RESEARCH
www.commprac.com
ISSN 1462 2815

DEVELOPMENT AND EXPERIMENTATION STUDY: EDUCATIONAL GAMES USING TANGRAM BASED ON A SCIENTIFIC APPROACH TO INCREASE EARLY CHILDHOOD CREATIVITY

Rakimahwati [1], Anton Komaini [2]*, Ilham [3], Rully Effendi [4], Eka Pentiernitasari [5] and Desmawati Roza [6]

[1,5,6] Department of Early Childhood Teacher Education, Faculty of Education, Universitas Negeri Padang, Indonesia.
[2,3,4] Department of Health and Recreation, Faculty of Sport Science, Universitas Negeri Padang, Indonesia.
*Corresponding Author Email: antonkomaini@fik.unp.ac.id

DOI: 10.5281/zenodo.11076457

Abstract

Science and technology in the era of the industrial revolution had a big influence on the development of children's creativity and teacher creativity in creating learning media for early childhood. Difficulties in developing the creativity of children and teachers are still often encountered in early childhood learning environments. The lack of learning media in developing the creativity of children and teachers is the main factor causing these difficulties. One of the learning media that can be developed via computers is games. This research aims to produce educational games using tangram to increase the creative development of early childhood so that children have curiosity and are interested in participating in the learning process and the sample in this research is early childhood students in classes B1 and B2 at YWKA Kindergarten. This research is a R&D (Research and Development) research with the ADDIE model design which stands for Analysis, Design, Development, Implementation, and Evaluation as well as a quasi-experiment using the Paired Samples Test (T-Test). The results obtained from developing children's creative abilities through tangram educational games are valid, practical and effective. The data collection instrument in this research is a questionnaire to test validity, practicality and effectiveness. The validation results of the Tangram educational game are valid and feasible with Likert scale results of 93.33% from experts. Apart from that, the average result for media experts was 89.41%. The practical results of the Tangram educational game are very decent with an average result percentage of 91%, the effectiveness percentage is 92%. Based on the results of the pre-posttest effectiveness test, each class in which the experiment was carried out received a score (B1: 35.08 ± 2.66 to68.62 ± 1.94; B2: 36.27 ± 1.83 to 69.8 ± 1.42). The statistical test results also show significance for each group ($p<0.05$) of the influence that educatnal games via tangram` have on increasing creativity in early childhood. This means that for children, parents and teachers educational games are an effective media for teaching and in increase early childhood creativity. Thus, the tangram educational game based on a scientific approach in increasing the creativity of early childhood in YWKA Kindergarten is valid, practical and effective.

Keywords: Educational Games, Tangram, Creativity Development.

INTRODUCTION

Creativity is a potential that needs to be developed from an early age (Segundo-Marcos et al., 2023). Creativity is an important concept for the successful implementation of educational programs (Yildirim, 2010). To develop children's creativity optimally, help and attention from educators and parents is needed (Anggraeni & Hibana, 2021). However, creativity in children cannot be developed in a short time. It takes a long time to increase children's creativity. Therefore, the development of children's creativity must start from an early age (Dereli, 2023). In helping children realize their creativity, teachers need to create an atmosphere that stimulates children's creative abilities from an early age and provide adequate facilities

and infrastructure. Creative teachers also play an important role in developing early childhood education and creativity.

Creativity is the creation of something new and original by chance (Gosain et al., 2023). It's like a child playing with wooden blocks, building a pile that resembles a house and then calling it a house (Putro, 2016). One approach that can stimulate the development of creativity in early childhood is play activities (Borman & Erma, 2018). Creativity stimulates students' senses, generates previously unknown knowledge, and assists students in synthesizing information while adding meaning to their educational experience (Bullard & Bahar, 2023). When playing, almost all aspects of a child's growth and development can be stimulated, including the development of creativity.

Creative skills and abilities are essential for elementary and middle school students who will grow into productive citizens and problem solvers and enter the world of work; arguments in favor of a focus on student empowerment and employability support the need to teach for creativity (Papaleontiou- Louca et al., 2014). Teaching for creativity fosters soft skills such as time management, willingness to learn, teamwork spirit, conflict resolution, and creative problem solving (Majid et al., 2012).

Low creativity in children at an early age causes children to feel lonely, afraid, angry or hopeless (Karina et al., 2024). According to (Hagen et al., 2023) lack of creativity in early childhood has an impact on the lack of skills and development in children. Not only that, a lack of creativity in children can hinder physical activities carried out in early childhood (Romance et al., 2023). Apart from inhibiting physical activity in children, low creativity in children at an early age can also interfere with children's physical fitness (Maryam et al., 2023) and also hinders energy balance and results in obesity and eating behavior (French & Allison, 2023).

Therefore, one strategy to avoid this risk is to create fun learning. The way to make learning fun is to create learning media (Herdiana et al., 2023). Making learning media must also follow technological developments. One of the learning media that can be developed through technology is games (Fitria, 2021). One form of game that can stimulate the development of children's creativity is the tangram game (Mufti et al., 2020).

Tangram is a colorful two-dimensional puzzle game from China (Itawari et al., 2017). Consists of one square which is divided into seven parts, including two large triangles, one medium triangle, two small triangles, one small square, and one small triangle and a small parallelogram (Hidayati Nur, 2017). The tangram game also introduces geometric shapes to children (Rahmi et al., 2020)It can also train children's imagination in assembling shapes (Hidayat et al., 2021). Apart from that, it can also develop thinking speed and help children to develop creative thinking (Erri Wahyu Puspitarini, 2016).

Based on observations, some children have low creativity. Children are generally creative. However, not all children can be said to have good creativity because some children sometimes seem less creative, that is, less active, and lack ideas for creating something different. Apparently the children were less interested in taking part in the ongoing learning because there was a lack of learning media used to explain the day's activities. Apart from that, the learning media used is less useful and interesting for children. Thus, this research aims to produce educational games using tangram to increase the development of creativity in early childhood so that children have curiosity and are interested in participating in the learning process.

METHOD

Research design

This research is Research and Development. The development model in this research uses the ADDIE (Analysis, Design, Development, Implementation and Evaluation) model. 1) Analysis stage. At this stage, analyze the situation of learning media development needs, namely educational games, planning process, feasibility, teachers and the environment to find out what products need to be developed. The analysis stage carried out by researchers includes two things; curriculum analysis and needs analysis. 2) Design stage. This stage designs educational games using tangram to stimulate the development of creativity in early childhood. The process of designing this educational game is, a) Determining the theme, subthemes and learning materials. b) Designing a Daily Learning Implementation Plan (RPPH). c) Application Selection. d) Storyboard Design. 3) Development Stage. At this stage we develop a designed educational game. The aim of this stage is to produce a product, namely a valid and practical educational game. The initial design of this educational game was consulted with experts. Then it is assessed by a competent person (validator) or expert in the field. 4) Implementation stage. This stage is carried out by preparing educational game products through Tangram, after being revised according to expert directions (declared appropriate by the expert) and after being tested. At this stage we also prepare the learning environment and student involvement in learning. Then we can see whether this educational game using tangram is effective for early childhood learning or not. 5) Evaluation stage. At this stage, evaluation of educational games using tangram is carried out to stimulate the development of creativity in early childhood (Branch, 2009).

Procedure

The following is a storyboard for an educational game that stimulates learning creativity using educational games via tangram, which can be seen in the following diagram (Figure 1).

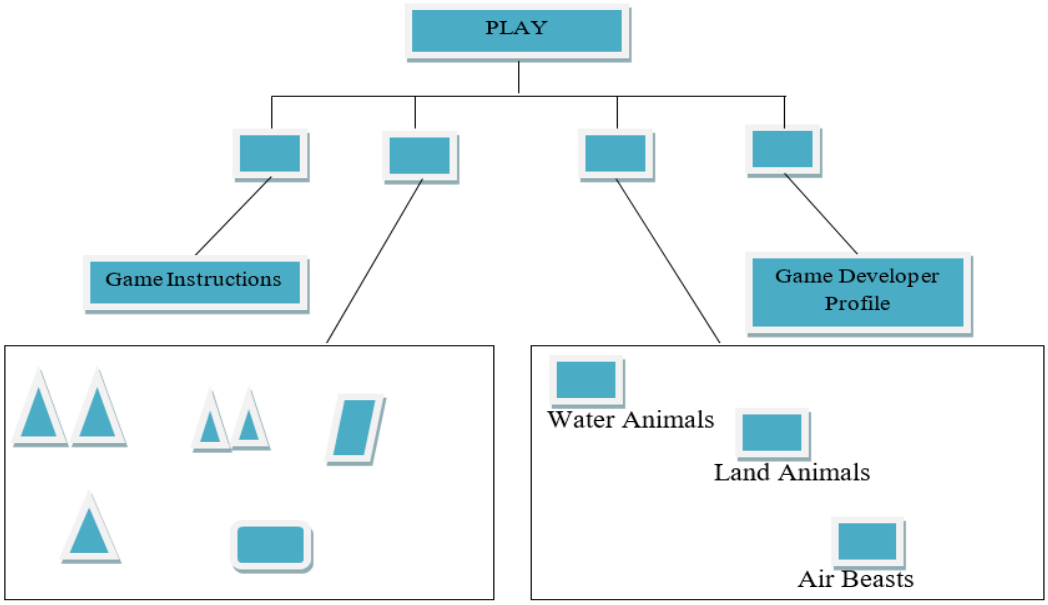

Figure 1: Educational game board

On the story board displays the cover (homepage) to start tangram, after that four menus will appear and students choose one of the four menus consisting of game instructions, getting to know tangram, games and game developer profiles. The getting to know tangram menu is designed so that children can understand the flat shapes of tangrams. In the game menu three games will appear, namely water animals, land animals and air animals, children can choose one of the games and play it.

Participants

A total of 28 early childhood students in classes B1 and B2 at the Kereta Api Women's Foundation Kindergarten (YWKA), participated in this research using a purposive sampling technique. Orang tua dan anak menandatangani surat persetujuan mengikuti semua rangakaian penelitian.

Instrument

The data collection instrument in this research is a questionnaire to test validity, practicality and effectiveness. After continuing with collecting pre-test and post-test data on participants.

Data analysis

Furthermore, in this research, researchers used descriptive statistics to explain each variable, while for the normality test it was analyzed using Kolmogorov Smirnov, homogeneity was analyzed using Homogeneity of Variances. Then, test the researcher's hypothesis using the Paired Samples Test (T-Test). Paired Samples Test (T-Test) is a method for determining the effectiveness of treatment which is characterized by the difference in averages before and after treatment (Frey, 2023). All data in this study was analyzed using the IBM SPSS statistical program.

RESULTS AND DISCUSSION

Analysis

At the analysis stage, the methods used by researchers were observation, interviews and documentation of teaching and learning activities at YWKA Kindergarten. The analysis steps carried out by researchers include two things; curriculum analysis and needs analysis. Based on curriculum analysis, there are core and basic competencies related to educational games and creativity development, especially creativity development. On the other hand, needs analysis is needed to examine children's characteristics based on their knowledge, skills and development.

Design

At this stage, researchers design educational game products based on problem analysis. The steps taken at the design stage begin with developing themes and subthemes, Learning Plans (RPPH), selecting applications, and designing storyboards. The theme raised is the animal theme with sub-themes water animals, land animals and air animals. RPP is important to see and assess the implementation of learning using the Tangram educational game. The application was chosen to develop a tangram educational game. Consists of the main application, supporting applications, and sound. A storyboard is an image sketch that is arranged systematically. By designing a storyboard, other people will understand the story idea for the game that will be created.

ISSN 1462 2815

Development

The products developed are validated by experts to find out whether they can be used properly. It is also necessary to see whether all components can work as expected. The following is the development of the tangrams educational game.

Table 1: Development of the Tangrams Educational Game

	This is the house cover of the educational tangram game which will read something like; “Let's play fun and exciting tangram” (Let's play fun and exciting tangram. When the player clicks on the triangle button, the main menu will open.
	This is the appearance of the main menu of the tangram educational game which has four menu options. They get to know tangram, game instructions, games, and the profile of the game developer.
	This is what it will look like if players click on this menu to understand more about tangram. You will hear the following sound; “Let's get to know tangram” (let's get to know tangram). In this menu there are large triangles, medium triangles, small triangles, squares and parallelograms which are the geometries found in tangrams.
	This is what it looks like if the player clicks the next button (next). The names of the shapes on the tangram will appear. If each image is clicked, the sounds “large triangle”, “medium triangle” (medium triangle), “small triangle” (small triangle), “parallelogram” and “small size square” will appear. " (small box).
	Game instructions menu display. It contains information about how to play the game.
	This is the game menu display. When you open this menu, you will hear “Select the game you want” (Select the game you want).

		This is what it looks like if the player clicks on the water animal game. Players can play this game by selecting a color on the left side of the screen and clicking on an uncolored tangram shape. In addition, players can shift the tangram shape to match existing patterns and animal images on the screen.
		This is what it looks like if the player clicks on the land animal game. Players can play this game by selecting a color on the left side of the screen and clicking on an uncolored tangram shape. Players can also shift the tangram shape to match existing patterns and animal images on the screen.
		This is what it looks like if the player clicks on the air animal game. Players can play this game by selecting a color on the left side of the screen and clicking on an uncolored tangram shape. Players can shift the tangram shape to match the existing pattern, and there are images of animals on the screen.
		Rewards will appear when players complete the game.
		Display when the player wants to exit the tangram game.

This educational game was designed and validated by material and media experts. Validation from media experts obtained a percentage score of 93.33%. This can be categorized as very valid. The media expert validity test was 89.41%. This means the media is very practical.

Application

Activities at the implementation stage are implementing educational game products prepared through Tangram which have been declared feasible by experts and tested on children. The next stage, educators carry out an assessment of educational games to find out the suitability of the game when used by children and how children respond after using educational games using tangram. The practicality test was carried out by YWKA Kindergarten educators in FGD activities consisting of 4 teachers. Practicality

test results were 91%. This means that the tangram educational game developed is very practical. The implementation of educational games through Tangram was carried out in YWKA Kindergarten class B, totaling 20 children, and obtained an effectiveness score of 92%. This is categorized as very effective.

Evaluation

The fifth stage in the ADDIE development model is the evaluation or assessment stage. Based on material experts, the validity of the questions was sufficient and valid, and the validator's assessment conclusions were declared suitable for continuing the research. Suitable for use with revisions. Revisions from media and material experts were carried out for better improvements. The practicality test results are very practical as an educational game that stimulates the development of children's creativity. Based on the results of testing the effectiveness of the Tangram educational game, it was declared effective as a learning medium.

After development is complete using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The educational game was tried out on students in class B1 and class B2, with a description of the participants presented in table 2 and continued with a description of the data in table 3 and figure 2.

Table 2: Description of Participants

Group	Sample
B1	
Man	8
Woman	5
Total Sample	13
B2	
Man	7
Woman	8
Total Sample	15

Table 3: Results of educational games for each group of students

Group	N	Data	Minimum	Maximum	M ± SD
B1 Students	13	Pre-Test	31	39	35.08 ± 2.66
		Post-Test	65	71	68.62 ± 1.94
B2 Students	15	Pre-Test	34	41	36.27 ± 1.83
		Post-Test	67	72	69.8 ± 1.42

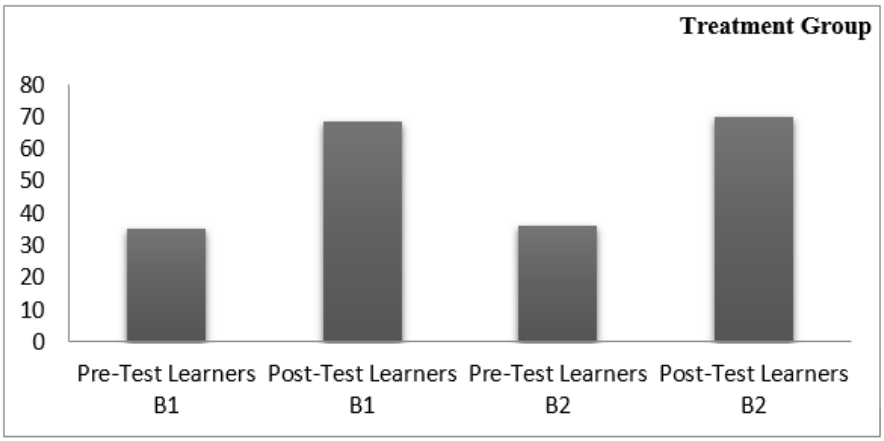

Figure 2: Results of educational games for each group of students

After getting a description of the participant data, we continued by testing the normality and homogeneity of B1 and B2 students, which are presented in table 4.Treatment group data is normally distributed and homogeneous if (p>0.05).

Table 4: Analysis Requirements Test

Learners	Normality test						Homogeneity Test		
	Kolmogorov-Smirnov			Shapiro-Wilk			Levene Statistics		
	Statistics	*df*	*P*	Statistics	*df*	*P*	*df1*	*df2*	*P*
B1	0.160	13	0.200	0.942	13	0.490	1	24	0.370
B2	0.153	15	0.200	0.953	15	0.580	1	28	0.403

Note: Data is normally distributed and homogeneous if (p>0.05)

Next, after the analysis requirements have been met, we continue with hypothesis testing using a paired sample test. As presented in table 5, the table shows that the groups of students are B1 (p<0.05) and students are B2 (p<0.05).

Table 5: T-Test

Paired Samples Test (T-Test)					
Group	m	elementary school	df	p	Conclusion
B1 Pre-Test vs Post-Test	-33,358	2,787	12	0.00	Significant
B2 Pre-Test vs Post-Test	-20,400	2,501	14	0.00	Significant

Note: Significance (p<0.05)

Based on the results and discussion above, throughthe ADDIE model (Analysis, Design, Development, Implementation and Evaluation) of educational games is very effective for students from the perspective of analyzing educational games with educational games and developing creativity, especially in developing creativity related to the existing curriculum for these students and in Needs analysis also examines children's characteristics based on their knowledge, skills and development. In line with research (Yazıcı Arıcı et al., 2023) Analyzing a development result must be carried out because it will influence optimal student outcomes.

Furthermore, in terms of educational game design, it is very easy and understood by students because it is assisted by the appearance of the stryboard which is attractive, simple and also based on the students' learning theme. In line with research (Ferreira de Almeida & dos Santos Machado, 2021) that design in a development is an important factor because it anticipates the level of boredom of students so with maximum design students get a level of enjoyment and comfort in the educational game. Next, at the development stage, this educational game has gone through the validation stage by material and media experts.

Validation from media experts obtained a percentage score of 93.33%. This can be categorized as very valid. The media expert validity test was 89.41%. This means the media is very practical as wellall components can work as expected. Next, at the implementation stage, practicality test results were found to be 91%. This means that the tangram educational game developed is very practical. The implementation of educational games through Tangram was carried out in YWKA Kindergarten class B and obtained an effectiveness score of 92%.

This was categorized as very effective. Furthermore, at the evaluation stage it was declared suitable to continue the research. According to research (Maslin et al., 2023) in an online environment it can also develop creativity in early childhood. Not only that,

creativity as a source of innovation and scientific discovery deserves to be at the heart of activities and teaching in early childhood classes through teachers' ideas (Ata-Akturk & Sevimli-Celik, 2023).

At the research stage, data description results were obtained for class B1 students with an average pre-test of 35.08 and post-test of 68.62. For class B2 students, the pre-test average was 36.27 and post-test 69.8. From these results, it was found that there was an increase in the average in each treatment group.

Furthermore, the results of statistical tests show that there is a significant influence provided by educational games through tangram on increasing creativity in early childhood with ($p<0.05$) in each treatment group. Our findings are in line with (Üret & Ceylan, 2021) that the influence of STEM education on the creativity of 5 year old children in kindergarten is positive and this effect is permanent. Not only that, creative drama activities also have an influence in early childhood on the executive function of children aged 60 to 72 months (Çiftçi & Aykaç, 2022).

According to creativity, it can also be increased through showing educational interaction videos provided by the teacher (Jilink et al., 2018).

Researchers believe that this tangram educational game can increase the creativity of young children. However, we recognize that future research needs to validate certain limitations.

CONCLUSION

Based on the results and discussion, it can be concluded that educational games through tangram are valid and appropriate for early age students and that there is an influence that educational games through tangram have on increasing the creativity of early childhood. This means that for children, parents and teachers, educational games are an effective medium for teaching or improving the creativity of early childhood.

References

1) Anggraeni, D., & Hibana. (2021). Redesigning Early Childhood Creativity Development through Storytelling. Kindergarten: Journal of Islamic Early Childhood Education, 4(1), 26–37. http://ejournal.uin-suska.ac.id/index.php/KINDERGARTEN/article/view/12196

2) Ata-Akturk, A., & Sevimli-Celik, S. (2023). Creativity in early childhood teacher education: beliefs and practices. International Journal of Early Years Education, 31(1), 95–114. https://doi.org/10.1080/09669760.2020.1754174

3) Borman, RI, & Erma, I. (2018). Development of Educational Games for Kindergarten (Tk) Children Using the Visualitation Auditory Kinesthetic (Vak) Learning Model Implementation. JIPI (Scientific Journal of Informatics Research and Learning), 3(1), 8–16. https://doi.org/10.29100/jipi.v3i1.586

4) Branch, R. M. (2009). Approach, Instructional Design: The ADDIE. In Department of Educational Psychology and Instructional Technology University of Georgia (Vol. 53, Issue 9).

5) Bullard, A. J., & Bahar, A. K. (2023). Common barriers in teaching for creativity in K-12 classrooms: A literature review. Journal of Creativity, 33(1), 100045. https://doi.org/10.1016/j.yjoc.2023.100045

6) Çiftçi, M. A., & Aykaç, M. (2022). The effect of creative drama activities in early childhood on the executive functions of children. Education 3-13, 50(2), 267–280. https://doi.org/10.1080/03004279.2020.1849343

7) Dereli, F. (2023). A multidimensional analysis of graduate theses in Turkiye on early childhood and creativity. 4(June), 11–37.

8) Erri Wahyu Puspitarini, DWPAPN (2016). Android-based educational games as learning media for early childhood. JIMP - Pasuruan Independent Informatics Journal, 1(1), 46–58. https://doi.org/10.37438/jimp.v1i1.7

9) Ferreira de Almeida, J.L., & dos Santos Machado, L. (2021). Design requirements for educational serious games with focus on player enjoyment. Entertainment Computing, 38(December 2020). https://doi.org/10.1016/j.entcom.2021.100413

10) Fitria, RA (2021). The Influence of Tangram Educational Game Tools in Increasing Understanding of Geometry Concepts in Qurrota A'yun Ponorogo Kindergarten. Aulad: Journal on Early Childhood, 4(1), 1–6. https://doi.org/10.31004/aulad.v4i1.83

11) French, S. J., & Allison, D. B. (2023). Creativity in energy balance, obesity and feeding behavior research, some thoughts. Physiology and Behavior, 266(March), 114161. https://doi.org/10.1016/j.physbeh.2023.114161

12) Gosain, K., Panga, M., & Ganesh, A. (2023). Impact of Early Childhood Classroom for Fostering Creativity and Intelligence. 6, 645–650.

13) Hagen, M. H., Cruzes, D. S., Jaccheri, L., & Fails, J. A. (2023). Evaluating digital creativity support for children: A systematic literature review. International Journal of Child-Computer Interaction, 38(December 2021), 100603. https://doi.org/10.1016/j.ijcci.2023.100603

14) Herdiana, R., Rahayu, A., Zulfiati, HM, Darmawanti, YP, & Tamansiswa, S. (2023). The Implementation of Tangram Puzzle to Enhance Creativity of First Grade Elementary School Students. July, 562–576.

15) Hidayat, H., Delviana, D., Fauziah, DF, & Yuniar, M. (2021). Developing Early Childhood Creativity Through Geometric Shapes in the Digital Era. Aulad: Journal on Early Childhood, 4(1), 16–21. https://doi.org/10.31004/aulad.v4i1.85

16) Hidayati Nur. (2017). Development of word search puzzles using a scientific approach as a medium for learning reading and writing for elementary school students in class I.

17) Itawari, R., Ahmad, A., & Fakhriah. (2017). Using the Tangram Game to Develop Early Childhood Creativity at Kindergarten FKIP Unsyiah Banda Aceh. Scientific Journal of Early Childhood Teacher Education Students, 2(1), 62–69.

18) Jilink, L., Fukkink, R., & Huijbregts, S. (2018). Effects of early childhood education training and video interaction guidance on teachers' interactive skills. Journal of Early Childhood Teacher Education, 39(4), 278–292. https://doi.org/10.1080/10901027.2017.1408042

19) Karina Hendrie Kupczyszyn, Vanessa Arán Filippetti, LO (2024). Socioeconomic status effects on children's creativity: The mediating role of executive functions. Thinking Skills and Creativity, 51.

20) Majid, S., Liming, Z., Tong, S., & Raihana, S. (2012). Student Reflection as a Tool for Assessing Standards. International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), 2(2), 1036–1042.

21) Maryam Mohammadi-Nia, Rasoul Yaali, Sadegh Amani-Shalamzari, CCTC (2023). The effect of 8 weeks of child designed vs teacher designed games on physical fitness and creativity in children 8–10 years. Physiology & Behavior, 259.

22) Maslin, K., Murcia, K., Blackley, S., & Lowe, G. (2023). Fostering young children's creativity in online learning environments: A systematic literature review. Thinking Skills and Creativity, 47(November 2022), 101249. https://doi.org/10.1016/j.tsc.2023.101249

23) Mufti, NN, Pranata, OH, & M, MRW (2020). Literature Study: Tangram as a Geometry Learning Media. Journal of Elementary Education Studies, 5(2), 93–99.

24) Papaleontiou- Louca, E., Varnava-Marouchou, D., Mihai, S., & Konis, E. (2014). Teaching for Creativity in Universities. Journal of Education and Human Development, 3(4). https://doi.org/10.15640/jehd.v3n4a13

25) Putro, KZ (2016). Developing Children's Creativity Through Play. Applicationa: Journal of Applications of Religious Sciences, 16(1), 19. https://doi.org/10.14421/applicationa.v16i1.1170

26) Rahmi, P., Mawaddah, Fajriah, H., & Maisarah. (2020). Application of Tangram Educational Game Tools to increase Children's Creativity in Recognizing Geometric Shapes at TKN Pembina Lawe Alas. Raudhah Journal, 8(1), 81–91.

27) Romance, R., Nielsen-Rodríguez, A., Mendes, R.S., Dobado-Castañeda, J.C., & Dias, G. (2023). The influence of physical activity on the creativity of 10 and 11-year-old school children. Thinking Skills and Creativity, 48(April). https://doi.org/10.1016/j.tsc.2023.101295

28) Segundo-Marcos, R., Carrillo, A.M., Fernández, V.L., & Daza González, M.T. (2023). Age-related changes in creative thinking during late childhood: The contribution of cooperative learning. Thinking Skills and Creativity, 49(May). https://doi.org/10.1016/j.tsc.2023.101331

29) Üret, A., & Ceylan, R. (2021). Exploring the effectiveness of STEM education on the creativity of 5-year-old kindergarten children. European Early Childhood Education Research Journal, 29(6), 842–855. https://doi.org/10.1080/1350293X.2021.1913204

30) Yazıcı Arıcı, E., Kalogiannakis, M., & Papadakis, S. (2023). Preschool Children's Metaphoric Perceptions of Digital Games: A Comparison between Regions. Computers, 12(7). https://doi.org/10.3390/computers12070138

31) Yildirim, A. (2010). Creativity in early childhood education programs. Procedia - Social and Behavioral Sciences, 9, 1561–1565. https://doi.org/10.1016/j.sbspro.2010.12.365