

Viruses and STEAM: How to Introduce Preventing Disease Transmission in Children through STEAM-Based Learning Methods?

Syarfina^{1✉}, Aina Yasmin², Mohammad Fauziddin³

Pendidikan Islam Anak Usia Dini, Institut Agama Islam Negeri Langsa, Langsa, Aceh, Indonesia⁽¹⁾

Pendidikan Anak Usia Dini, Albukhary International University, Kepala Batas, Pulau Pinang, Malaysia⁽²⁾

Pendidikan Guru-Pendidikan Anak Usia dini, Universitas Pahlawan Tuanku Tambusai, Indonesia⁽³⁾

DOI: [10.31004/aulad.v5i2.372](https://doi.org/10.31004/aulad.v5i2.372)

✉ Corresponding author:
[syarfina@iainlangsa.ac.id]

Article Info

Abstract

Keywords:
Preventing Disease Transmission;
Virus;
STEAM;
Early childhood

An introduction to preventing the transmission of diseases is not only essential during a pandemic because viruses are the closest part of the children. However, this is not easy to teach in early childhood, which is in a substantial period; interesting methods are needed and accepted by children's logic. This study aimed to describe the process of introducing ways to prevent disease transmission in children through learning methods based on Science, Technology, Engineering, Art, and Mathematics (STEAM). This qualitative research method was presented with a descriptive approach. Informants in this study were teachers who teach children aged 5-6 years at TPA Gampong Daulat, Langsa, Aceh. Researchers collected data through observation techniques. The data were analyzed in three stages: data reduction, data presentation and conclusion drawing. The results showed that the STEAM-based learning method was integrated into the concept and practice of health protocols. Ways of transmitting diseases caused by viruses in the form of washing hands, wearing masks, and keeping a distance taught based on the STEAM method make children actively involved and think logically and critically. The effectiveness of the STEAM-based learning method in teaching other aspects of health can be studied further.

1. INTRODUCTION

Early childhood is classified as vulnerable to contracting diseases (Nwachuku & Gerba, 2006; Ufiyah Ramlah, 2021), either because of their body immunity, activities in the family, environmental conditions, knowledge, or compliance with health protocols (Cianetti et al., 2020). Infection is one of the causes of children getting sick quickly. Infectious diseases related to viruses and bacteria are among the most critical health problems in developing countries, including Indonesia (Mutsaqof et al., 2016). Diseases caused by viruses and bacteria often occur in children, such as flu, cough, diarrhea, tuberculosis, typhoid, and skin diseases (Jauhari, 2020). This study discusses introducing ways to prevent the transmission of diseases caused by viruses.

In Indonesia, the government recommends implementing health protocols to prevent virus transmission by washing hands, using masks, and maintaining distance, known as 3M. Since the pandemic, counselling for early childhood has also been carried out to prevent children from contracting the coronavirus. The program aims to achieve the realization of health development and improve the quality of human resources in Indonesia (Jauhari, 2020) because healthy children are assets to building a strong country. The entire community is taking precautions to protect themselves, their families and communities from COVID-19.

However, introducing ways to prevent the transmission of diseases caused by viruses is not only important during a pandemic because viruses are invisible microorganisms around us, including those closest to children (Vanneste et al., 2022). Children must continue to learn how to prevent disease transmission to ensure children are more alert, love cleanliness more, and form the character of children who care about their health. Making children care about health and hygiene can ensure the survival of children, especially efforts to reduce the number of early childhood affected by the disease, as well as ensure the maximum growth and development of children (Soediono, 2014). Moreover, early childhood is the proper phase for planting children's character (Khaironi, 2017).

Teaching young children how to prevent disease transmission has challenges because early childhood is a concrete era (Piaget, 1965). Pre-school institutions and teachers play an essential role in this regard. Teachers should create a program appropriate for early childhood development (Aisyah et al., 2021; Hidayat & Nur, 2018). Preschool teachers are required to create exciting and fun learning methods to build children's readiness to go to school in the dimension of physical well-being (Fridani & Agbenyega, 2013). Physical well-being, including health status (High, 2018), also part of the prevention of diseases caused by viruses.

Meanwhile, the observations show that learning related to preventing disease transmission in early childhood is still not the core of learning in early childhood. Teachers' understanding of the health dimension is also not comprehensive in building children's school readiness (Syarfina et al., 2018). The activity of washing hands becomes a habit before and after eating, but it is not introduced in more detail the effect of washing hands on the process of transmitting disease. Children wash their hands inappropriately and with water that does not flow (Hasanah & Mahardika, 2020). In addition, most children have inappropriate habits when sneezing and coughing. They do not know how to cover their hands or elbows when they sneeze and cough, so they can transmit the disease to their friends through droplets droplet (Kurniawaty, 2021). In every academic year of early childhood education institutions, almost children have been unable to attend the teaching and learning process for several days or weeks because of illness with symptoms that are often felt, including stomach pain, runny nose, fever and cough (Takaeb et al., 2019).

Introducing ways to prevent the transmission of diseases caused by viruses can be done, one of which is through learning methods based on science, technology, engineering, art and mathematics (STEAM). The STEAM-based learning method is one of the rapidly growing learning methods today because it contains four main elements of Learning and Innovation skills that children must possess: creativity, criticality, communication, and collaboration (Peppler, 2017). STEAM is a learning method that utilizes science, technology, engineering, art and mathematics in an integrated manner that is student-centered and has been developed in various countries from preschool to post-doctoral levels, both formal and informal education (Gonzalez & Kuenzi, 2014). STEAM education has been recognized in the United States as an educational reform described as an instructional approach to preparing children for the global economy of this century (Yakman & Lee, 2012).

STEAM learning for health education can be integrated into the 2013 PAUD curriculum with an integrative thematic and scientific approach. This learning method is close to the child, and the material raised follows everyday life (Asmar & Hasnawati, 2019), such as developing children's critical thinking regarding preventing disease transmission, elaborating open-ended questions, and practicing it daily. STEAM is also used to understand the integrated nature of several disciplines, including health, long-term academic success, economic well-being (Herro & Quigley, 2016), and community development (Siregar et al., 2019).

Research on the implementation of STEAM learning methods in early childhood has been widely carried out, such as the implementation of STEAM in increasing children's independence (Amalia et al., 2021; Septiani & Kasih, 2021). Through the steam method, children learn to be independent in their ways and desires, where they can explore themselves in various situations; for example, they wear their shoes and clothes. In addition, applying the STEAM method in learning can increase children's creativity, characterized by the ability to solve problems and connect with the surrounding environment (Wahyuningsih et al., 2020). STEAM was also implemented in developing early childhood cooperative attitude based on project learning (Harjanty & Muzdalifah, 2022), and children encounter outstanding social development (Tabiin, 2020). However, the rate of implementation by the teachers was initially limited (EL-Deghaidy et al., 2017), and there has been no research on implementing the STEAM method to prevent disease transmission in early childhood. Therefore, this study aims to describe the process of introducing ways to prevent the transmission of diseases caused by viruses through the STEAM learning method in children aged 5-6 years.

2. METHODS

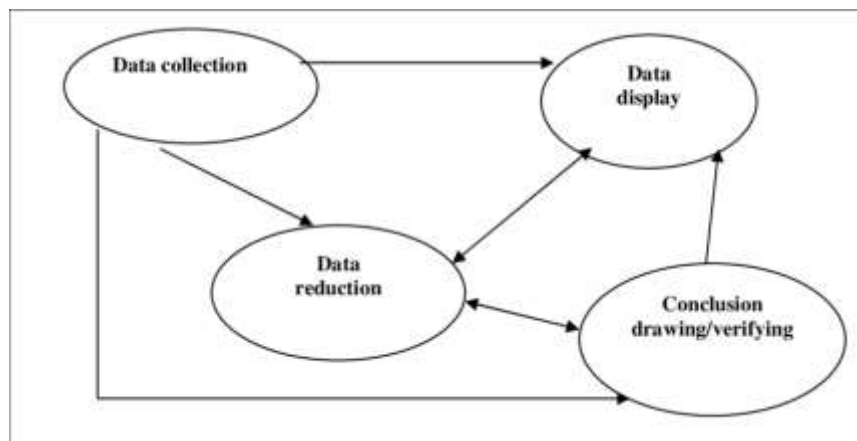
This study uses a qualitative method with a descriptive approach. Informants in this study are teachers who teach children aged 5-6 years in TPQ Gampong Daulat, Langsa, Aceh. The researchers chose the two participants based on the purpose of the sample, which was to see how the STEAM learning method had been applied. Of the ten teachers, only two introduced their students to the prevention of disease transmission, so the researchers made the two teachers as informants. Researchers collect data through observation techniques. Observations were made during the teaching and learning process by using observation sheets. Researchers recorded the STEAM learning method applied when introducing disease prevention methods. Table 1 is an observation sheet.

Table I. Observation Sheet for the Implementation of the STEAM Method

STEAM	Indicator
Science	The child's ability to use simple scientific knowledge, the process of understanding the natural environment, and the ability to participate in decision making.
Technology	The child's knowledge of using new technology can be analysed according to the development level.
Engineering	The child's understanding of how technology can be developed through a design process. In this case, simple engineering that the child does understand simple tools.
Art	The child's understanding of art.
Math	The child's mathematical knowledge of concepts of numbers, patterns and relationships, geometry and space, classifying and grouping, measurement, and statistics (data display).

The results of observations in the form of field notes on scenarios of STEAM learning activities; science, technology, engineering, art, and mathematics and the results of interviews for supporting data were analyzed through three stages: data reduction, data presentation and conclusion drawing/verification.

At the data reduction stage, the researcher sorts some data to focus/simplify the most important things in the STEAM learning method stage to provide convenience in appearance, presentation and conclusion. Furthermore, the data is presented in a particular form to look clear and under similar categories to be displayed in harmony with the problems faced. Finally, conclusion drawing/data verification is carried out continuously throughout the research process.

**Figure 1. Miles and Huberman Model Data Analysis**

3. RESULT AND DISCUSSION

After analyzing the data, it was found that several themes became the highlight of STEAM learning in preventing disease transmission. The integration of STEAM with health is focused on recommendations for following the health protocol; washing hands, wearing masks, and physical distance. Socialization to follow health protocols in preventing the transmission of diseases caused by viruses in the form of washing hands, wearing masks, and physical distance has been carried out. One of the efforts to prevent virus transmission in early childhood is through health education programs at early childhood education institutions; by introducing the characteristics of viruses, the ability of viruses to transmit disease, and how to prevent them (Bangun et al., 2022). However, during counseling, children only listen, and there is no evaluation of the extent to which children understand the prevention method. The direct non-involvement of children results in not forming curiosity and enthusiasm in children in applying them in everyday life.

In the end, children must constantly be reminded to wash their hands, wear masks, and keep their distance daily; not even a few are reluctant. After the new normal occurred, some children asked permission not to attend the TPA because of illness, so the development of their Quran skills was hampered. It makes teachers try to find other more exciting methods in introducing ways to prevent disease transmission, especially those caused by viruses. Teachers who teach the age group of 5-6 years then apply the STEAM-based learning method. STEAM learning content has an impact on early childhood, one of which is increasing children's interest and understanding of technology and the ability to solve problems in the real world (Mulyani, 2019). In this case, the children are invited to solve problems related to disease transmission. Contents of learning science, technology, engineering, arts, and mathematics that are well integrated have the opportunity to create programs to prevent disease transmission through concepts and practices. Therefore, the results show that learning to prevent disease transmission according to the health protocol in the form of washing hands, wearing masks, and maintaining distance are taught based on STEAM.

STEAM Integration in Introducing Preventing Disease Transmission in Early Childhood

The learning stages of the introduction of ways to prevent disease transmission in children begin with the introduction of the virus. The teacher shows pictures of the forms of viruses, explains their habitats, and how they reproduce. In a simple video, the teacher shows what diseases are caused by viruses. This is included in the content of **science** as studies events that occur in nature. Viruses in this case are included in life science, living things. Life science introduces kids to a wide range of concepts including genetics, cell biology, viruses and bacteria, organisms, ecology, energy, survival and much more (Cabe-Trundle & Sackes, 2015).

The teacher exemplifies the process of transmitting the virus through children's daily activities, for example, shaking hands, eating, sharing utensils, sneezing, coughing, and so on, according to the child's experience. Science learning provides children with opportunities to gain learning experiences through observing, asking questions, gathering information, reasoning and communicating (Permendikbud No. 18A of 2013). The science learning process is designed so that students actively connect concepts through the stages of observing. The children then conclude the dangers of the virus and the importance of maintaining cleanliness to avoid transmission. Observation activities in the early childhood learning process show children's curiosity, sincerity and thoroughness about viruses.

Furthermore, children are invited to think critically about how to avoid the transmission of diseases caused by viruses. Through science, children are expected to be able to solve problems in daily activities (Perignat & Katz-Buonincontro, 2019), and make connections with the surrounding environment (S. Wahyuningsih et al., 2020). If the virus is on your hands, then the way to avoid transmission is to wash your hands properly and eat clean soap. If the virus lodges in the nose or mouth when sick, then the way to avoid transmission is to wear a mask. If the virus is around us without knowing from whom and where then the way to avoid transmission is to keep a distance or avoid crowds of people.

Children have introduced the tools and materials needed in terms of preventing the transmission of diseases caused by viruses, for example, tools and materials needed for washing hands, tools and materials for making hand sanitizers, as well as tools and materials for making masks, both those around the child or those around the child. It does not yet exist so that children indirectly learn the content of **technology** learning. In early childhood learning, technology refers to using the equipment and developing gross and fine motor skills (Sa'adah, 2020). The learning revolution developed by utilizing technology has proven to give birth to many conveniences, helps teachers and students, shortens time, and produces various other benefits. STEAM contains scientific technology-based learning and the ability to solve problems in the real world (Kofac, 2017). Learning that emphasizes technology also intends to provide understanding to students in understanding various materials using a scientific approach, that information can come from anywhere, not depending on direct information by the teacher. Therefore, learning conditions encourage students to find out from various sources.

The teacher invites the children one by one to wash their hands using a technique according to the World Health Organization (WHO) standards. One of the diseases in children can be prevented by diligently washing hands because washing hands can reduce the risk of the transfer of viruses and bacteria through children's hands. If children rarely wash their hands, the transfer of viruses or bacteria can trigger infection (Jauhari, 2020). However, children also need to know that in addition to soap, hand washing can also use hand sanitizer. However, using hand sanitizers is not justified if the hands have germs that are very dirty and difficult to clean, so a source of clean running water is still needed. The principles of the six steps of hand washing that children practice include: (1) pour soap, or liquid hand rub on the palms, then wipe and rub the palms gently in a circular direction, (2) wipe and rub the backs of both hands alternately, (3) rub between the fingers until clean, (4) clean the fingertips alternately with interlocking positions, (5) rub and rotate the thumbs alternately, (6) place the fingertips into the palms of the hands then rub gently. Finally, rinse with clean running water.

In addition to learning the STEAM content in hand washing **techniques**, the children also learned the procedure for merely making hand sanitizers. Suppose in technology; children learn simple technology such as scissors and needles in sewing masks, faucets and carpentry tools to make water flow for washing hands, coloured pencils and rulers to measure distance, then in the Engineering section. In that case, children think about how to design something they want to be resolved.

Furthermore, children enter into art-filled learning that can be integrated into every learning content. In this section, children are invited to color pictures of viruses and make viral collages from loose parts. Loose parts media is a natural material-based media because it comes from the environment and is deliberately processed and used to support learning activities (Oktari, 2017). Natural materials such as stone, wood, twigs, seeds, and dry leaves, are considered safe, easy to obtain, and minimal in cost. Loose Part stress in freedom to explore, solve, and think so that the children can have space to think, evaluate, and determine the best way to achieve their goals and complete the project (Muntomimah & Wijayanti, 2021). STEAM-based learning using loose parts increased the 4c children's ability (Prameswari & Anik Lestarinigrum, 2020). Art learning involves more motor skills to produce a work. The children's works are pictures of a virus that has been colored with crayons, pictures of the process of transmitting a virus made by the teacher and then plastered with loose parts on it, and masks designed according to the child's imagination.

Finally, the content of learning mathematics is separated into several activities according to early mathematical concepts for early childhood by providing worksheets. The first activity, count the number of viruses in toys. In this activity, the teacher provides worksheets in the form of pictures of toys and viruses scattered in a circle (Figure 2). Then, the teacher asked the children to count the number of viruses. The child then writes the number on the sheet.



Figure 2. Children's Worksheet to Calculate the Number of Viruses

Another day, the teacher distributed worksheets containing pictures of how to wash hands (Figure 3). Children are invited to order the correct way to wash their hands and write the numbers in the boxes provided. In other activities, children learn the concept of choosing and classifying from pictures of nutritious foods like vegetables and fruit (Figure 4). The teacher provides fruit and vegetable boards to display children's classification results.



Figure 3. Children's Worksheet for the sequence of hand washing steps

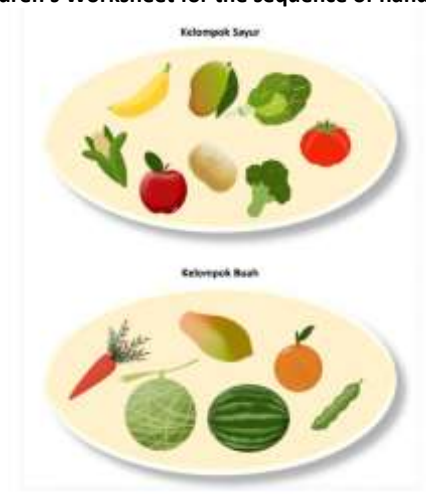


Figure 4. Classifying the fruit and vegetable

Next, the children together calculate the safe distance to greet friends who are sick using the room's tiled floor box. Measurements are also made with tape and shoes. Measurement is one of the mathematical abilities used by children to determine the size of an object or distance compared to similar objects. To become mathematical thinkers, they need to be allowed to organize concrete objects before they can use symbols they know abstractly (Charlesworth & Lind, 2013). Mathematical concepts are easier to understand when mathematics is a part of children's daily activities. Early childhood mathematical concepts are classified into 6, namely the concept of numbers, the concept of patterns and relationships, the concept of geometry and space, the concept of selecting and grouping, the concept of measurement, and statistics (data display) (McGuire et al., 2020; Mononen et al., 2014). Effective practice does not limit mathematics to one particular time. In contrast, early childhood teachers help children develop mathematical knowledge throughout the day so that children can investigate mathematics through many types of hands-on experiences (Wortham, 2005), including their knowledge of the prevention of disease transmission.

When learning occurs, children look enthusiastic and happy and feel involved in the prevention process. The STEAM learning method makes them find out how to solve problems. Questions that arise from children are also very critical. Children's creativity also emerged from the learning, not only in terms of the character of caring for health and hygiene but also creativity from each activity related to the introduction of ways to prevent disease transmission. In line with the results of research from (Hapidin et al., 2020; L & Krogh, 2020) that the STEAM learning method can make children curious, excited, and thirsty to learn. Children can solve problems in daily activities (Schmitt et al., 2018) and connect with the surrounding environment (S. Wahyuningsih et al., 2020). . In addition, it is hoped that the attitude of children who care about the environment is formed, the attitude of maintaining the health of themselves and others, personal hygiene, and cleanliness of the immediate environment such as toys, clothes, food, beds, and the like.

The limitation of this study is that it does not reveal the teacher's obstacles in implementing the STEAM learning method in introducing ways to prevent the transmission of this disease. Of course, teachers need more time and media in preparation, teaching, and facilities from the Institute. Is everything fulfilled? However, in overall observations, the researchers saw that in applying the STEAM learning method, children recognized the virus "concretely." By knowing the transmission mode, children think about how to prevent the transmission of diseases caused by viruses.

4. CONCLUSION

When the most crucial phase of the pandemic ends, everything will not return immediately to as it was before. It will be necessary to stay in health protocols for preventing children from disease transmission caused by viruses that might be useful for another as yet undefined time in the future. in early childhood. The content of learning science, technology, engineering, art, and mathematics that is integrated in a structured way creates engaging activities in preventing disease transmission through concepts and practices according to health protocols in the form of washing hands, wearing masks, and taking care. By knowing how to prevent disease transmission, it is hoped that the attitude of children who care about the health of themselves and others, personal hygiene, and the surrounding environment will be formed.

5. REFERENCES

- Aisyah, Salehudin, M., Yaton, S., Yani, Komariah, D. L., Aminda, N. E. R., Hidayati, P., & Latifah, N. (2021). Persepsi orang tua dalam pendidikan karakter anak usia dini pada pembelajaran online di masa pandemi covid-19. *PEDAGOGI: Jurnal Anak Usia Dini Dan Pendidikan Anak Usia Dini*, 7(1), 60–75. <https://doi.org/10.30651/pedagogi.v7i1>
- Amalia, D., Sutarto, J., & Sugiyo Pranoto, Y. K. (2021). Pengaruh Pembelajaran Jarak Jauh Bermuatan STEAM Terhadap Karakter Kreatif dan Kemandirian. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 6(3), 1233–1246. <https://doi.org/10.31004/obsesi.v6i3.1765>
- Asmar, S., & Hasnawati. (2019). *Model Pembelajaran STEAM dengan Pendekatan Saintifik* (Makassar: PT Rosdakarya, 2019). Makassar: Rosdakarya.
- Bangun, H. A., Sitanggang, T., Manurung, K., Masyarakat, S. K., Sari, U., Indonesia, M., Hukum, S., Sari, U., Indonesia, M., Keperawatan, P. S., Sari, U., & Indonesia, M. (2022). *Edukasi Cuci Tangan Pakai Sabun Di Era Pandemi Covid-19 Di SMAN 19 Kota Medan 1 Program*. 3(1), 84–93.
- Cabe-Trundle, K., & Sackes, M. (2015). *Research in Early Childhood Science Cabe Trundle and Sackes*.
- Charlesworth, R., & Lind, K. K. (2013). *Math & Science for Young Children* (7th ed.). Wadsworth Cengage Learning.
- Cianetti, S., Pagano, S., Nardone, M., & Lombardo, G. (2020). Model for Taking Care of Patients with Early Childhood Caries during the SARS-Cov-2 Pandemic. *International Journal of Environmental Research and Public Health*, 388, 539–547.
- EL-Deghaidy, H., Mansour, N., Alzaghibi, M., & Alhammad, K. (2017). Context of STEM integration in schools: Views from in-service science teachers. *Eurasia Journal of Mathematics, Science and Technology Education*, 13(6), 2459–2484. <https://doi.org/10.12973/EURASIA.2017.01235A>

- Fridani, L., & Agbenyega, J. S. (2013). *Rethinking school readiness and transition policy and practice in early childhood education (ECE): a whole schooling framework* (pp. 121–153). Analytrics. <https://research.monash.edu/en/publications/rethinking-school-readiness-and-transition-policy-and-practice-in>
- Gonzalez, H. B., & Kuenzi, J. J. (2014). Science, technology, engineering, and mathematics (STEM) education: A primer. *Attrition in Science, Technology, Engineering, and Mathematics (STEM) Education: Data and Analysis*, 97–142.
- Hapidin, Gunarti, W., Pujiarti, Y., & Siti Syarah, E. (2020). STEAM to R-SLAMET Modification: An Integrative Thematic Play Based Learning with R-SLAMETS Content in Early Childhood Education. *JPUD - Jurnal Pendidikan Usia Dini*, 14(2), 262–274. <https://doi.org/10.21009/jpud.142.05>
- Harjanty, R., & Muzdalifah, F. (2022). Implementation of STEAM project-based learning in developing early childhood cooperation. *Atfaluna: Journal of Islamic Early Childhood Education*, 5(1), 47–56.
- Hasanah, U., & Mahardika, D. R. (2020). Edukasi Prilaku Cuci Tangan Pakai Sabun pada Anak Usia Dini untuk Pencegahan Transmisi Penyakit. *Jurnal Seminar Nasional Pengabdian Masyarakat LPPM UMJ*, 1–9.
- Herro, D., & Quigley, C. (2016). Innovating with STEAM in middle school classrooms: remixing education. *On the Horizon*, 24(3), 190–204. <https://doi.org/10.1108/OTH-03-2016-0008>
- Hidayat, S., & Nur, L. (2018). Nilai Karakter, Berpikir Kritis Dan Psikomotorik Anak Usia Dini. *JIV-Jurnal Ilmiah Visi*, 13(1), 29–35. <https://doi.org/10.21009/jiv.1301.4>
- High, P. C. (2018). School Readiness: Technical Report. *American Academy of Pediatrics*. <https://doi.org/10.1542/peds.2008-0079>
- Jauhari. (2020). Jurnal Buah Hati. *Jurnal Buah Hati*, 7(2), 125–137.
- Khaironi, M. (2017). Pendidikan Karakter Anak Usia Dini. *Jurnal Golden Age*, 1(02), 82. <https://doi.org/10.29408/goldenage.v1i02.546>
- Kurniawaty, Y. (2021). *E-DIMAS*. 12(4), 741–746.
- L, S., & Krogh, P. M. (2020). *The Early Childhood Curriculum Inquiry Learning Through Integration*. Routledge.
- McGuire, P., Himot, B., Clayton, G., Yoo, M., & Logue, M. E. (2020). Booked on Math-Developing Math Concepts in Pre-K Classrooms.pdf. *Early Childhood Education Journal*.
- Mononen, R., Aunio, P., & Koponen, T. (2014). Investigating RightStart Mathematics Kindergarten Instruction in Finland. *Journal of Early Childhood Education Research*, 3(1), 02–26.
- Mulyani, T. (2019). Pendekatan Pembelajaran STEM untuk menghadapi Revolusi. *Seminar Nasional Pascasarjana 2019*, 7(1), 455.
- Muntomimah, S., & Wijayanti, R. (2021). The Importance of STEAM Loose Part Learning Effectiveness in Early Childhood Cognitive Learning. *Proceedings of the 2nd Annual Conference on Social Science and Humanities (ANCOSH 2020)*, 542(Ancosh 2020), 47–52. <https://doi.org/10.2991/assehr.k.210413.012>
- Mutsaqof, N., Aniq, A., Wiharto, & Suryani, E. (2016). Sistem Pakar Untuk Mendiagnosis Penyakit Infeksi Menggunakan Forward Chaining. *Jurnal Teknologi & Informasi ITSmart*, 4(1), 43. <https://doi.org/10.20961/its.v4i1.1758>
- Nwachuku, N., & Gerba, C. P. (2006). Health risks of enteric viral infections in children. *Reviews of Environmental Contamination and Toxicology*, 186, 1–56. https://doi.org/10.1007/0-387-32883-1_1
- Oktari, V. M. (2017). Penggunaan Media Bahan Alam Dalam Pembelajaran Di Taman Kanak-Kanak Kartika I-63 Padang. *PAUD Lectura: Jurnal Pendidikan Anak Usia Dini, Vol 1 No 1 (2017): Paud Lectura*, 49–57.
- Peppler, K. (2017). 21st-Century Skills. *The SAGE Encyclopedia of Out-of-School Learning*. <https://doi.org/10.4135/9781483385198.n301>
- Piaget, J. (1965). *The stages of the intellectual development of the child*. In B.A. Marlowe & A.S. Canestrari's (Eds), *Educational Thousand Oaks*. (psychology). Sage.
- Prameswari, T., & Anik Lestarinigrum. (2020). Strategi Pembelajaran Berbasis STEAM Dengan Bermain Loose Parts Untuk Pencapaian Keterampilan 4c Pada Anak Usia 4-5 Tahun. *Efektor*, 7(1), 24–34. <https://doi.org/10.29407/e.v7i2.14387>
- Sa'adah, N. (2020). Penerapan Pembelajaran Steam Untuk Meningkatkan Konsentrasi Anak Hiperaktif Melalui Permainan Magic Puffer Ball Di Tk Talenta Semarang. *Skripsi Universitas Islam Negeri Walisongo*.
- Schmitt, S. A., Lewis, K. M., Duncan, R. J., Korucu, I., & Napoli, A. R. (2018). The Effects of Positive Action on Preschoolers' Social-Emotional Competence and Health Behaviors. *Early Childhood Education Journal*, 46(1), 141–151. <https://doi.org/10.1007/s10643-017-0851-0>
- Septiani, I., & Kasih, D. (2021). Implementasi Metode STEAM Terhadap Kemandirian Anak Usia 5-6 Tahun di Paud Alpha Omega School. *Jurnal Jendela Pendidikan*, 01(November), 192–199.
- Siregar, N. C., Rosli, R., Maat, S. M., & Capraro, M. M. (2019). The Effect of Science, Technology, Engineering and Mathematics (STEM) Program on Students' Achievement in Mathematics: A Meta-Analysis. *International Electronic Journal of Mathematics Education*, 1(1). <https://doi.org/10.29333/iejme/5885>
- Soediono, B. (2014). Kondisi Pencapaian Program Kesehatan Anak Indonesia, KEMENKES RI Pusat data dan Informasi. In *Journal of Chemical Information and Modeling* (Vol. 53, p. 160).

- Syarfina, S., Yetti, E., & Fridani, L. (2018). Pemahaman Guru Prasekolah Raudhatul Athfal Tentang Kesiapan Sekolah Anak. *Jurnal Pendidikan Usia Dini*, 12(1), 153–163. <https://doi.org/10.21009//JPUD.121.13>
- Tabiin, A. (2020). Implementation of STEAM Method (Science, Technology, Engineering, Arts And Mathematics) for Early Childhood Developing in Kindergarten Mutiara Paradise Pekalongan. *Early Childhood Research Journal (ECRJ)*, 2(2), 36–49. <https://doi.org/10.23917/ecrj.v2i2.9903>
- Takaeb, L., Elisabeth, A., Ndun, H. N. J., & Ndoen, E. M. (2019). Upaya Integrasi Pencegahan Penyakit Menular Pada Anak Usia Dini. *GEMASSIKA: Jurnal Pengabdian Kepada Masyarakat*, 3(2), 151. <https://doi.org/10.30787/gemassika.v3i2.417>
- Ufiyah Ramlah. (2021). Gangguan Kesehatan Pada Anak Usia Dini Akibat Kekurangan Gizi Dan Upaya Pencegahannya. *Ana' Bulava: Jurnal Pendidikan Anak*, 2(2), 12–25. <https://doi.org/10.24239/abulava.vol2.iss2.40>
- Vanneste, Y. T. M., Lanting, C. I., & Detmar, S. B. (2022). The Preventive Child and Youth Healthcare Service in the Netherlands_ The State of the Art and Challenges Ahead _ Enhanced Reader.pdf. *International Journal of Environmental Research and Public Health*.
- Wahyuningsih, S., Nurjanah, N. E., Rasmani, U. E. E., Hafidah, R., Pudyaningtyas, A. ., & Syamsuddin, M. . (2020). STEAM Learning in ECE_ A Literature Review. *International Journal of Pedagogy and Teacher Education (IJPTE)*, 4(1), 33–44.
- Wahyuningsih, Siti, Pudyaningtyas, A. R., Hafidah, R., Syamsuddin, M. M., Nurjanah, N. E., & Rasmani, U. E. E. (2020). Efek Metode STEAM pada Kreatifitas Anak Usia 5-6 Tahun. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 4(1), 295–301. <https://doi.org/10.31004/obsesi.v4i1.305>
- Wortham, S. C. (2005). *Assessment in Early Childhood Education*. Pearson Education.
- Yakman, G., & Lee, H. (2012). Exploring the Exemplary STEAM Education in the U.S. as a Practical Educational Framework for Korea. *Journal of The Korean Association For Science Education*, 32(6), 1072–1086. <https://doi.org/10.14697/jkase.2012.32.6.1072>