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Teacher's Understanding of Project Learning Models through Children's Comics with STEAM Content in Indonesia

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ABSTRACT: Comic media is one of the learning media that can contain messages and information about various knowledge, experiences, and events in a complete, interesting, and meaningful way. The contents of these stories can also accommodate a variety of learning content such as science, technology, engineering, art, and mathematics known as STEAM content (Science, Technology, Engineering, Art, and Math). This study aims to obtain information on teachers' understanding of the project learning model and STEAM content used in ECE units. Based on survey research and case studies, this research involved 34 ECE teacher participants representing teachers in the Seribu Islands district, DKI Jakarta. Data collection was carried out using a Google form questionnaire, participatory observation, focused discussions, and document analysis. The research produced several findings, first, comic media is very effective and interesting to provide an overview of STEAM project activities and content for ECE units. Second, learning projects containing STEAM content can be designed through learning tools and teaching modules based on maritime themes. Third, project learning with STEAM content can be one of the characteristics of the implementation of the independent curriculum in ECE units. Finally, the use of comic media in project learning with STEAM content can increase early childhood maritime cultural literacy. It is hoped that the use of comic media will help ECE educators in the Seribu Islands Regency improve their understanding of maritime cultural literacy in early childhood.

Keywords: teacher's understanding, ECE steam content, children's comics

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1 INTRODUCTION

STEAM (Science, Technology, Engineering, Art, and Math) content learning is one of the main issues and continues to be the subject of study in the development of the theory and practice of education in early childhood. STEAM content is an integral part of the curriculum component of early childhood education (DeJarnette, 2018; Mengmeng et al., 2019). The STEAM component can be used as material for developing various types of play activities in early childhood. In studying ECE curriculum content, learning content does not include STEAM but may include R-SLAMETS content (Religion, Science, Literacy, Art, Math, Engineering, Technology, and Social Study). STEAM and R-SLAMETS learning contents are vehicles and conceptual insights that can be used as play activities in early childhood to help children achieve optimal levels of developmental achievement. In addition, play activities containing STEAM or R-SLAMETS content will also support the acquisition of various skills children need such as scientific investigation, problem-solving, critical thinking, cooperative, and communication skills (Prameswari & Anik Lestariningrum, 2020; Wahyuningsih et al., 2020).

The implementation of STEAM or R-SLAMETS content requires a learning model that uses a thematic-integrative approach. One of the learning models based on integrative thematic approaches in early childhood is the project learning model (Connor et al., 2015; Hapidin et al., 2018). The project learning model is a learning process that seeks to present a series of activities that provide opportunities for students to carry out various exploratory, collaborative, and problem-solving activities to produce a product (Garba et al., 2015). Project learning will also help create a learning atmosphere that contextually integrates various learning content into a continuum and meaningful play activity (Almulla, 2020; Farida & Rasyid, 2019; Ismuwardani et al., 2018).

STEAM learning based on the project learning model can also integrate maritime cultural learning content which has important meaning for educational units that have characteristics of maritime areas such as Indonesia. Maritime culture becomes strategic learning content in preparing the character of students in the maritime culture (Lampe, 2012; Relevansi & Ahmad, 2017). In the context of learning, maritime cultural content can be represented more broadly as maritime cultural literacy. Maritime cultural literacy study is an initial study conducted in Indonesia to reinforce students (early childhood) in acquiring knowledge, values, attitudes, behavior, and maritime cultural characteristics (Hapidin et al., 2020; Hapidin, Nurjannah, 2018).

In the context of learning in ECE units, the fundamental problem is the weakness of learning various content which is carried out through various thematic play activities. With this thematic approach, it will be easy to integrate various content such as STEAM or R-SLAMETS content. Another problem is the lack of understanding of ECE educators about the various variations of the use of learning models that can integrate the intended content. Therefore, research and development are expected to provide solutions for using project learning models packaged in the form of comic media. This media model is expected to present the learning experience (play) of early childhood and ECE educators

who follow the project's learning flow. Apart from that, content contained in comic stories will be inserted with content from STEAM and R-SLAMETS. Therefore, this research aims to obtain information on teachers' understanding of the project learning model and STEAM content used in ECE units.

2 THEORETICAL STUDY

2.1 *Teacher's Understanding and Practice of STEAM*

Teachers' instructional activities and behavior are influenced by their pedagogical attitudes and ideas about what they can achieve through their pedagogy. Teachers with positive attitudes toward innovative teaching, such as in STEM education, are likelier to use innovative teaching techniques. Teachers' pedagogical and teaching approaches are influenced by their beliefs and knowledge about STEAM education (Chen et al., 2021). A growing body of research has shown that various factors, including teacher expertise, professional growth, readiness, and STEM-related self-efficacy, have an impact on teachers' STEM beliefs and implementation strategies (Jamil et al., 2018). In addition, according to research, teachers' value for STEM education influences their readiness to engage and use STEM-based approaches (Margot & Kettler, 2019).

A STEAM-focused teaching approach is based on expertise and an understanding of how best to communicate relevant information to children. Children are regularly exposed to STEAM topics in an unstructured setting that is child-friendly and fun. Early childhood can learn how to ask questions, think about, seek, and design their own solutions to related real-world problems through play-based multisensory experiences (Horrace, 2021). Early childhood in ECE institutions is encouraged and assisted to develop logical thinking skills at the nexus of mathematics, science, technology, engineering, and the arts. To combine content and context, preschool teachers create STEAM practices that use play as a common platform for the transdisciplinarity (Wahyuningsih et al., 2020). To help children see the connections and connections between different disciplines, content integration is a technique that combines many content areas into one curriculum. A teacher can make content more relevant to students by focusing on certain elements from one area and integrating settings from other disciplines (Quigley et al., 2017).

The need to support excellent teaching methodology and implementation strategies in early school settings has arisen because of the increased attention that STEAM is receiving on a worldwide scale. Additionally, new competencies for teaching STEM education have been produced by STEAM-related professional skills (Maiorca et al., 2021). According to Smith et al., (2015), cross-curricular connections students make are beneficial to STEM education because they equip students with the skills to approach and solve problems that are like those they will face in the future. The use of this integrated cross-curricular approach in classrooms by teachers piqued their interest (Asghar et al., 2012).

2.2 *ECE Steam Content*

When teachers lack knowledge and understanding, children learning is constrained. Teachers who feel they are unable to contribute to classroom learning during STEM activities may have little STEM knowledge and experience. The self-efficacy of teachers who believe they possess the knowledge and abilities to implement STEM activities, on the other hand, is high. Teachers' views of the value of STEM have an impact on their capacity to grow as STEM educators (Bell 2016). This will have an impact on how STEM education is taught. According to teachers, learning the material while juggling many classes can be difficult (EL-Deghaidy et al., 2017).

Teachers thought it was challenging to create fresh STEM issues while merging many subjects. Additionally, according to teachers, it was difficult to integrate the STEM pedagogical approach with their standard content ideas (Asghar et al., 2012). These educators appeared unable to recognize these things as anything other than distinct. Some instructors are still hesitant to use STEM activities in the classroom, even after receiving professional development (Herro & Quigley, 2017). Teachers' resistance to using STEM has been observed by many professional development facilitators. Engineering appears to be the subject area that teachers are least confident in instructing (Srikoom et al., 2017). STEM teachers exhibit a range of fidelity with implementation.

Following other people's curriculum plans makes teachers nervous (Bagiati & Evangelou, 2015). Concerns about incorporating STEM education into their current curriculum were also raised by teachers. STEM integration may be hindered by rigid curriculum alignment and age-level requirements. Teachers also mentioned the challenges of combining two rigid curriculum plans and their perception that the STEM curriculum can be rigid (Bagiati & Evangelou, 2015). In addition, some teachers believe that poor communication between STEM teachers' different perceptions of one another's fields results in feelings of irrationality and a failed interdisciplinary curriculum.

The open-ended responses from early childhood teacher participants regarding the difficulties they might face in teaching STEM were analyzed qualitatively, and several themes emerged, including (a) a lack of time to teach STEM, (b) a lack of instructional resources, (c) a lack of professional development, (d) a lack of administrative support, (e) a lack of knowledge about STEM topics, (f) a lack of parental involvement, and (g) a reluctance among teachers to work together. Additionally, some educators speak of the challenges they face in addressing the diverse needs of their pupils, including their various cognitive developmental stages, learning disabilities, and learning levels. These themes are consistent with the results of earlier studies on STEM education, such as those by (Gebbie et al., 2012).

For instance, Brown et al., (2011) indicated the necessity for collaboration in schools on STEM education when instructors have not received training on topics relating to STEM education outside of their content area. Teachers should tailor or adapt activities to accommodate individual children's strengths and needs so that they are challenging but achievable and emphasized the importance of choosing science content that matches the

students' cognitive capacities in response to the issue of difficulties with meeting diverse student needs.

3 METHOD

This research is a qualitative descriptive study (Kim et al., 2017) with two types of data, using survey methods (as quantitative data) and participatory observation methods (as qualitative data) involving 34 ECE teachers representing ECE teachers in Kepulauan Seribu district, DKI Jakarta. The institutions that became the place of observation were the State Kindergarten 01 Pulau Untung Jawa and the State Kindergarten 01 Pulau Kelapa.

Data collection was carried out using a google form questionnaire, participatory observation, focused discussions, and document analysis. The google form questionnaire is intended to obtain information on teachers' understanding of project learning models and STEAM content that can be used in ECE units. The questionnaire consists of a combination of open and closed questions. Participants provide answers to questions that have been provided in the Google form.

Participatory observation is carried out when teachers receive training materials and workshops on project learning models containing STEAM content based on comic media. Researchers are directly involved in aiding teachers in designing learning projects containing STEAM content using comic media. Focused discussions were conducted before and after teachers received training and workshops on developing learning tools and teaching modules. The documents that are the focus of analysis are photo documents and training videos as well as teacher workshops and reflections on the practice of project learning models containing STEAM content.

4 RESULT AND DISCUSSION

4.1 *Result*

4.1.1 *Teacher's Understanding of the Project Learning Model*

Through the Google form questionnaire, data were obtained about the teacher's understanding of the project learning model. Understanding the project learning model contains (1) an Introduction to terms, (2) Urgency & Meaning of Project Learning, (3) Project learning objectives and principles, (4) Project learning steps, and (5) Project results (see table 1-5).

Table 1. Component 1: Introduction to the term Project Learning Model

Data Description
82.35% (28 people) of ECE educators gained an understanding of the term project learning model from seminars, training, and the like.
14.7% (5 people) of ECE educators obtained it while studying for an ECE Bachelor's degree.

Table 2. Component 2: Urgency & Meaning of Project Learning

Data Description
– 94.11% (32 people) of ECE educators understand the meaning of project learning. – 5.89% (2 people) ECE educators do not understand the meaning of the project learning model.
– 94.11% (32 people) of ECE educators expressed an understanding of the importance of project learning in ECE units with various expressions, such as making it easier for teachers, giving children opportunities to think, gaining direct experience in learning. – 2.94% (1 person) ECE educators do not understand the project learning model in ECE units

Table 3. Component 3: Project Learning Objectives and Principles

Data Description
– 91.17% (31 people) of ECE educators expressed an understanding of the goals and principles of project learning in various meanings such as developing children's creativity, and critical thinking, and encouraging children to understand real life. – 8.82% (3 people) of ECE educators do not understand the objectives and principles of project learning.

Table 4. Component 4: Project Learning Steps

Data Description
– 70.59% (24 people) of ECE educators understand the steps for implementing the project learning model. – 29.41% (10 people) of ECE educators do not understand the steps for implementing the project learning model.

Table 5. Component 5: Project Results

Data Description
– 82.35% (28 people) of ECE educators understand the steps for carrying out project learning – 17.65% (6 people) ECE educators do not understand the results of using the project learning model.

4.1.2 *Teachers' Understanding of STEAM Content*

The STEAM content understanding questionnaire consists of (1) Introduction to terms, (2) Urgency & Meaning of STEAM content, (3) Purpose and scope of STEAM content learning content, (4) How to use STEAM content in learning in ECE units and (5) Illustrations process and results of STEAM content learning activities. The survey results can be seen in the table 6-10.

Table 6. Component 1: Introduction to the term STEAM Learning Content

Data Description
– 91.18% (31 people) of ECE educators already know or have known the term STEAM learning content. – 8.82% (3 people) of ECE educators had never heard of the term obtaining it while studying at S-1 ECE.
– 82.35% (28 people) of ECE educators obtained an introduction to the term STEAM learning content from seminar or training resource persons. – 8.82% (6 people) of ECE educators obtained an introduction to the term STEAM content from searches on Google and also from the heads of the education office.

Table 7. Component 2: The Urgency and Meaning of STEAM Learning Content

Data Description

– 97.06% (33 people) of ECE educators think that it is important that STEAM learning content is implemented in ECE units. – 2.94% (1 person) ECE educators do not consider STEAM learning content important. – 91.18% (31 people) of ECE educators expressed the importance of STEAM learning content with various arguments, including (1) building children's ability to solve problems, (2) developing children's creativity, (3) making learning inspiring and fun, (4) foster self-confidence, curiosity and more focused learning and (5) build children's enthusiasm. – 8.22% (3 people) ECE educators did not convey any reasons for the importance of STEAM learning content.

Table 8. Component 3 : STEAM Content Learning Objectives

Data Description
– 61.76% (21 people) ECE educators expressed an understanding of the learning objectives of STEAM content in ECE units by providing various descriptions, including (1) giving children an understanding of science, technology, fun mathematics, (2) learning becomes directed, (3) learning becomes more concrete – 38.24% (13 people) ECE educators did not convey an understanding of the purpose of STEAM learning content in ECE units.

Table 9. Component 4: Scope of STEAM Learning Content

Data Description
– 73.53% (25 people) of ECE educators understand the scope of STEAM learning content. – 26.47% (9 people) ECE educators do not understand the scope of STEAM learning content for ECE units.

Table 10. Component 5: STEAM ECE Learning Content Illustration

Data Description
– 67.65% (23 people) of ECE educators understand 32.35% (11 people) of ECE educators do not understand illustrations or descriptions of STEAM learning content carried out in ECE units. – 32.35% (11 people) ECE educators do not understand the illustrations or descriptions of STEAM learning content implemented in ECE units.

4.1.3 *Designing a STEAM Content-Loaded Project Learning Model*

Through focused discussion activities as well as training and workshops, researchers and teachers collaborate to produce learning tools that contain project learning models containing STEAM content. The discussion activity begins with building a shared understanding of the use of themes that are in accordance with the needs and characteristics of ECE units in the archipelago and sea areas. The agreed theme is the maritime focus with the theme when Dama goes to sea and the sub-theme of my first adventure goes to sea. The theme concept webbed design can be illustrated in Figure 1.

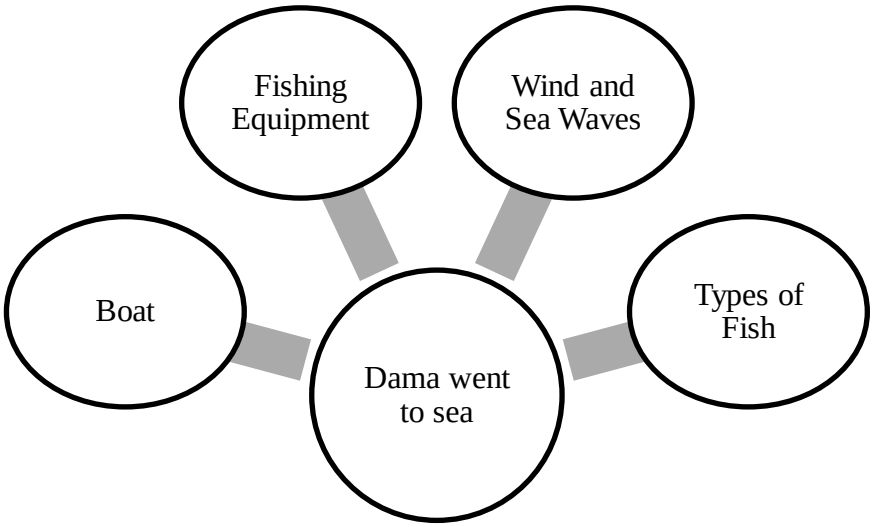

Figure 1. The theme concept webbed design

This theme is used to integrate learning outcomes for ECE units in accordance with child development achievement standards. This can be illustrated by learning achievement information (see Table 11).

Table 11. Learning Outcomes

1. Get to know the basic teachings of religion.
2. Know the causal relationship of a condition or situation that is influenced by natural laws.
3. Have awareness of text messages, alphabet, and phonemics,
4. Have imagination and creativity through exploring and expressing thoughts and/or feelings in the form of simple actions and/or works that can be produced through cognitive, affective, artistic sense, and fine and gross motor skills.
5. Having an awareness of numbers,
6. Appreciate his own efforts to be better

Based on learning outcomes, learning objectives are prepared containing STEAM and R-SLAMETS content that are appropriate to the characteristics and stages of child development. The purpose of the content in question can be described in table 12.

Table 12. Purpose of Play Activities

Description
- Children can say a prayer on a vehicle (Religion-NAM)
- Children can describe simple natural phenomena in the sea (Science or Science)
- Children can communicate the types of sea transportation by connecting pictures and letters or words (Literacy or Literacy)
- Children can make simple works of fishing boats from natural lost parts around the beach (Art = Art)
- Children can group and count the number of loose parts of natural materials used to make boats (Math = Mathematics)
- Children make boat sketch designs on paper or other objects (Engineering or engineering)
- Children make fishing rods from materials in the surrounding environment (Technology)
- Children display or market their work to other people (social studies

Based on these learning objectives, the teacher arranges play activities and creates play scenarios that contain learning syntax for each phase of project learning. The design can be described in table 13.

Table 13. Learning Syntax at Each Phase

Stages	Learning Syntax
Opening	1. Pray and greet. 2. Sing “My Ancestors” 3. Children listen to the story "When Dama Goes to Sea." 4. The child conveys the experience of going to sea.
Phase 1: Conduct Exploration Activities	The teacher asks trigger questions, for example: 1. In the story earlier, what play activities did Dama like? 2. What work does Dama produce in play? 3. What materials does Dama look for and use to play? The teacher conveys a choice of play activities that produce work. Children discuss choosing project activities to be made.
Phase 2: Planning the Project	The teacher and the children prepare materials and tools for playing. Children playing in groups sketching boats.
Phase 3: Implementing the Project	1. Children are playing making boats from loose parts of coastal natural materials 2. Playing counting the number of materials to make a boat.
Phase 4: Project Monitoring and Evaluation	The teacher aids the child in working on the project. The teacher asks about the child's difficulties in doing the project.
Phase 5: Presentation & Display	Child presentation of project results Children display the results of the project

4.1.4 *Implementation of Comic Media-Loaded STEAM Content-Loaded Project Learning Models*

In accordance with the design of play activities with the project learning model, the teacher carries out the learning process at the stages and syntax that has been prepared. Early learning activities begin with the habit of praying which reflects learning religious content (Religion). The activity continued with singing according to the theme "my ancestors" related to social studies content, especially getting to know the history of the Indonesian nation as a sailor. Children are also invited to watch a comic video that tells the story “When Dama went to Sea" (see table 14).

Table 14. Project learning phases

	1. Review stories and ask trigger questions
	2. Planning a Boat Building Project

	3. Implementing the Project Children collaborate and work together to make boats according to their own plans, imagination, and creativity
	4. A boat that has been successfully made by children
	5. Phase 4 (Monitoring the implementation of Project Activities) The teacher carries out monitoring and accompaniment of children carrying out the "making a boat" project
	6. Phase 5 (Subsidiary Presentation and Display of Project Results)
	7. Children display project results

Based on the presentation of the research data, this research categorizes the results of participatory observation into several important things (see Table 15).

Table 15. Participatory Observation Result Data Description

Data Description
1. ECE teachers already have a fast and precise strategy for compiling and developing learning tools and teaching modules in implementing project learning and Literacy-STEAM in ECE units.
2. ECE teachers can adapt well in implementing project learning with STEAM content using comic media.
3. Early childhood shows high interest and enthusiasm for showing stories in digital comic media.
4. Early childhood can gain a good understanding of the contents of stories in comics and can plan the activities and tasks of the selected project.
5. Old children show a serious attitude in carrying out play activities that show the implementation of project tasks.

6.	Early childhood can present project results and provide a description of the project results that have been prepared.
7.	The use of digital comic media has assisted teachers in implementing project learning with STEAM content to develop maritime cultural literacy in early childhood.

4.2 *Discussion*

The necessity of teaching STEM in the setting of early childhood education and the impact of teachers' attitudes about their ability to teach STEM in teaching quality and related student learning outcomes in this context are the driving forces behind this study. With a focus on potential teacher heterogeneity about these beliefs, the relationship between these beliefs, and teachers' teaching experience, teachers' awareness of the value of STEM education in early childhood, the goal of this study was to examine early childhood teachers' beliefs about their readiness to teach STEM and the difficulties they might encounter in doing so. In addition, through a qualitative-type analysis of the participant's responses to the two open-ended survey questions, issues and problems that emerged from early childhood teachers' opinions about the significance of early childhood STEM education and the challenges they might face in teaching STEM were investigated.

After attending the training the teacher must trust that the child's persistence and curiosity in STEM tasks is invaluable, and gradually the child begins to feel encouraged and empowered by their ability to solve challenging problems. In addition, children's academic achievement improves as a result of designing complex and open-ended STEM challenges. Training for teachers provides confidence that incorporating engineering into math and science curricula makes them more attractive. They should also come to believe that the child has a genuine interest in STEM-related issues. Teachers are expected to report that student reactions to STEM instruction are excellent. Therefore, some studies suggest that teachers feel that adding STEM to their curriculum is done to increase children's enjoyment and engagement (Herro & Quigley, 2017).

According to the current research, there are direct connections between teachers' perceptions of their teaching knowledge, their emphasis on the STEAM approach, and their readiness to implement its instructional techniques. Teachers in this study had just a limited understanding of the fundamental competencies required to support STEAM teaching, which led to their having very moderate attitudes regarding using STEAM concepts in their classrooms. This result is in line with those of El-Deghaidy et al. (2017), who observed that teachers' knowledge of STEAM is limited because they do not comprehend the fundamentals of the interdisciplinary learning approach which is a hallmark of STEAM education. The ability of instructors to use their knowledge of two or more STEAM fields to foster cognitive growth in young students is the cornerstone of a successful STEAM implementation. Teachers are not required to be experts in all STEAM fields, according to Quigley et al. (2017). To find and fill any gaps in their subject matter knowledge, draw meaningful connections that relate to children's lives, and inspire them to think creatively, teachers must be professionally prepared. According to Simoncini and Lasen (2018), early childhood professionals must adopt habits of thought

that enable them to use teaching strategies that turn STEM subjects such as science, technology, engineering, and mathematics into engaging experiences for children who naturally want to know.

Another finding from this study is the use of digital comic media has assisted teachers in implementing project learning with STEAM content to develop maritime cultural literacy in early childhood. Through digital comic media the full integration of STEAM into early childhood education is a process far beyond the capacity of any teacher, it is comparable to putting together puzzle pieces to allow children to have a meaningful perspective on the world. Developing STEAM instructors' intentional acceptance of new teaching and learning approaches, where the integration of subject matter and context forms the center of teaching, is an important component of STEAM teacher education. The ability to explore unfamiliar areas, try new ideas, adapt, and the inevitable failure that comes with experimentation are examples of "soft skills" that instructors must develop, according to Shernoff et al., (2017).

Understanding children's requirements and how to progressively encourage their learning is a key component of teaching STEAM to young children. In other words, the pipeline for successfully adopting developmentally appropriate STEAM practices is the teacher's knowledge base of the technique (Gartrell, 2016). To enhance children's cognitive development without compromising the fun of play, exploration, and expressive arts, STEAM learning must be integrated in a way that is appropriate to their age and stage of development (Sharapan, 2012). According to the study findings, the majority of teachers in Indonesia think that STEAM education is suitable for child development. Their poor understanding of STEAM and its efficient deployment procedures, however, is an obstacle.

5 CONCLUSION

The results of this study indicate that initial investigations into Indonesian early childhood teachers' understanding of STEAM learning, should reconsider what the capabilities of ECE teachers are, especially during cutting-edge teaching methodologies such as STEAM, given the diversity of perspectives among teachers on what and how STEAM methods can be incorporated into in ECE class pedagogy. This raises an important issue regarding the current situation of early childhood education programs in Indonesia in terms of STEAM teacher training courses. It also highlights the possibilities for professional growth for teachers in contemporary industry. Before the STEAM approach was prioritized, many teachers in this survey were in college and received their degree. Even though the STEAM terminology is still new to Indonesian early childhood education it is starting to gain popularity among educators. Indonesian ECE educators are progressively adopting new perspectives on early childhood education considering the expanding national focus on innovative methods of teaching children, such as STEAM principles.

To advance STEAM learning, one must critically review instructors' current practice in STEAM-related subject areas, evaluate teachers' knowledge base, identify gaps, and fill in any gaps with appropriate knowledge and professional development. The results of this study should motivate professionals and policymakers to participate in the current STEAM initiative for Indonesian early childhood. Professionals and academics must create the best programs that enable teachers to improve their educational progress and adapt to new emerging trends and ways, considering how important STEAM is as a promising approach. Current initiatives could concentrate on how teacher preparation programs are structured and how best to assist instructors as they work to incorporate STEAM instruction into early childhood classrooms. Building a digital STEAM education platform (such as through digital comic media) that allows teaching young children through early childhood education by integrated STEAM practices that are appropriate to developmental stages is one such suggestion. Given the current initiatives in Indonesian education towards digital transformation, certain digital platforms can be made available to all teachers across the kingdom to enable the exchange of ideas, experiences, and lessons learned related to STEAM pedagogy.

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