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Identifying the Components of STEAM Teaching for Children

Morteza Zarei [1], * Hossein Zeinalipour [2], Abdolvahab Samavi[3]

[1] PhD Student, Department of Educational Sciences, Faculty of Humanities, University of Hormozgan, Bandar Abbas, Iran.

[2] Assistant Professor, Department of Educational Sciences, Faculty of Humanities, University of Hormozgan, Bandar Abbas, Iran.

[3] Associate Professor, Department of Educational Sciences, Faculty of Humanities, University of Hormozgan, Bandar Abbas, Iran.

Abstract

Background: Due to the applications of the Steam approach in teaching and solving the educational problems in basic sciences such as mathematics and science among children, the importance of Steam teaching for children is now more understood. This issue has led to the design and implementation of the present study with the aim of identifying the components of Steam teaching for children.

Methods: The method of the present study was qualitative and analytical and on the basis of the Grounded Theory. The data of the present study was collected in 2020. The sampling method was purposive in which the books and articles related to the Steam-based teaching method were analyzed using Max Kyoda 10 software with three-step coding methods (open, axial and selective).

Results: The results of data analysis showed that the central and recurring category in content analysis of Steam-based teaching is "problem-oriented integration of art with Steam" and means "understanding and applying art in real situations, natural integration of art with the Steam through problem solving. As the main teaching strategy"; and the other extracted coding categories such as causal conditions, contextual conditions, interfering conditions, strategies and outcomes are related to it.

Conclusion: Using the identified components can provide the basis for the development of Steam teaching for children and lead to the creation of desirable operational activities in this area.

Key Words: Grounded Theory, STEAM, Teaching components.

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**** Corresponding Author:***

Hossein Zeinalipour, Assistant Professor, Department of Educational Sciences, Faculty of Humanities, University of Hormozgan, Bandar Abbas, Iran. Email: hzainalipour@yahoo.com

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1- INTRODUCTION

Children, as key assets of any society, must have a desirable level of health (1). The capacities of children in different fields have caused different countries to try to identify talents and cultivate children's talents in different environments, including schools (2). In this regard, different educational methods have been formed and created that are implemented in different environments. One of the most practical training methods is the Steam method (3). The Organization for Economic Co-operation and Development (OECD) has put Steam education on their agenda since 2007 and 2008 to develop students' talents, and has made extensive efforts to develop it. Steam is an educational method that combines the disciplines of science, engineering, technology and mathematics and incorporates them into its curriculum according to the relationship they have with each other; but it must be noted that the challenges faced by future generations require creative solutions, and Steam alone cannot pass this ability on to the new generation. Of course, science, technology, engineering, and math are among the coral subjects of knowledge, and important aspects of many jobs, but they focus only on the capabilities of the left side of the brain, or the analytical part of children's brains. Attention to the features of the right side of the brain has led to the addition of art to the Steam framework in recent years (4).

In 2012, the idea of teaching Steam to start *innovative schools* began in the United States and several countries around the world. The letter "A" in Steam means the presentation of the arts and humanities to the learners, as well as using them in teaching, with the aim of increasing children's participation in the Steam field by trying to adapt educational services at primary and university levels to the needs of the future work force for improving the countries' economy. The acronym Steam is relatively new and is attributed to Yakman (2008); He discovered how to understand the principles of mathematics and science through art. He sought to prevent the segregation of the strings and to develop a valid integrated approach with the inclusion of the arts. Steam advocates the belief that combining art is essential for the growth of children's creativity, and in addition prevents math and science from being unrelated to the real demands and needs of the world (5).

Steam's approach in elementary schools typically focuses on the presentation of arts and technologies, such as the use of robots to teach programming or coding that are integrated with the experimental science curricula or focus on engineering activities (6).

Yakman (2008) argues that "Steam is an evolving educational paradigm that examines how academic disciplines, including science, technology, engineering, the arts, and mathematics, are organized in a framework with an integrated curriculum approach" (7). Yakman's research led to the identification of the Steam Framework for Functional Literacy, in which children are able to think in different dimensions of the subject and make connections between multiple disciplines. He argues that "Steam helps children better understand the concepts rooted in other disciplines, perspectives and cultures, so they can collaborate and work together while maintaining their identity" (8).

Steam fans believe this is a fair way to engage and prepare children for 21st century skills and careers. Steam is a fair approach because it also addresses issues that children are interested in (9). Steam also includes learning methods to help children enjoy exploring and designing solutions, such as drawing, computer graphics, performing arts, creative

thinking, and even fun problem solving (10).

The functions of the Steam teaching method on students' perceptions (11), learning (12), problem solving (13) and job orientation (14) have been studied and proved. Nevertheless, the research gap in the development of Steam method education is well understood. Considering the applications of the Steam approach in teaching and helping to solve the educational problems of basic sciences among children, in this research we performed the content analysis of the books and articles related to Steam, to identify the components of Steam-based teaching in Children.

The use of the Steam-based educational approach in teaching basic sciences, especially mathematics and experimental sciences, can increase creativity in children and reduce problems, such as the memory-based learning in science and mathematics. The issue of inapplicability of what has been learned is another educational problem that can be solved by applying the Steam-based approach in teaching. Also, the connection of different aspects of Steam education and humanities and the integration of disciplines in a proper way are other advantages of using the Steam approach. Paying attention to the living environment in education and to the concerns of children and the local community increases the interest in learning scientific concepts and can help solve life problems.

However, the evidence shows that the science curriculum in many countries, including Iran, has not been able to cultivate the spirit of science and exploration, creativity and thinking skills in students. The data provided by the Trends in International Mathematics and Science Study (TIMSS) shows that Iranian elementary science curricula have many weaknesses and our children must be strengthened in hypothesis making, data analysis, problem solving, the use of scientific tools and methods, and conducting environmental research (15).

In our schools and educational centers, art education is not very important and does not have a proper place in the school curriculum, i.e. it has been pushed to the margins of the educational system and has been neglected in the curriculum (16). One of the issues challenging the educational and curriculum planners is how to establish a relationship between art and the other parts of the school curricula, so that it can provide the students with the relevant knowledge and the capability to apply it (17). With this in mind, the main purpose of the present study was to identify the components of Steam teaching for children and to propose a model for the development of it.

2- MATERIALS AND METHODS

The present study is qualitative research that tries to identify the components of Steam teaching for children with an exploratory approach. Internet resources, books, dissertations and Persian scientific databases and authoritative English scientific databases were used for data collection. Searches were done through the following websites: Google Scholar, Proquest, Amazon,. And the website of The United Nations Educational, Scientific and Cultural Organization (UNESCO); based on the keywords of Steam, Teaching methods, Interdisciplinary education, Steam-based lesson plan. A total of 500 English articles and 12 books on Steam education were reviewed and 10 books were used for analyzing the extracted data and concepts as well as identifying the components of Steam-based teaching. Three-step coding methods (open, axial, selective) of Strauss and Corbin Foundation (1992) were used to encode the texts.

In the present study, a systematic design is used. In the systematic method of Strauss

and Corben (1992), the researcher uses a paradigm model to produce a theoretical framework. In this method, they emphasize the three stages of open, axial and selective coding (Bazargan, 1394: 43).

The data collection tool included a receipt that was executed in the field. This was done by the research team by examining the theoretical foundations in this field in the period from 2010 to 2020.

2-1. Inclusion and Exclusion criteria

The criterion for a research study into the analysis section is the focus of the resource on the field of Steam education; and on the group of children; and the articles not focusing on the Steam method and covering other age groups were excluded.

2-2. Data analysis

Data analysis was performed using Max Kyoda 10 software and led to the identification of components of Steam-based teaching. In order to calculate the validity of the coding, the method of intra-subject agreement with the participation of 3 coders was used, reaching the Coding agreement rate of 0.80.

3- Results

After the analyses, 6 main themes including causal conditions, contextual conditions, interfering conditions, Pivotal phenomenon, strategies and outcomes were identified. The results of the analysis are presented as follows in the form of open and axial coding, subcategories and major categories.

The results of open and axial coding analyses, including subcategories and major categories, indicate that the Pivotal phenomenon of Steam-based teaching is "problem-oriented integration of art with Steam", which includes the categories of "understanding and applying art in real situations, the natural integration of art with other disciplines, and the integration of art in the steam as the basis of learning".

"Problem-oriented integration of art with Steam" means "the understanding and applying art in real situations, and the natural integration of art with Steam through problem solving as the main teaching strategy."

The results of open and centralized coding analyzes, including the subcategories and major categories, further indicate that the interfering categories of Steam-based teaching include "Difficulties in the design and implementation of valid assignments and projects, Supports of the benefactor stakeholders in teaching, difficulty of establishing a relationship with society and life through teaching, difficulties in applying the cognitive and neurological in Steam teaching".

The Contextual conditions affecting the Steam-based teaching include "the existence of different definitions in relation to Steam, the facilitative role of teacher, attention to the compliance of the scientific projects with standards, temporal and spatial problems in the teaching performance."

Causal conditions of Steam-based teaching include the categories of "creating fun and excitement in the classroom by using games, teaching the application of science and math concepts in Professional skills, promoting the creative skills for the Labor market, paying attention to the needs of students in the teaching design".

The category of *action and interaction* of Steam-based teaching includes "using literature in learning, using technological equipment in education, scenario design based on the real problems, project-based teaching and learning, participatory teaching, using valid evaluations."

The category of Steam-based teaching outcomes consists of "creating opportunities for the cultural and social developments of the citizens, paying attention to culture and the lived experiences in evaluation, developing the

skills required for independent learning, and understanding the importance of art in life."

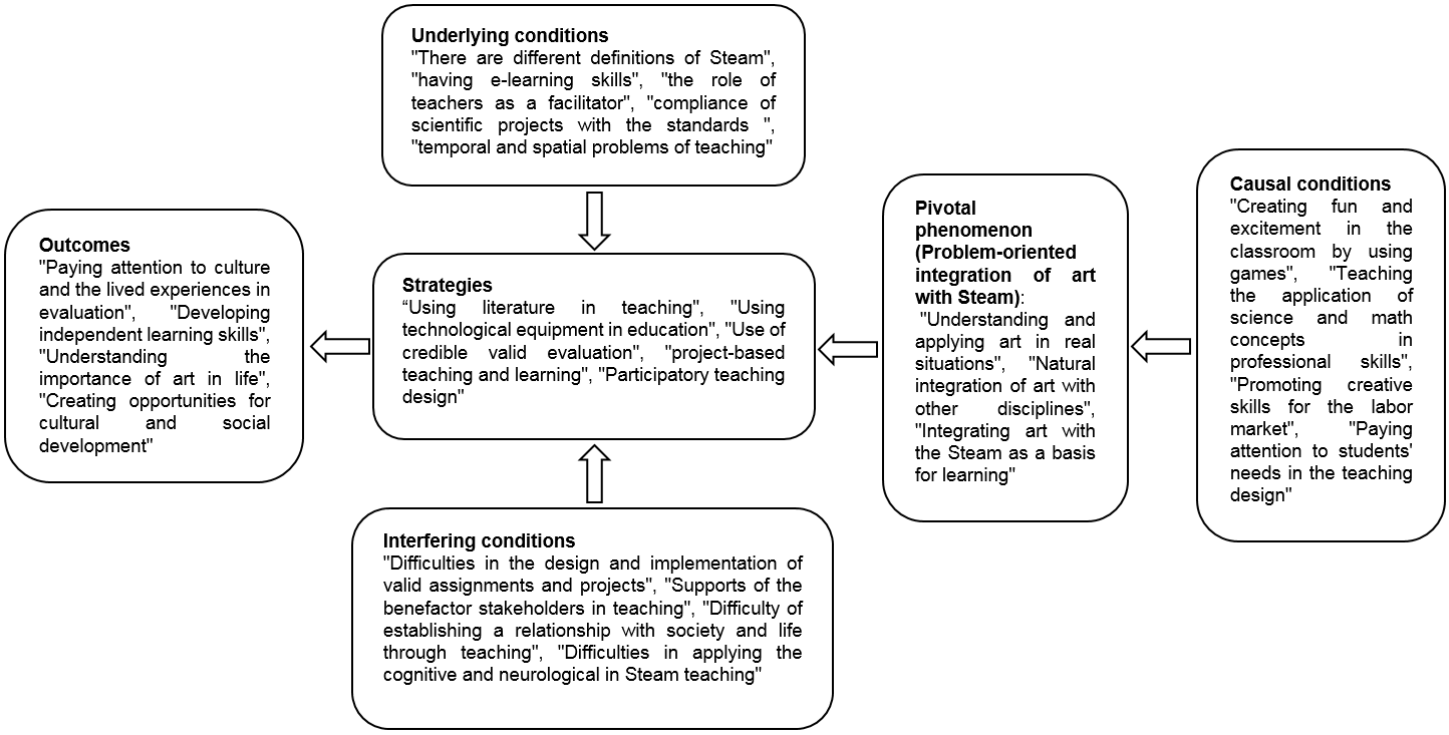

Fig. 1: The proposed model of the components of Steam-based teaching for children based on the grounded theory

4- DISCUSSION

The present study was designed and conducted to identify the components of Steam teaching for children. The results of the present study revealed that in order to implement Steam teaching for children, serious attention should be paid to causal conditions, contextual conditions, interfering conditions, pivotal phenomenon, strategies, and outcomes. Thus, in order to achieve the intended outcomes of the Steam teaching for children, it is first necessary to pay attention to improving the underlying contextual conditions and controlling the interfering ones.

This issue has been mentioned in various researches. The results of a study by Cheng and Lin (2020) showed that the Steam-based innovative educational model can motivate children before entering technical universities and allow them to understand the latest technological trends to create the right context for growth and finding suitable job orientations in the future (14). The results of a study by Wellington et al. (2020) show that the use of steam education typically involves guided learning through questioning, where children learn through direct experience of nature and technology which leads them to high-level or abstract thinking (12). Ozkan (2020) showed that the support of Steam education in a learning-oriented environment strengthens children's conceptual understanding (11). Similarly, Kim, et al. state that the Steam program, using the learning and project-design strategies, enables girls to build self-confidence to improve their ability to generate solutions to the real world's problems (18).

To interpret this, it should be noted that the trans-disciplinary nature of Steam teaching can be achieved through the participation and support of institutions that can raise issues that children can solve, establishing a connection with the local community and the participation of educators. Problem-based learning engages participants with credible learning opportunities with interdisciplinary solutions. The presence of the specialized parents and local community members in the classroom can enrich what students are learning. The key to the success of Steam teaching is the interdisciplinary skills of its stakeholders. Instructors and experts can help students in the classroom by answering questions, discussing skills and ways to connect with industry and academia, possible ways of searching for a problem in the real world, and providing feedback on children's solutions. The experts not only present their first-class experience and knowledge of the work field, but also provide children with a concrete example of how to transfer learning beyond the walls of the classroom. Effective teaching requires the expertise for making interdisciplinary connections; but, at the same time teachers do not have the necessary expertise in all disciplines. Instead, the teachers need to be able to identify the gaps in their knowledge, and Fill them with different resources and in cooperation with the specialists in each field.

5- CONCLUSION

There are no clear boundaries about what Steam teaching is. Different definitions and the variety of methods of artistic integration are some of the areas that have caused the teachers to be confused with the Steam-based approach. The problem-solving approach emphasizes the role of the teachers as facilitators. In problem-based learning projects, the children need to be responsible for their work and should be given considerable independence. Teacher's facilitation in Steam education is in coordination with the methods of children's learning in different subjects; i.e., Steam teaching should not be in conflict with the standards of different courses. This coordination can be made through valid assignments, and horizontal adaptation of the concepts of the disciplines to the standards of different courses. Most real-world problems are multidisciplinary and can provide different standards. The process of selecting standards for Steam design is repetitive, meaning that the standards are removed and added along with the progress in the design and implementation of the lesson. It is also possible to reverse the teaching design process, i.e., first select problem-based learning and then examine which standards can be taught through the selected approach.

Since the focus is on integrating the topics, it is best to review the standard list of topics in each discipline and assess their participation in the project. The best standards to be applied are those which address a wide range of issues. Collaborative and interdisciplinary design with the presence of experts at the community level supports the trans-disciplinary nature of the Steam teaching. The design teams suggest the real-world problems, and their related projects, with a focus on the teacher's expertise, can provide the school with the opportunity to work on more complex projects.

Interdisciplinary group designs with the presence of experts and educators from outside the community can significantly enhance the trans-disciplinary nature of Steam teaching. In general, in order to achieve the identified outcomes, strategies such as the use of literature in teaching, the use of technological equipment in education, the use of valid evaluations, project-based teaching and learning, and the collaborative design of the teaching process should be implemented.

6- REFERENCES

1. Landrigan, P. J., Fuller, R., Fisher, S., Suk, W. A., Sly, P., Chiles, T. C., & Bose-O'Reilly, S. (2019). Pollution and children's health. Science of the Total Environment, 650, 2389-2394.
2. Bramlett, M. D., Blumberg, S. J., Zablotsky, B., George, J. M., Ormson, A. E., Frasier, A. M., ... & Wang, F. (2017). Design and Operation of the National Survey of Children's Health, 2011-2012. Vital and health statistics. Ser. 1, Programs and collection procedures, (59), 1-256.
3. World Health Organization. (2017). don't pollute my future! The impact of the environment on children's health (No. WHO/FWC/IHE/17.01). World Health Organization.
4. Sousa, D. A& Pilecki, T (2013). From STEM to STEAM: Using brain-compatible strategies to integrate the arts. Thousand Oaks, CA: Corwin Press.
5. Harris, W. (2012). Examination Paediatrics: a guide to paediatric training, The New Zealand medical.124, (15), 17-18. Retrieved from: http://journal.nzma.org.nz/journal/124-1347/4998.
6. Quigley, C., F., Herro, D. (2019). An educator's guide STEAM engaging students using real world problems by Teachers College. New York, USA: Teachers College.
7. Yackman,G.(2008). STEAM education: An overview of creating a model of integrative education, presented at the Pupils Attitudes toward Technology (PATT-19) Conference: Research on Technology, Innovation, Design & Engineering Teaching, Salt LakeCity, Utah.
8. Yakman, G. (2012). What is the point of STE@M? A brief overview. Retrieved from https:// annegilesclelland .typepad.com/files/whatissteam.pdf.
9. Guyotte, K. W. , Sochacka, N. W., Costantino, T. E., Walther, J. & Kellam, N. N. (2015). STEAM as social practice: Cultivating creativity in transdisciplinary spaces. Art Education, 67(6), 12–19.
10. Jolly, A. (2014). STEM vs. STEAM: Do the arts belong? Education Week, 18. Retrieved from http://www.edweek.org /tm/articles/2014/11/18/ctq-jolly-stem-vs-steam,html.
11. Ozkan, G. (2020). Investigating the effectiveness of STEAM education on students' conceptual understanding of force and energy topics. Available from: https://doi.org/10. 1080/02635143 .2020.1769586.
12. Wellington, A., E., Genevieve, D., J. &Yeh, A. (2020). Beat and rhythm: Teaching science via integrated STEAM and digital technologies, Teaching Science, (66), 2, 15-16.
13. Park, N. & Ko, Y. (2014). Computer education's teaching-learning methods using educational programming language based on STEAM education. Network and parallel computing, 75(13), 320-327.
14. Cheng, J., Lin, H. (2020). Development and Technical Experience of Plastic Injection Machine for STEAM Education. Available from: https://doi.org 10.1007/978-3-030-49065-2_16.
15. Talebi, Nima (2015). The Impact of Teachers' Professional Development on Children's Performance in the 4th Grade Students According to Thames (2011), M.Sc. Thesis, Kharazmi University.
16. Maleki, Hassan and Sadeghi, Ali (1388). The Neglected curriculum of Iranian high schools according to the national and international needs, 7th Congress of Iranian Curriculum Studies Association, Tehran, Tarbiat Moallem University.
17. Khalili, Mahsa (2005), What Children Should Know About Visual Arts, Journal of Art Education, 20, (89), 106-107.
18. Kim, H., Chae, D. H. (2016). The Development and Application of a STEAM Program Based on Traditional Korean Culture. Eurasia Journal of Mathematics Science and Technology Education 12(7):1925-1936. http://: 10.12973/ eurasia.2016.1539a.