers' pedagogical practices during the reflection stage of STEAM-PjBL implementation. Research findings indicate that reflection in PjBL-based STEAM learning contributes to the development of children's metacognitive skills and self-regulated learning. Through reflection, children are supported in thinking, understanding, monitoring, and evaluating their learning while being encouraged to learn from previous experiences. During reflection, teachers play an important role in providing scaffolding. These findings suggest that teachers already possess practical competence in facilitating experiential and reflective learning through authentic classroom practice. However, they have not yet consistently recognized and articulated these practices as deliberately planned instructional methods. This suggests that teachers' pedagogical awareness should be strengthened so that intuitive classroom practices can be translated into explicit instructional planning, thereby promoting stronger instructional alignment. Consequently, strengthening teachers' pedagogical awareness and capacity is essential for achieving instructional alignment (Pramudyani et al., 2025). Teachers need to consistently align learning objectives, play-based activities, instructional strategies, methods, techniques, and assessment throughout the learning process (Ait-hroch et al., 2025; Respicio & Bauyot, 2026). Additionally, well-designed instructional modules can support teachers in systematically translating pedagogical intentions into explicit teaching modules, thereby promoting more coherent, contextual, and developmentally appropriate STEAM-PjBL implementation for young children.

4. CONCLUSION

The implementation of STEAM-PjBL in early childhood education demonstrated strong instructional alignment in classroom practice across three key aspects: the alignment of instructional strategies, the alignment of instructional methods and techniques, and the alignment of learning objectives, activities, and tasks. This alignment was reflected in children's active engagement in exploration, collaboration, and reflection, which supported contextual and meaningful learning experiences. The instructional strategies implemented by teachers provided opportunities for children to engage in decision-making and collaborative learning, while the instructional methods and techniques promoted experiential and discovery-based learning. Furthermore, classroom learning activities reflected the integration of STEAM and PjBL principles in supporting the development of children's 21st-century skills. However, this study also revealed a discrepancy between the intended curriculum and the enacted curriculum. Although teachers successfully implemented STEAM-PjBL principles during classroom practice, these principles were not consistently documented in teaching modules and other instructional planning documents. Consequently, the observed instructional alignment was stronger in classroom implementation than in written instructional planning. These findings highlight the importance of teacher professional development in strengthening teachers' capacity to explicitly translate pedagogical intentions into written instructional planning, thereby ensuring stronger alignment between the intended and enacted curriculum. Future research should involve a larger number of early childhood education institutions representing diverse teacher characteristics and learning environments to further examine how instructional alignment can be systematically embedded in both classroom practice and instructional planning.

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