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STEAM Learning Assessment in the Growth and Development of Early Childhood Literacy

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Abstract

Penilaian perkembangan literasi anak perlu didukung dengan penilaian pembelajaran STEAM. Penelitian ini bertujuan untuk menganalisis penerapan asesmen pembelajaran STEAM dalam pengembangan literasi anak usia dini. Penelitian ini menggunakan pendekatan ex-post facto dengan metode deskriptif kuantitatif penerapan pembelajaran STEAM dengan teknik penilaian autentik. Instrumen pengumpulan data berupa observasi dengan skala 4 terstruktur, berorientasi validitas isi; catatan anekdot untuk merekam perilaku tertentu, dan portofolio untuk mendapatkan data tentang kinerja, pengetahuan, dan keterampilan kreatif anak, dengan tiga aspek utama: struktur, konten, dan holistik. Observasi pembelajaran, catatan anekdot, dan analisis hasil kerja dilakukan pada 20 anak kelompok B. Data yang diperoleh dideskripsikan dalam 5 aspek literasi: sains, teknologi, teknik, seni, dan matematika. Perkembangan literasi dideskripsikan dalam data ordinal dan dianalisis secara deskriptif dengan teknik persentase. Hasil penelitian menunjukkan bahwa semua anak berkembang secara lengkap terkait literasi teknologi dan matematika. Rata-rata, mereka berkembang dengan sangat baik; 90% anak berkembang sempurna dalam aspek ilmiah, dengan perkembangan rata-rata sesuai harapan; 60% anak berkembang sepenuhnya dalam literasi teknik dan 50% dalam literasi artistik, dengan perkembangan rata-rata seperti yang diharapkan. Penelitian ini menyiratkan bahwa penilaian pembelajaran STEAM dapat membantu dalam mengembangkan literasi anak usia dini.

***Keywords**: Pembelajaran STEAM, Asesmen, Tumbuh Kembang, Literasi.*

Abstract

Assessment of children's literacy development needs to be supported by STEAM learning assessments. This study aims to analyze the application of the STEAM learning assessment in the development of early childhood literacy. This study uses an ex-post facto approach with a quantitative descriptive method of implementing STEAM learning with authentic assessment techniques. The data collection instrument was observation with a scale of 4 structured, content valid oriented; anecdote notes to record specific behaviors, and portfolios to obtain data on children's performance, knowledge, and creative skills, with three main aspects: structure, content, and holistic. Observation of learning, anecdotal notes, and analysis of work results was carried out on 20 children in group B. The data obtained was described in 5 aspects of literacy: science, technology, engineering, art, and mathematics. Literacy development is described in ordinal data and analyzed descriptively using percentage techniques. The results showed that all children developed completely regarding technological and mathematical literacy. On average, they developed very well; 90% of children developed completely in the scientific aspect, with an average development according to expectations; 60% of children developed completely in engineering literacy and 50% in artistic literacy, with an average development as expected. This research implies that the STEAM learning assessment can assist in developing early childhood literacy.

Keywords: STEAM Learning, Assessment, Growth and Development, Literacy

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1. INTRODUCTION

Literacy in early childhood is useful for helping to understand other people and the environment, conveying thoughts and feelings to others, fostering interest in literacy, and stimulating the emergence of knowledge, attitudes, and skills for further study (Fortuna & Fitria, 2021; MS et al., 2022). In line with the development of science and technology, literacy involves the ability to read, write, speak, count, solve life's problems, understand and use one's potential (Akkas & Suryawati, 2021; Safitri et al., 2020; Yansyah et al., 2021).

Education and learning in early childhood can be done by integrating STEAM to help understand human life, which has been done since ancient times and always improves with continuous innovation to keep abreast of developments and maintain the preservation and balance of nature (Riyani & Wulandari, 2022; Wahyuningsih et al., 2020). Early childhood like to express/innovate to gain knowledge using STEAM concepts in solving problems they face and build STEAM skills within themselves to become positive habits and understand the world around them. Matters related to STEAM in early childhood follow the steps of children's activities observing natural objects around them, like changes in shape and color when mixing some materials. It shows the activity of science. Understanding the concepts of more, less, two-dimensional shapes, and so on, is a mathematical activity. Using technology to mix water, soil, and tools to stir is a technological activity. Trying various materials to mix, and finding a tool that can help to mix, is an engineering activity. Shaping soil into shapes and creating color types by mixing materials is an artistic activity.

However, currently, the achievement of literacy growth in early childhood learning through the STEAM model requires assessment activities. Assessment of early childhood literacy in the learning process of the STEAM model, starting from measuring/collecting data, analyzing qualitative and quantitative data, conducting assessments to obtain achievement status for literacy development, and conducting evaluations to obtain conclusions about the completeness of literacy growth and development. The assessment results also found the children's strengths and weaknesses individually, in groups, and classically. The results of a diagnosis of children's weaknesses in literacy development are very useful for developing follow-up plans and prioritizing education and learning services so that each child can achieve the standard level of child growth and development in literacy. From the problems above, it is necessary to conduct a scientific study on the assessment of STEAM learning in the growth and development of early childhood literacy. Assessment is collecting data, analysis, and interpretation to make the right decisions on the achievement of the child's developmental level and the success of learning activities (Efiawati et al., 2021; Fatmawati & Aziz, 2022). Assessment is an activity to correct, minimize, and improve delays in aspects of child development (Rofi'ah & Fatonah, 2021). Assessment results can show positive growth and development of children and those experiencing difficulties or weaknesses in achieving learning outcomes and diagnosing causative factors. Diagnostic assessment is an assessment carried out specifically to identify students' competencies, strengths, and weaknesses so that learning can be designed according to the conditions and needs of the child (Effendi & Hendriyani, 2020; Firmanzah & Sudibyo, 2021; Nuswowati et al., 2020). The diagnostic assessment aims to diagnose basic abilities and determine the child's initial condition. Academically, it has two parts of objectives: non-cognitive and cognitive (Rosnawati, 2021). Diagnosing learning difficulties can be done by identifying children with difficulties, localizing the difficulty level, determining the causative factors, choosing alternative assistance, determining how to overcome them, and designing a follow-up program (Darimi, 2016).

STEAM learning is a learning model that can integrate various fields of knowledge, such as science, technology, engineering, art, and mathematics, which are needed in the world of work today (Wahyuningsih et al., 2020). Applying the STEAM model learning can strengthen children's literacy, indicated by significantly increased learning outcomes before and after the STEAM model learning is carried out, from very low categories to medium, high, and very high categories (Sari et al., 2021). Project-based learning in the STEAM model can increase children's learning activities and outcomes (Firmansyah, 2019). Applying the STEAM learning model develops children's involvement in various scientific disciplines simultaneously to review problems from various perspectives to prepare children to face the challenges of today's increasingly complex world (Zubaidah, 2019). Implementing project-based learning with the STEAM model affects children's learning achievement and science process skills (Badriyah et al., 2020). There is also an approach to learning that applies the STEAM model in an integrative, collaborative manner that produces scene, technology, engineering, art, and mathematic literacy (Sumarno et al., 2021). Learning with the STEAM model can train children to communicate, collaborate, think critically, solve problems, and be creative and innovative so that children can face global challenges (Karmiati & Herman, 2021). Aspects that need to be considered in learning the STEAM model for early childhood are questions, observation, exploration, developing skills and processes, communicating, and playing (Novitasari., 2022).

Previous research findings stated that the STEAM model's learning process effectively increased learning outcomes and created positive children's activities and responses (Suriyana & Novianti, 2021). The integration of STEAM learning projects through the WhatsApp group application can support science processes, creative thinking skills, scientific and digital literacy, and children's motor skills (Suryaningsih & Ainun Nisa, 2021). Lesson plan learning tools and student worksheets in the STEAM-PjBL learning model, based on the results of trials with very good qualifications and are feasible to apply in the learning process, and these products can be used by teachers (Dewi et al., 2021). The STEAM learning model based on parental support effectively increases children's creativity (Budiyono et al., 2020; Salsabila & Muhid, 2021). There are differences in children's critical thinking abilities before and after receiving the treatment of project-based learning with the STEAM model (Cahyani & Sulastri, 2021). Applying PjBL STEM collaboration learning can improve science attitudes between men and women, and all students express satisfaction with STEM PjBL learning, resulting in motivation and interest in learning (Afriana et al., 2016). PjBL-STEAM learning can develop children's soft skill abilities built on a thorough understanding of the interrelationships of fields of knowledge through 21st-century skills learning experiences (Fitriyah & Ramadani, 2021; Lestari, 2021; Rohman et al., 2022). The renewal of this research is to apply an ex-post facto approach with a qualitative descriptive method for implementing STEAM learning with authentic assessment techniques. This research aims to analyze the application of the Steam learning assessment in the growth and development of early childhood literacy. This research is expected to provide an overview of how the STEAM assessment is applied to assess early childhood literacy growth and development.

2. METHODS

This type of research is ex post facto research with a quantitative descriptive approach which will be carried out at the State Kindergarten Pembina North Lombok Regency in 2022. There are 20 children as research subjects from group B, which are determined by a purposive sampling technique based on consideration of the highest scores from observational literacy initial, which concerns literacy reading, writing, speaking, arithmetic, and solving problems. Data collection techniques use observation, anecdote notes, and portfolios of learning activities applying the STEAM model and literacy development. Literacy development is focused on scientific, technological, engineering, art, and mathematic literacy. Unstructured interviews with teaching teachers and school principals were conducted to refine data about the implementation of the STEAM learning model in early childhood. The learning implementation indicators consist of daily learning implementation plans and daily learning implementation plans consisting of objectives, materials and media, activity steps, assessments, and assessment criteria. The implementation of learning consists of initial activities, implementation of learning (introduction, core, and closing), and final activities.

STEAM literacy observation guidelines consist of the following indicators: 1) scientific literacy concerning the physical sciences, life, earth, and space; 2) technological literacy consists of getting to know the technology they use, introducing the functions of the technology around them, getting to know the concepts of science, mathematics in technology, understanding the good and responsible use of technology; 3) engineering literacy (engineering) such as designing, manufacturing, developing, and finding problems and producing technology; 4) art literacy (art) consisting of fine arts, dance, music, and drama; 5) mathematical literacy consists of number concepts, number operations, comparisons, and groupings. The instrument meets content validity based on expert validation. Guidelines are made on a multilevel scale, with the following criteria: 4 = very good, 3 = good, 2 = good enough, and 1 = not good. Observation results were analyzed descriptively and qualitatively using analytical methods: data presentation, data reduction, and conclusions/verification (Bungin, 2012). The evaluation criteria use the completeness limit. Namely, the achievements of categories 4 and 3 are complete, and those of categories 2 and 1 are not complete. The assessment criteria are as follows: 3.51 – 4.0 very well developed; 2.51 - 3.50 develops as expected; 1.51 – 2.50 starts to grow; 1.0 – 1.5 not yet developed. The data for each STEAM literacy was analyzed to find the average number of observed data. The average score obtained is converted to the assessment criteria used to determine the status of early childhood literacy development. The scheme of the research steps is presented in Figure 1.

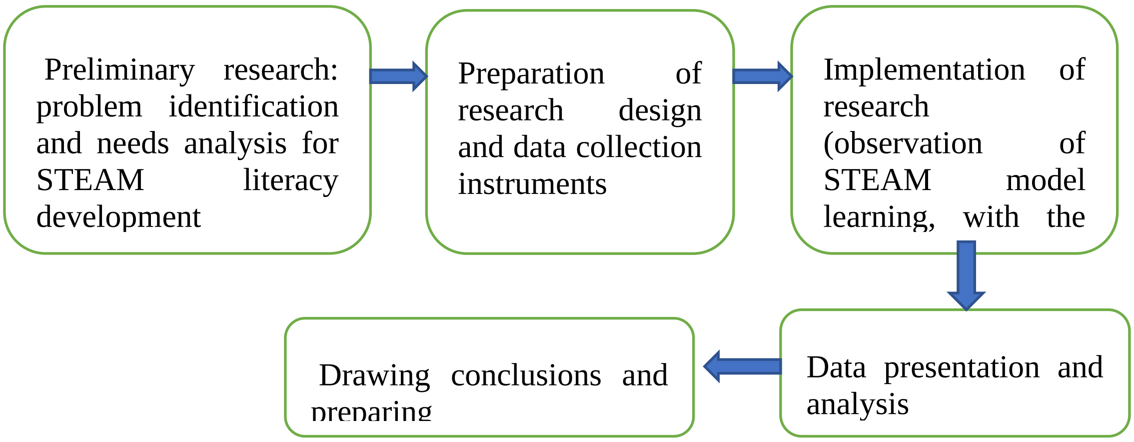

Figure 1. Scheme of the research steps

3. RESULTS AND DISCUSSION

Result

The observed learning activities were recorded and made a portfolio during the lesson in my environment theme, which was studied for three weeks. Data collection was carried out at the end of learning on the animal sub-theme in the first week, the plants sub-theme at the end of the second week, and the natural environment sub-theme at the end of the third week. Research focuses on the growth and development of scientific, technological, engineering, artistic, and mathematical literacy. These aspects consist of scientific literacy: physical science, life science, and Earth/Space science. Technological literacy consists of learning the simple technologies they use, introducing surrounding technologies, and learning scientific and mathematical concepts in technology. Engineering literacy involves finding problems, finding ideas, executing, and developing. Art literacy includes fine arts, dance, music, and dramatic arts. Mathematical literacy consists of number concepts, number operations, comparisons, grouping, patterns, and geometry. The research instrument was prepared based on the indicators described from the aspects and sub-aspects of each STEAM component. The sub-aspect of physical science in the form of inanimate objects consists of changes that occur and the energy that affects them, such as material properties, magnetism, gravity, density, light, weight and equilibrium, shape changes, force, motion, and speed. The science of life, related to living things, consists of humans, animals, and plants, with indicators: parts, functions, benefits, cycles, and the relationship of living things with their environment. Earth and Space science consists of water, air, rock, soil, and natural disasters, while space science consists of space objects such as the Moon, Stars, Sun, and their effects on weather, day and night, seasonal changes, and temperature. . The data collection instrument was tested for content validity using experts and was declared valid. The instrument items are in the form of statements accompanied by a graded scale (developing very well, developing as expected, starting to develop, and not yet developing) which describes the growth and development of literacy in STEAM. The results of observing the growth and development of STEAM literacy are presented in Table 1.

Table 1. Data from STEAM Literacy Observation Results

NO	STEAM LITERACY				
	Science	Technology	Engineering	Art	Mathematics
∑	68	72	52	50	71
Average	3,4	3,6	2,51	2,50	3,55

The results of descriptive data analysis on STEAM literacy show that in the growth and development of scientific literacy of 20 children, most (50%) are developing very well, and only a small proportion (10%) are starting to develop. The other 40% are developing as expected. Every learning in early childhood implemented in play activities has optimally stimulated aspects of science, even though a game/learning system fosters scientific literacy and develops other aspects of literacy. All students have achieved complete technological literacy development. Most (60%) of children have achieved very well-developed technological literacy development, and a small number of others (40%) are developing as expected. In these two categories of technological literacy growth and development achievements, all children have reached a level of development above the lower limit of completeness. The results of the data analysis on the development of engineering literacy (engineering) show that most of the children (60%) out of 20 people have achieved the development that develops according to expectations, while the other 40% are at the level of starting to develop. Engineering literacy was found to have yet to reach optimal development. Even though most of it had been completed, many children still needed to complete it. The developmental aspect of art (art) achieves the development results of 50% of the 20 children developing according to expectations, and the other 50% are at the level of development. In the artistic aspect, it shows the lowest average level of child development among other STEAM literacy. The development of mathematical literacy in children found that 55% of 20 children had achieved development in very good developing status, and 45% in developing status as expected, and all children developed completely.

Discussions

STEAM learning is a model that integrates various fields of knowledge, such as science, technology, engineering, art, and mathematics, to stimulate children's participation optimally. The implementation of STEAM learning integrates technology, pedagogy, content, and competence. The main basis for implementing learning is problem-based, case-based, and project-based. This learning base is appropriate to the adaptation needs of graduates with 21st-century skills. Assessment of early childhood literacy growth and development applies an authentic assessment model, an assessment carried out jointly and integrated with learning activities. The techniques used are observation, anecdotal notes, and portfolios. The measurement instrument uses a multilevel observation guideline with four (4) categories: 4 = very well developed, 3 = developing as expected, 2 = starting to develop, and 1 = not yet developing. The instrument for assessing the work uses the same pattern as the observation instrument. However, aspects of the children's work are divided into 3 parts: the structure, the work, the content of the work, and the holistic product. The growth and development of early childhood literacy are expressed as complete growth and development consisting of very well-developed categories and developing as expected. The incomplete category consists of categories that are starting to develop and still need to.

The study results indicate that early childhood is interested in liking material in aspects of technological literacy and mathematics. It is evident from learning activities in early childhood that all children can achieve completeness. Literacy in the scientific aspect shows the widest distribution of growth and development results. These findings indicate that there are still a small number of children whose growth and development have not been completed, which requires a diagnostic assessment to analyze the causal factors regarding developmental achievements that are classified as incomplete. Similar to artistic literacy development, children have yet to achieve optimal developmental status. 50% of the status of artistic literacy development is classified as incomplete. The findings on artistic literacy are very interesting to analyze what causes early childhood to show the most problematic status of literacy development to find a solution. STEAM learning generally uses four important activities: communication, collaboration, critical thinking, and creativity (Sari et al., 2021; Wahyuningsih et al., 2020). The theory relevant to learning in early childhood is J. Piaget's theory of assimilation and accommodation. Assimilation is the process by which an organism responds to the environment according to its cognitive structure, namely the type of adjustment between the cognitive structure and the physical environment.

Meanwhile, accommodation is a mechanism for intellectual development through modifying the cognitive structure, which is useful for demonstrating a child's intellectual development (Olson, 2010). Learning for the growth and development of STEAM literacy, assimilation, and accommodation in children are two ways for individuals to grow and develop through interactions between themselves and their environment. When a child learns from an environment where the environment is internalized according to the child's cognitive framework, in this case, the child carries out the assimilation process. Whereas at the time of interaction with the environment where the child adapts to the environment in his growth and development, an accommodation process occurs. Productive and innovative learning processes of children occur when children carry out assimilation and accommodation. Children's cognitive development is influenced by environmental factors, both the community and the school environment (AD, 2018; Anida & Eliza, 2020). The child's environment can internalize objects that stimulate cognitive development (Afsari et al., 2022). Literacy in the scientific aspect shows the results of growth and development, which have the widest distribution in several aspects. First is the technology sub-aspect, namely products that are always created and developed to meet the needs of living things and the environment in the form of discoveries of new knowledge and technologies. All tools or objects that make our lives easier are called technology, such as electronics, household appliances, work tools, etc. Several activities in early childhood involve technology development, such as technology that children always use, such as pencils, paper, spoons, plates, and others; introduce the technology functions that are around it; familiar with scientific and mathematical concepts in technology, such as the influence of materials, shapes, and sizes on the function of the technology; educating and teaching children to use good and responsible technology (Norita & Hadiyanto, 2021; Priatna, 2018; Zaini &

Soenarto, 2019). Second, the engineering sub-aspect is the child's ability to design, manufacture, develop, and find problems. Humans use science and mathematics to produce technology. The engineering process in early childhood consists of: finding problems, exploring causative factors, and setting boundaries, generating ideas, discussing ideas and problems, and selecting ideas and their solutions, making plans consisting of analyzing needs, designing products. Arrange the stages to be carried out; execute plans to find ideas, and test the success of solving problems; Developing is an activity to develop ideas and products (Aisyah et al., 2021; Rai et al., 2021).

Third, the Art (art) sub-aspect plays a role in helping humans express their imagination and creativity so that there is wide space for exploration in finding solutions to the problems they face. Art forms that can be observed in early childhood are fine arts, namely expressing imagination and creativity through drawings, paintings, shapes, handicrafts, sculptures, objects, and others; the art of dance, namely art through movement; the art of music, rhythmic sound or not, from various movements and songs; drama arts, namely role-playing activities. Fourth, the mathematical sub-aspect consists of number operations, patterns, geometric shapes, measurement concepts, and data processing concepts to help observe and experiment with seeing scientific facts. The concept of numbers consists of knowing the symbols and meanings of numbers, counting the number of objects, and calling numbers 1-10, ordering numbers, and using numbers in communication; number operations consist of using numbers +, -, x in calculating concrete objects; comparisons, such as equal, more than, less than, and those related to measures such as length, less, equal, as much; grouping, grouping according to certain characteristics, such as shape, size, color, number, type, and level; patterns, understanding pattern concepts such as sequences of numbers, pictures, movements, stories and sounds with repeated processes; geometry, understanding 2 and 3-dimensional shapes, and their relation to spatial relationships, such as the position of objects in space.

The process of child growth and development in science learning is currently dominantly used in STEAM. It is contrary to the Behavioristic theory, which states that learning is an interaction between individuals and their environment, so behavior changes occur (Rayanto & Sugianti, 2020). This theory is irrelevant to early childhood growth and development, with the construction of high-level thinking patterns in children, namely developing analytical skills, evaluating an object, and carrying out creative behavior that is only sometimes linear. The formation of STEAM literacy in children follows the Gestalt theory, which states that the whole is more important than the parts/elements (Gredler, Margaret E. dialih bahasakan Tri Wibowo, 2011). Achievement of child development in literacy aspects of STEAM, not independent aspects, but always collaborating in achieving child development. A learning activity carried out in play activities in early childhood, aspects of STEAM can emerge, although only sometimes orderly and highly dependent on the child's talents, interests, and past experiences.

This finding is reinforced by previous research, which states that the STEAM learning model can train children to solve problems creatively and innovatively, collaborate, think critically, and communicate so that they can face global challenges (Karmiati & Herman, 2021). Applying guided inquiry using the STEM approach model affects children's understanding of concepts and argumentation skills (Paramita et al., 2021). STEM learning (PjBL) can generate children's motivation and interest in learning because they enjoy following the learning stages (Afriana et al., 2016). Project activities can adopt and develop complete and integrated STEAM literacy in children. Learning the STEAM model by linking science, technology, art, and mathematics can develop soft skills because children are given comprehensive knowledge through various fields related to 21st-century skills (Lestari, 2021). Implementing the STEAM learning model, which is carried out collaboratively and collaboratively, can develop children's literacy in science, technology, engineering, art, and mathematics. The most superior development results are in the technological and mathematical aspects. Implementing the STEAM learning model supports the needs of children's growth and development to adapt to the influence of globalization in the 21st century. STEAM learning is very relevant to the case and project-based learning model. Case and project-based learning (PjBL) develops children's ability from an early age to plan (engineering), carry out activities, and compile simple reports on project results. This research implies that the STEAM learning assessment can assist in developing early childhood literacy. These findings can be recommendations for literacy development in early childhood.

4. CONCLUSION

The STEAM learning model applying authentic assessment can develop scientific, technological, engineering, artistic, and mathematical literacy with the following achievement levels: all students achieve complete technological and mathematical literacy development. Whereas in children's, scientific literacy is complete, engineering literacy is complete, and art literacy is 50% complete. The STEAM learning model is collaboratively integrative by applying TPACK, namely the use of educational technology in studying material to achieve competency learning outcomes about comprehensive literacy development and optimal 21st-century skills.

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