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JPPM (Jurnal Pendidikan dan Pemberdayaan Masyarakat)
9 (1), 2022, 83-93

The Effectiveness of STEAM-Based Multisensory Model Implementation Training for Strengthening Teachers' Competence

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Received: 13 January 2022; Revised: 20 February 2022; Accepted: 21 March 2022

Abstract: Teachers, as professionals in early childhood education institutions, must continually improve their competencies to keep up with the era. Learning prepared for children to face the 21st century is knowledge based on Science, Technology, Engineering, the Arts, and Mathematics which can be applied by activating all of the child's senses. One of the ways to improve competence is through training activities. This study aims to determine the effectiveness of STEAM-based multisensory model implementation training activities to increase teacher competence at *IGRA* (*Raudhatul Athfal* Teacher Association), Dukun District, Magelang Regency. The research subjects were 38 teachers. The training process's effectiveness was measured using Instrument Authentic Assessment Based on Teaching and Learning Trajectory with Student Activity Sheets (AABTL with SAS). The results showed that the STEAM-based multisensory model implementation training for strengthening teacher competence at *IGRA*, Dukun District was effective with an average score of 82.3% of trainees. The material most mastered by participants was multisensory material, while the material less mastered by participants was STEAM material in Early Childhood Education.

Keywords: earlychildhood, teacher training, multisensory model, STEAM learning

How to Cite: Novitasari, K., Utami, N.A., et al. (2022). *The Effectiveness of Steam-Based Multisensory Model Implementation Training for Strengthening Teachers' Competence . JPPM (Jurnal Pendidikan dan Pemberdayaan Masyarakat), 9*(1), 83-88. doi: https://doi.org/10.21831/jppm.v9i1.51853

Introduction

Early childhood education as the foundation of children's education and levels to prepare a generation of learners needs serious attention. At this time, children grow and develop very rapidly in various aspects. Early childhood requires appropriate educational services provided by professional educators (Botutihe et al., 2020). Currently, public awareness of the importance of *PAUD* (early childhood education) has increased (Annisa et al., 2020). This increase needs to be responded positively by early childhood education institutions as partners of parents in educating children. Early childhood education institutions should be able to develop the competence of their human resources, especially educators. Educators with a background in early childhood teacher education are educators who already have academic and practical knowledge in carrying out their mandate to teach and educate early childhood.

The focus of most education development projects is the issue of teacher performance development (Ibrahim (2014); Abdu et al., 2022). Teachers are required to be able to adopt all future expectations that aim to advance the education system. To create quality learning in early childhood classes, teacher competence is needed. Teachers' competencies relate to their values, behavior, communication, goals and practice, and support professional development and curricular studies (Phoebe L. Gallego & Manuel E. Caingcoy, 2020). Improving teacher performance is needed to improve the early childhood education system (Abdu et al., 2022). Efforts to improve teacher performance can be achieved by developing their information, skills and experience, which in turn will lead to an increase in the level of children and achieve growth. One of the pillars that determines the quality of early childhood education learning is the competence of the teacher, which is developed not only through experience and example, but also through early and permanent theory-practice training (Otero-Mayer et al., 2021).

Qualified educators need to master professional, pedagogical, personality, and social competencies, as stated in Government Regulation no. 16 of 2007 on standards of the competence of early childhood teachers (*PAUD/TK/RA*). Professional competence in question is the ability to understand the growth and development of children, the ability to provide educational stimulation, care and protection, and the ability to build cooperation with parents in the education. The second competency that teachers must possess is pedagogic competence. Pedagogic competence in early childhood education teachers is very important because with this competence, educators can manage learning optimally (Hermawan et al., 2022). Teacher's pedagogic competence includes the ability to manage learning, students' understanding, design and implement learning, evaluate learning outcomes, and develop students to actualize their various potentials. Pedagogic competence is the ability of educators in planning learning activities, implementing learning processes, and assessing learning processes and outcomes. Based on previous research, the teacher's pedagogic ability in early childhood education learning is very important. With this ability, teachers will be more creative and flexible in designing learning in the classroom, so that children will be happier in carrying out learning (Hermawan et al., 2022). Third, Personality competence is the ability to behave and act according to the child's psychological needs, according to the child's norms, religion, culture and beliefs, and to present oneself as a person with noble character. Meanwhile, social competence is the ability of teachers to adapt to the environment and communicate effectively with students.

The mindset of educators is one of the successes of implementing the curriculum (Thu, 2021). From this opinion, children will learn well if educators have an open mindset and are in accordance with current conditions. Educators need to know the latest issues regarding early childhood learning, both locally, nationally, and globally. Therefore, children's learning process can keep up with the times.

Seeing the challenges of education in the 21st century, early childhood education teacher competence has an important role in the success of children's education. Improving the quality of education in Indonesia is illustrated by the competence that must be possessed by teachers, namely professional, pedagogical, personal and social competencies, as stated in Government Regulation no. 16 of 2007 concerning the competency standards of early childhood education teachers. A professional teacher must have a professional predicate and demonstrate work performance in accordance with his/her profession. The development of professional competencies applied in the development of learning models is a required part of learning in early childhood education. Teachers must have the ability to develop learning models according to the child's developmental stage, themes, and learning objectives that are fun, meaningful, and able to arouse children's curiosity. Training is a solution for educators to improve their knowledge and skills in carrying out their professional duties and responsibilities (Pertiwi et al., 2018). Early childhood educators are required to always improve their competence through

training because many of them do not have the competence and qualifications in accordance with the provision (Fauzi, 2017).

In this century, children need to master the 4C skills, namely creativity, critical thinking, communication, and collaboration (Center, 2010). Through these 4C skills, the learning process prioritizes children's skills to be able to adapt to the conditions of the times. The condition of this era is when mathematics, verbal communication, and knowledge become a solution when done through collaboration independently in positive communication. In the future, around 85% of jobs will require workers to master various skills in the fields of science, technology and mathematics (Tabiin, 2020). Educators must be able to help children in their growth and development to be more creative, collaborative, communicative, and able to think critically, and help them learn to be independent. Therefore, the learning process in this century needs to integrate children's skills in knowledge,

Learning that is prepared for children to face the 21st century is learning based on Science, Technology, Engineering, the Arts, and Mathematics (STEAM) (Wahyuningsih et al., 2020). The Indonesian government has proposed STEAM as one of the materials studied in teacher professional education, because the STEAM education model is believed to be able to improve the quality of children's education and prepare them for the educational needs of the twenty-first century (Sit, 2022). The concepts of STEAM (science, technol- ogy, engineering, arts, and math) have been examined to determine the benefits of enhancing the cognitive domain of learning of memory, reaction time, and innate intelligence (Pabalan et al., 2018). STEAM education, which means that the arts are combined with the STEM (science, technology, engineering and mathematics) disciplines, is an emerging paradigm for education in many parts of the world (Areljung & Günther-Hanssen, 2021). The application of STEAM-based learning (Science, Technology, Engineering, Arts, and Mathematics) provides many benefits for children because STEAM-based learning is part of a curriculum that develops children's creativity with an emphasis on collaboration, creativity, verbal and non-verbal communication, research, problem-solving, and critical thinking. Through this learning approach, children are not only sought to be smart in academic aspects but also in social and emotional aspects (Kim et al., 2012).

STEAM-based learning in early childhood can motivate children to conceptualize and explore as well as develop and use existing educational game tools, nurture knowledge or cognitive abilities, children's manipulative and affective development, and simply apply knowledge (Tabiin, 2020). One of the basic characteristics of STEAM education is doing meaningful learning in real situations (Zhou, 2022). During reality inspired play, children develop a sense of agency by taking on different decision-making roles and using different open-ended resources, materials, tools, and skills to stimulate creative play (Ng et al., 2022). STEAM-based learning can train children in implementing their knowledge as a form of problem-solving related to the surrounding environment. The STEAM approach as part of a learning innovation that combines science and mathematics nurtures students to have logical and rational thinking; moreover, the early childhood education curriculum also accommodates arts and arts appreciation which is an important aspect of early childhood development in terms of diversity of learning (Prameswari & Lestariningrum, 2020). STEAM education could also provide a path to building mutual understanding across professional cultures and knowledge domains, as well as motivate learners, and contribute to solving societal and global issues (Herranen et al., 2021).

Loose parts are a potential medium to support STEAM learning, using loose parts can facilitate children to be free to work in developing their ideas, creativity and imagination (Rahardjo, 2019). Loose parts are materials that are open, can be separated, can be put back together, carried, combined, lined up, moved and used alone or combined with other materials (Siantajani, 2020). Loose parts material can be in the form of objects with small, medium or large sizes. In addition, loose parts can also be found and used indoors and outdoors. The types of

loose parts are divided into natural materials, plastic-based objects, metal objects, used packaging, pieces of bamboo and wood as well as objects made of yarn and fabric. Loose parts found in the child's immediate environment will be a strength for children to be creative. The variety of loose parts presented by educators will further stimulate children's problemsolving abilities. Different materials will present different problems. Learning with loose parts media will encourage children to be able to observe, try, and decide what material to use.

Loose parts media in STEAM learning has proven to be effective in improving early childhood cognitive skills such as critical thinking, creative thinking, problem solving, learning mathematics and so on (Muntomimah, S., & Wijayanti, 2020). Therefore. Educators are expected to apply STEAM learning with loose parts media so that children can have space to think, evaluate and determine ways to achieve goals and complete their projects.

IGRA is an abbreviation of the "Ikatan Guru Raudhatul Athfal" which means an association of Islamic Kindergarten teachers. The competence of teachers under *IGRA* in Dukun District still needs to be strengthened in various ways. From the results of interviews with the *IGRA* head of Dukun District, it is known that teachers still find it difficult to be innovative in STEAM-based learning activities. These STEAM components include an integrated approach to learning that requires an intentional connection between standards, assessments and lesson design (Lu et al., 2021). The difficulties experienced by early childhood education teachers in STEAM-based learning are the understanding of the STEAM concept which is still rigid by following reference books, the limitations of tools, materials, time, and the application of the STEAM concept which does not refer to effective early childhood learning. Teachers highlighted the need of training on the STEAM philosophy, essential concepts, and specific methods; access to STEAM-specific digital resources/software; practical training/seminars or blended learning training (Mokhena et al., 2016).

An appropriate learning model is needed so that learning materials for early childhood are delivered effectively. Children live and learn in a multisensory world. Within a typical school environment there is an abundance of facilitatory multisensory information (e.g., auditory and visual speech information, and written and spoken instruction), in addition to dis- tracting stimuli (e.g., background noise and move- ment) (Barutchu et al., 2020). This material needs to be presented in various sensory modalities. Multisensory is one of the methods which has been adopted in the application of teaching and learning strategies (Maliki & Yasin, 2017). Combining information using all the different sensory modalities is very important for a person and survival and core features of human daily life (Nava et al., 2020). The modalities used are visual, auditory, kinesthetic, and tactile (VAKT). The learning model that is able to optimize children's senses is a multisensory learning model. An active learning method that stimulates all senses (multisensory) is more effective for preschool children because it is in accordance with the needs and psychological characteristics of children (Ruhaena, 2015). Multi-sensory activity gives such a good impact to children like for life skills, language and speech development, memory as well as simple activities that brings joys to children, (Patch, 2020; Manja et al., 2022). Teaching with a multisensory approach helps students link new information to prior knowledge and understand relationships between concepts (Esplendori et al., 2022). Multisensory learning encourage more effective information processing than unisensory (Shams & Seitz, 2008). Although these findings cover different levels of processing and may be mediated by different mechanisms, it appears that the multisensory benefits to learning are an overarching phenomenon. The multisensory reading approach includes tracing (touching), listening (auditory), writing (movement), and seeing (visual). For this reason, the implementation of this method requires tools (media) such as letter cards, paint, sand, embossed letters, and other tools that can be touched (concrete).

Research Method

This research is an explanatory case study aimed at photographing and explaining an activity or phenomenon in detail. Through this method, the researcher examined the data to explain the phenomena. The purpose of this research was to find out the effectiveness of the training process for early childhood education teachers in implementing the STEAM-based multisensory learning model. The research subjects were 38 PAUD teachers in Dukun District, Magelang Regency. The effectiveness of the training process was measured using the Authentic Assessment Based on Teaching and Learning Trajectory with Student Activity Sheets (AABTL with SAS) instrument adopted from the research by (Rochman et al., 2018). AABTLT with SAS aimed to ensure and see to what extent training participants absorbed the materials and instructions given by the instructor. The use of AABTLT with SAS has been widely implemented in previous studies such as those of (Misbahudin et al., 2018) and (Komalasari et al., 2018).

Results and Discussion

The STEAM-based multisensory model implementation training was held for one day. Beginning with filling out a pre-test questionnaire to the participants to measure the participants' initial competence in the STEAM-based multisensory model. The next step was the presentation by three resource persons regarding 1) multisensory learning, 2) STEAM in early childhood education or *PAUD*, and 3) Loose parts.

Effectiveness of the STEAM-based Multisensory Learning Model Implementation Training Process

The effectiveness of the training process was conducted by using the AABTLT instrument. The instructor prepared a number of questions (quizzes) or tasks that must be done by participants based on the material presented by the instructor. Participants' answers to these questions were stated in Student Activity Sheets (SAS). SAS shows the trainee's learning trajectory. SAS indicates the level of material absorption. The effectiveness of the training provided by the instructor is characterized by high SAS scores.

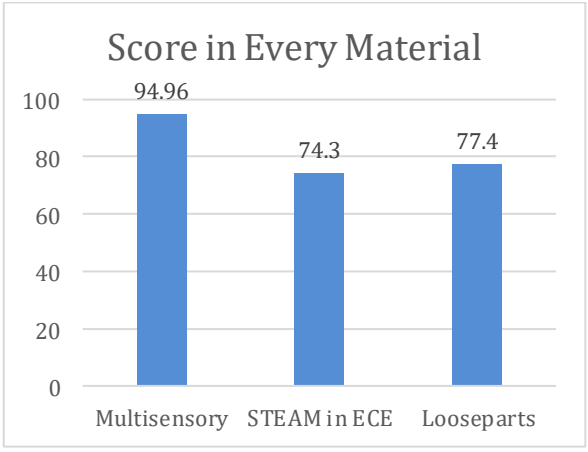

Figure 1. The score of each material

Based on the data that has been obtained, the material that is most mastered by the participants is multisensory learning with a score of 94.96 followed by material on Loose Parts with a score of 77.4. In carrying out learning that contains STEAM, the teachers is still confused. Where steam should be inserted and how to insert it in learning. Teachers are familiar with loose

parts through the trainings they have attended, even though the implementation is not yet perfect. But they have recognized that loosepart is easy to use for critical thinking, creative thinking, problem solving, learning mathematics (Muntomimah, S., & Wijayanti, 2020). The material with the lowest score is STEAM in Early Childhood Education with a score of 74.3.

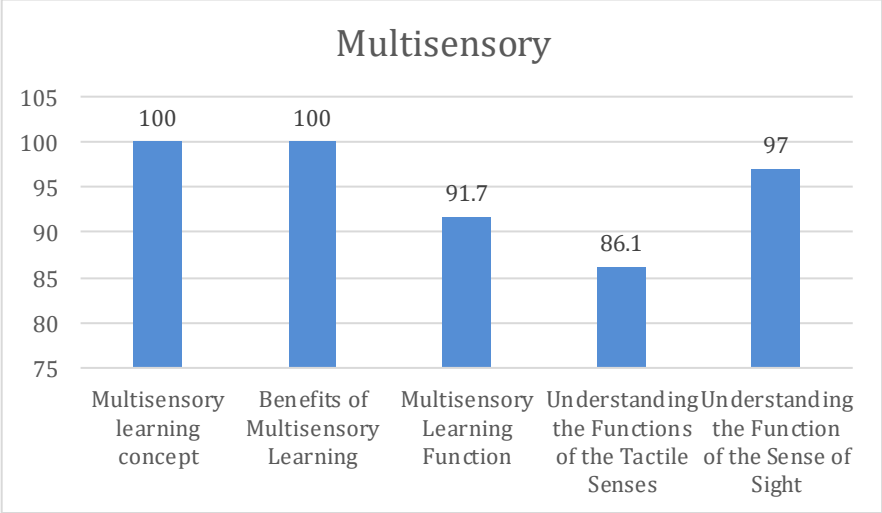

Figure 2. The score of multisensory material

For early childhood educators, learning that involves more than one sense has been widely used. Children are easier to receive information if they activate several senses, for example, in recognizing cats, children will more easily remember cats if they have seen, heard, touched, and smelled a cat. Multisensory exposure can result in superior object recognition compared to unisensory exposure (Shams & Seitz, 2008). These sensory processes continue to develop throughout late childhood (Barutchu et al., 2020). Learning media available at early childhood education institution, in general, are also multisensory, for example, sets of blocks (can be seen and touched), natural materials around the institution such as wood, leaves, flowers, sand, stones, and so on. In addition, digital learning media are now available and can be accessed easily via YouTube by every educator. In addition to providing information to educators and early childhood, the YouTube platform also allows interaction between educators and students (Rani & Rahayu, 2021). Children can see and hear content on YouTube that activates their senses of sight and hearing.

Another material that is also mastered is Loose Parts. The term loose parts has been widely discussed among early childhood educators, but its implementation is still a common problem. Educators' perceptions of the use of loose parts in early childhood learning are very diverse (Mastuinda et al., 2020). In the training process, it was found that educators were still not confident in using loose parts in the learning process. The reasons include: 1) not having ideas for the use of loose parts, 2) limited use of tools and materials, and 3) limitations in managing games using loose parts.

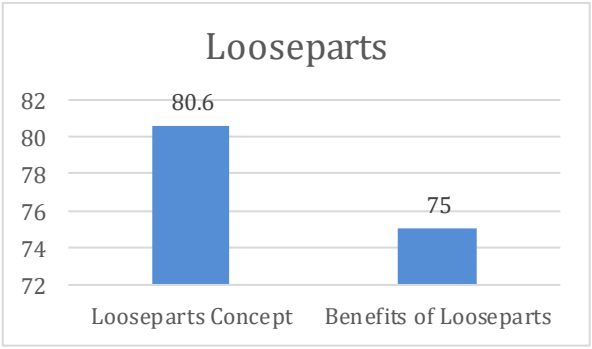

Figure 3. The score of loose parts material

Further investigation revealed that the actual use of loose parts in learning activities does not require special tools and materials. Loose parts can be in the form of natural materials, such as wood, plastic, metal, cloth, ceramics (Swadley, 2021), and so on which are widely available around us. This media has the potential to be implemented in learning with the STEAM approach and has the advantage of providing freedom and opportunities to solve various types of problems (Rahardjo, 2019). Loose parts provide opportunities for children to increase their fantasy and imagination. Imagination is the basis of creative problem-solving (Dillon, 2018). Giving children the opportunity to play loose parts outdoors in the early years will support various aspects of their development in a positive way (Flannigan & Dietze, 2017).

The material that is still not widely mastered is the material on STEAM in early childhood education with a score of 74.3. The proliferation of information regarding the independent learning curriculum at early childhood education institutions, one of which is Literacy and STEAM learning outcomes, has made educators familiar with the term STEAM in early childhood education. The STEAM approach in early childhood education learning is carried out to foster children's interest in and love of science, technology, and the arts (Zubaidah, 2019). In the STEAM approach, learning involves a creative process and no one uses only one method for the discovery and investigation process. STEAM education has the potential to shape new ways of learning in early childhood (Areljung & Günther-Hanssen, 2021). During the early childhood years, these learning activities allow children to discover material using their senses (Wahyuningsih et al., 2020). Through this, they can understand significant scientific and mathematical associations, such as the concepts of 'more or less' and 'sooner or later' from an early age.

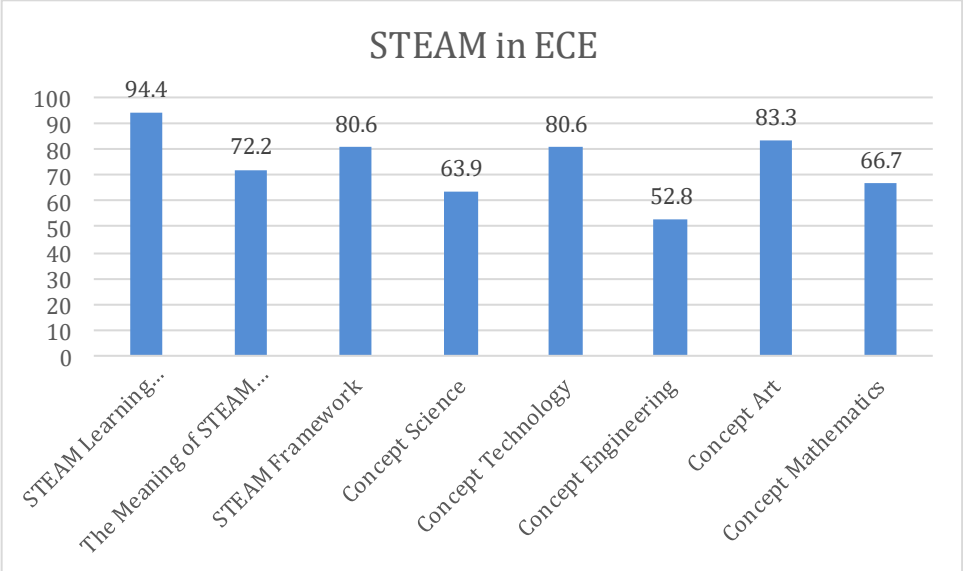

Figure 4. STEAM material scores in early childhood education

Recently, the world of education, especially in kindergartens led by the Minister of Education and Culture Nadzim Makrim has initiated a learning model for early childhood, namely learning that contains STEAM (Science, Technology, Art, and Math) (Ellizah et al., 2020). This is to answer the challenges of the world of education which currently cannot be separated from the world of science and technology. The application of a STEAM-based curriculum (Science, Technology, Engineering, Arts, and Mathematics) provides many benefits for children because the STEAM-based curriculum is part of a curriculum that develops children's creativity with an emphasis on collaboration, creativity, verbal and non-verbal communication, research, problem-solving, and critical thinking. Through this learning approach, children are not only strived to be smart in academic aspects but also in social and emotional aspects (Kim et al., 2012). Through the STEAM approach, it is expected that children can more easily understand the concepts presented and can implement them in everyday life and explore the potential that exists within themselves to the fullest. Learning activities for early childhood that contain many elements of art also support STEAM to be applied in all conditions. STEAM brings together artistic and scientific creativity in a reformulated contract between science, art, environment and society, to work towards potentially competing goals (Burnard & Colucci-gray, 2021).

Based on the data obtained, educators still do not fully understand the concept of STEAM, especially the concepts of Science, Engineering, and Mathematics. On the concept of science, 36.2% of the participants did not understand that science is knowledge obtained systematically through observation, study, and experiment (Djamarah, 2000). In the concept of Engineering, 47.2% of educators did not understand that engineering begins with identifying a problem, then trying to solve that problem (Lestari et al., 2020). On the concept of mathematics, as many as 31.6% of educators did not know that the concept of mathematics in early childhood includes classification, serialization, calculation, measurement, geometry, chart, and arithmetic (Syafri, 2018).

Conclusion

Based on the results and discussion, it can be concluded that the implementation of STEAM-based multisensory model training for strengthening teacher competence at *IGRA* Dukun District is effective with an average score of 82.3% of trainees. The material that was most mastered by participants was multisensory material, while the material that was less mastered by participants was STEAM material in early childhood education. From the results of the discussion, early childhood educators need to be given many examples of STEAM-based learning practices to enrich knowledge about STEAM-based learning in early childhood education institutions.

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