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ORIGINAL

The Effectiveness of the Outdoor Learning Activity (OLA) Model Based on Javanese Culture in Improving Children's Working Memory

La Efectividad del Modelo de Actividad de Aprendizaje al Aire Libre (OLA) Basado en la Cultura Javanesa en la Mejora de la Memoria de Trabajo de los Niños

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ABSTRACT

Introduction: this research aims to determine the effectiveness of the Outdoor Learning Activity (OLA) model based on Javanese culture in improving children's working memory (WM) and to identify the differences in working memory achievements in each OLA activity implemented, including Kubro Siswo dance, Engklek, and fun cooking.
Method: the research used a Pre-test and Post-test Nonequivalent Control Group Design with 171 subjects from the control group, experimental group 1, and experimental group 2. Data collection was conducted using a working memory test, and the data analysis used was one-way ANOVA and N-Gain Score.
Results: the N-Gain scores for Experimental Group 1 and Experimental Group 2 reached 77,29 and 80,50, respectively, greater than 76. The average working memory achievement in each OLA activity shows Engklek at 47,03, Kubro Siswo dance at 45,65, and Fun Cooking at 44,24.
Conclusions: the research results show that the N-Gain score >76, indicating that the Javanese culture-based OLA model is effective in improving children's working memory. It is concluded that the Engklek treatment is the OLA treatment with the highest average working memory score, followed by the Kubro Siswo dance treatment and lastly the Fun Cooking treatment.

Keywords: Outdoor Learning Activity; Javanese Culture; Working Memory.

RESUMEN

Introducción: esta investigación tiene como objetivo determinar la eficacia del modelo de actividades de aprendizaje al aire libre (OLA) basado en la cultura javanesa para mejorar la memoria de trabajo (WM) de los niños e identificar las diferencias en los logros de la memoria de trabajo en cada actividad OLA implementada, incluyendo la danza Kubro Siswo, Engklek y cocina divertida.
Método: la investigación utilizó un diseño de grupo de control no equivalente preprueba y posprueba con 171 sujetos del grupo de control, el grupo experimental 1 y el grupo experimental 2. La recogida de datos se realizó mediante una prueba de memoria de trabajo, y el análisis de datos utilizado fue ANOVA unidireccional y puntuación N-Gain.
Resultados: las puntuaciones N-Gain del grupo experimental 1 y del grupo experimental 2 alcanzaron 77,29 y 80,50, respectivamente, superiores a 76. El rendimiento medio de la memoria de trabajo en cada actividad OLA muestra Engklek en 47,03, Kubro Siswo dance en 45,65, y Fun Cooking en 44,24.
Conclusiones: los resultados de la investigación muestran que la puntuación N-Gain >76, lo que indica que

el modelo OLA basado en la cultura javanesa es eficaz para mejorar la memoria de trabajo de los niños. Se concluye que el tratamiento Engklek es el tratamiento OLA con la puntuación media de memoria de trabajo más alta, seguido del tratamiento de danza Kubro Siswo y, por último, del tratamiento Fun Cooking.

Palabras clave: Actividad de Aprendizaje al Aire Libre; Cultura Javanesa; Memoria de Trabajo.

INTRODUCTION

Early childhood includes the preschool period, which is the time when a child's first experiences at school are obtained.[1] This period represents a critical phase where a child's subsequent development is influenced by the basic competencies and self-concept they possess.[2] Early childhood children have six aspects of development, and cognitive ability is one of the aspects that must be stimulated.[3] A child's cognitive abilities are closely linked to brain function. Research results show that brain neuroscience is fully interconnected with the learning process.[4]

Based on a report from the World Health Organization (WHO)(5), it is stated that around 340 million children and adolescents aged 5-19 years, or one in five children (18,4 %), are globally affected by obesity. In addition, statistical data shows that 80 % of school-aged children are not physically active, which impacts their health, particularly their cognition and academic performance. Preschool is included under early childhood since it is during this time that a child has their first school experiences. Therefore, increased physical activity can be achieved through various outdoor activities, including Outdoor Learning Activity / OLA.[6] Physical activities in OLA that children engage in will impact their cognitive abilities.

The results of the last 10 years of neuroscience research show significant evidence that physical activity is related to children's cognitive abilities.[7,8,9,10] Children aged 5-6 years need executive function (EF) cognitive abilities as a readiness to learn towards elementary school. EF is the ability to play with ideas, discover new things, face unexpected challenges, and remain focused.[11] EF skills can help children solve problems, practice self-control, and adjust cognitively.[12] There are three components of EF, namely Inhibition, working memory (WM), and cognitive flexibility. (CF). WM is regarded as the strongest predictor of a child's academic achievement.[13] Additionally, the physical activities performed have a positive impact on children's working memory.[14]

The ability to manage and store information for brief periods without the need for outside help or signals is known as working memory.[15,16,17] WM plays an important role in supporting the entire range of complex daily cognitive activities of children, such as reasoning, language comprehension, long-term learning, and mental arithmetic[18] as well as being the strongest predictor of children's academic achievement.[13]

The improvement of working memory (WM) at the age of 6 is sufficiently developed to be used during complex tasks that require the coordination of WM subcomponents, namely the visuospatial sketchpad, phonological loop, and episodic buffer.[19,20] This is in line with Baddeley and Hitch, who first introduced working memory in 1974. There are four components in the multiple-component model of working memory, namely the central executive, phonological loop, visuospatial sketchpad, and episodic buffer. The central executive component functions as an attentional controller that limitedly controls attention and two subsystems within the storage system. The visuospatial sketchpad functions to input, retain, and manipulate visual (images) and spatial information. The phonological loop functions to input, retain, and manipulate sound-based or verbal information. Meanwhile, the episodic buffer functions to integrate received information with episodic event memories in long-term memory that already exists.[21]

It can be interpreted that the central executive functions as a "control center" that oversees the manipulation, retrieval, and processing of information (non-verbal or verbal) for meaningful functions such as decision-making, problem-solving, or even scriptwriting.[22] There are several terms in the cognitive process, including memory, storage, encoding, and retrieval. Memory is the child's ability to mentally store knowledge that has been previously learned. Storage is the process of placing what has been learned into memory from the beginning. Children rarely store information exactly as received but instead encode it by modifying the information in a way, such as coding a verbal input as a visual image. Meanwhile, retrieval is the process of recalling previously stored information.[23]

In essence, human memory consists of three components, namely the sensory register, working memory (short-term), and long-term memory. The sensory register is the memory component that receives unencoded information (input). Visual input is stored in visual form, while audio input is stored in audio form, and the sensory register has a large capacity, allowing it to store a lot of information at one time.

Attention plays a crucial function in transferring information to working memory by directing mental processing toward specific stimuli. Thus, working memory is the component of memory that continues to focus attention on information for a short period while the child is still trying to understand. Working memory is the

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component that performs most of the mental work in the memory system, hence it is called "working".[23] The capacity of a child's working memory will also affect their long-term thinking ability.[24]

Cognitive processes, particularly children's WM, can be enhanced through physical activities in OLA.[6] Additionally, children's physical activities can also increase by 22 % when designed in OLA.[25] Physical activities in OLA can supply blood to children's brains and cause natural chemicals to support a greater number of neuron connections.[26] The implemented OLA activities are linked to culture. Culture-based learning is a strategy for creating a learning environment and designing learning experiences that integrate culture as part of the learning process.

The culture developed in the learning process aligns with the specific regional culture. As emphasized in the accreditation instrument of the National Accreditation Board for Early Childhood Education and Non-Formal Education, it is stated that educators must stimulate children to introduce the diversity of regional cultures.[27] Therefore, each unit of early childhood education institutions should implement local culture in learning activities and incorporate project-based play in their teaching.[28] The culture implemented in this research is Javanese culture through activities such as playing Kubro Siswo dance,[29] playing Engklek,[30] and fun cooking traditional Javanese food, specifically from Magelang, which involves making Gethuk.[31] Therefore, the OLA model based on Javanese culture was designed to enhance children's working memory.

However, until now, in learning activities, the capacity of children's working memory is still found to be low, as observed in early childhood mathematics recognition, where children still have difficulty remembering, following instructions, and recalling the use of certain strategies[32,33,34] as well as the continued limitation of physical activities.[35] That is, outdoor learning activities (OLA) have not been fully implemented due to concerns about injury risks[36] and a lack of knowledge about utilizing space and play elements.[37] Therefore, this study aims to determine the effectiveness of Jawad culture-based outdoor learning activities in improving children's working memory.

METHOD

This study used a Pre-test and Post-test Nonequivalent Control Group Design, where the non-equivalent aspects include the number of students, the location of the institution, and the educators. The research design comprises 3 groups randomly selected, consisting of one control group and two experimental groups, namely experimental group 1 and experimental group 2. The control group did not receive the Javanese culture-based OLA treatment. Instead, it receives conventional OLA, which includes playing ball (throwing and catching the ball, kicking the ball, and bouncing the ball), body exercises, and moving while singing. Meanwhile, the experimental groups received the Javanese culture-based OLA treatment, which includes Kubro Siswo dance, Engklek, and fun cooking. The Nonequivalent Control Group Design is presented in table 1.

Table 1. Pre-test and Post-test Nonequivalent Control Group Desain

Sample	Pre-test	Treatment	Post-test
CC	O_1	-	O_2
EC_1	O_3	X	O_4
EC_2	O_5	X	O_6

Where:

- CC : Control Class (CC)
- EC : Experimental Class (EC)
- O_1 : Pre-test Control Class
- O_2 : Post-test Control Class
- O_3 : Pre-test Experimental Class 1
- O_4 : Post-test Class Experiment 1
- O_5 : Pre-test Class Experiment 2
- O_6 : Post-test Experimental Class 2
- X : OLA treatment model

Research Instrument

Data collection in this research was conducted using a working memory measurement test instrument[38] that has been tested for validity and reliability on 65 children in Indonesia. The validity results from 49 items showed r count > t table with r table = 0,244, and the reliability was 0,954.

Research Subjects

This study involves 9 early childhood education services that cater to children aged 5-6 years and were

selected randomly. The 9 early childhood education services are located in Indonesia and are divided into 3 groups, including 3 institutions in the Control group with 48 children, 3 institutions in the Experiment 1 group with 56 students, and 3 institutions in the Experiment 2 group with 67 students. Thus, the total number of subjects is 171 children. This research has received approval from the Ethics Committee of Yogyakarta State University (Reg. No: T/6.93/UN34.9/KP.06.07/2024).

Procedure

The research was conducted over 3 months by administering pre-tests and post-tests to the Control group, Experiment Group 1, and Experiment Group 2. Data analysis was conducted using one-way ANOVA to determine (a) whether there are differences in WM in the OLA treatments (Kubro Siswo dance, Engklek, and fun cooking) between the control and experimental groups, and (b) to identify the differences in the impact of OLA treatments including Kubro Siswo dance, Engklek, and fun cooking on children's WM. Additionally, an N-Gain Score assessment was conducted to determine the effectiveness of the OLA model in improving WM with criteria as described in table 2.

Table 2. Categories of N-Gain Score Effectiveness Interpretation

Percentage (%)	Category
<40	Not Effective
40-55	Less Effective
56-75	Moderately Effective
>76	Effective

Source: [39]

RESULTS

Based on the results of descriptive statistical analysis showed in Table 3, it is known that the average WM score in the Control group is 27,59, the average in Experiment Group 1 is 39,70, and the average in Experiment Group 2 is 39,90. Meanwhile, each group can be observed in the Figure 1-3, whereas Figure 1 shows that the descriptive statistical results of the control group at Aisyiyah Bustanul Athfal 3 (ABA 3) with a pre-test score of 23,00 and a post-test score of 26,29, at Aisyiyah Bustanul Athfal 8 (ABA 8) with a pre-test score of 26,36 and a post-test score of 28,18, while at Kindegarten Kemala Bhayangkari the pre-test score reached 28,65 and the post-test score 30,43. Based on the descriptive statistics results, the control group has not shown a significant increase between the pre-test and post-test scores obtained at each institution.

Figure 2 shows the descriptive statistics results of the experimental group 1, indicating that at the Aisyiyah Bustanul Athfal 7 (ABA 7) institution, the pre-test score was 35,05 and the post-test score reached 45,95, at the Kindegarten Trisula 3, the pre-test score reached 40,67 while the post-test score reached 47,78, and at the Kindegarten Pertiwi Kiringan, the pre-test score was 31,30 while the post-test score reached 43,89.

Meanwhile, figure 3 shows the descriptive statistics results of the experimental group 2, indicating that at the Aisyiyah Bustanul Athfal 5 (ABA 5) institution, the pre-test score was 34,30 and the post-test score reached 45,39, at the Kindegarten Taman Indria, the pre-test score reached 35,34 while the post-test score reached 46,79, and at the Kindegarten Pembina, the pre-test score was 30,53 while the post-test score reached 44,87. The descriptive statistics results of Experiment Group 1 and Experiment Group 2 show a significant increase between the pre-test scores and the post-test scores obtained in each institution.

Table 3. Results of Descriptive Statistical Analysis WM

		N	Mean	Std. Deviation	Min	Max
Control	Pre-test	48	26,48	4,908	15	38
	Post-test	48	28,71	4,376	18	40
	Total	96	27,59	4,759	15	40
Experiment 1	Pre-test	56	34,14	4,274	26	44
	Post-test	56	45,25	2,665	38	49
	Total	112	39,70	6,610	26	49
Experiment 2	Pre-test	67	33,91	3,969	19	44
	Post-test	67	45,88	2,319	38	49
	Total	134	39,90	6,825	19	49

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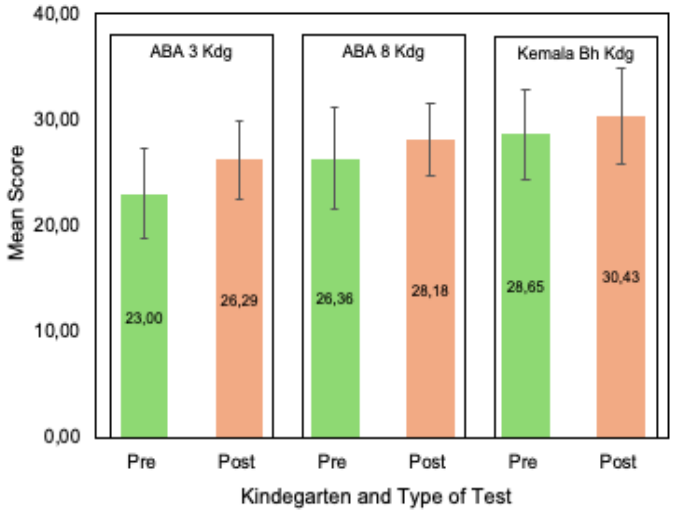

Figure 1. Descriptive Statistical Analysis Diagram of WM Control Group

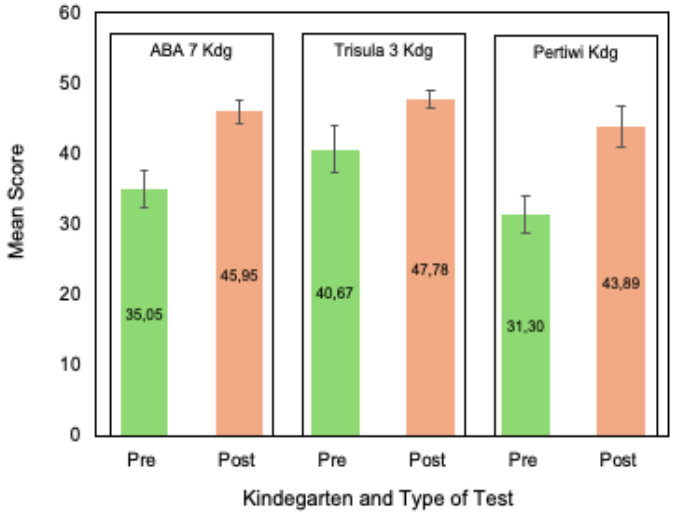

Figure 2. Descriptive Statistical Analysis Diagram WM Experimental Group 1

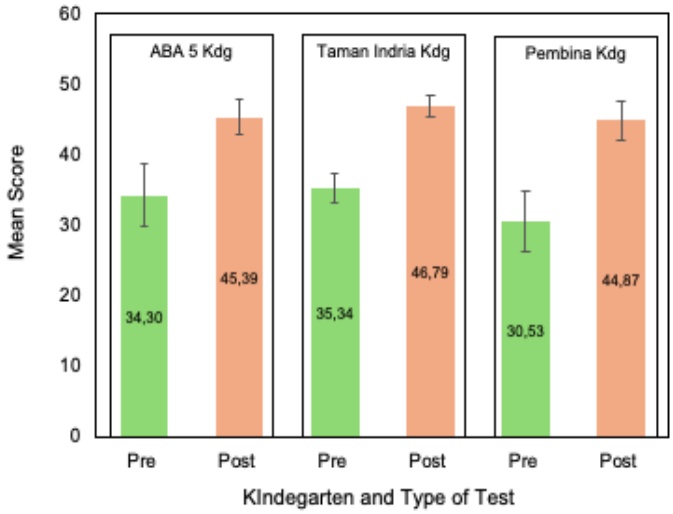

Figure 3. Descriptive Statistical Analysis Diagram WM Experimental Group 2

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Furthermore, the results of the One-Way ANOVA test to determine the differences in WM between groups, namely the control group, Experiment Group 1, and Experiment Group 2 in table 4, yielded a significance value of 0,000 (sig. 0,000 < 0,05), which means that there are differences in WM based on the group. The Control group is significantly different from Experiment Group 1 and Experiment Group 2. Additionally, Experiment Group 1 is significantly different from the Control group, and Experiment Group 2 is also significantly different from the Control group.

Table 4. One-Way ANOVA Test Results by Group

Group	Mean	Std. Deviation	F	Sig.
Control	28,71	4,376		
Eksperiment 1	45,25	2,665	503,138	0,000
Experiment 1	45,88	2,319		
Total	40,85	8,225		

The results of the One Way ANOVA test based on OLA treatments, including Kubro Siswo dance, Engklek, and fun cooking, in Table 5, yielded a significance value of 0,000 (sig. 0,000 < 0,05), indicating that there are differences in WM-based on OLA treatments. Kubro Siswo dance is significantly different from Engklek and Fun Cooking, Engklek is significantly different from Kubro Siswo dance and fun cooking, and fun cooking is significantly different from Kubro Siswo dance and Engklek. Therefore, it can be concluded that the Engklek treatment is the OLA treatment with the highest average WM value of 47,03, followed by the Kubro Siswo dance treatment with an average WM of 45,65, and lastly, the fun cooking treatment with an average WM of 44,24.

Table 5. Results of One-Way ANOVA Test based on OLA Treatment

Treatment OLA	Mean	Std. Deviation	F	Sig.
Kubro Siswo dance	45,65	2,069	15,471	0,000
Engklek	47,03	1,515		
Fun Cooking	44,24	2,870		
Total	45,59	2,492		

The N-Gain Score test was conducted to evaluate the effectiveness of the OLA model in improving children's WM. Based on the N-Gain Score analysis results in Table 6, the average N-Gain Score in the Control group was 9,10. Meanwhile, the average N-Gain Score for Experimental Group 1 reached 77,29, and the average N-Gain Score for Experimental Group 2 reached 80,50. In the Control group, the N-Gain Score of 9,10<40 indicates that the group not given the OLA treatment was not effective in improving WM. In contrast, Experimental Group 1 and Experimental Group 2, which were given the OLA treatment, achieved N-Gain Scores of 77,29 and 80,50, respectively, both greater than 76, indicating that Experimental Group 1 and Experimental Group 2 were effective in improving children's WM.

Table 6. N-Gain Score Results of OLA Treatment

Group	Highest N-Gain Score	Lowest N-Gain Score	Average N-Gain Score	Effectiveness Interpretation
Control	59,09	-11,11	9,10	9,10<40 (Not Effective)
Experiment 1	100,00	47,62	77,29	77,29>76 (Effective)
Experiment 2	100,00	55,00	80,50	80,50>76 (Effective)

DISCUSSION

Through this experiment, we found that the control group and experimental groups 1 and 2 differ in their average working memory as a result of OLA activities. It indicates that the average working memory significantly improved when implemented in the experimental groups. Thus, it is interpreted that there is a need for a planned outdoor play activity stimulus to enhance children's working memory capacity. This is in line with research findings that state that children's cognitive abilities are closely related to brain function, and neuroscience is fully connected to the learning process.[4] Supported by a report from the World Health Organization (WHO)[5], around 340 million children and adolescents aged 5-19 years, or one in five children (18,4 %), are globally affected by obesity. Additionally, statistical data shows that 80 % of school-aged children are not

physically active, which impacts children's health, particularly their cognition and academic performance. So, outdoor play activities become one of the solutions to address children's obesity and academic issues.

The existence of research findings state that physical activities in OLA, such as swinging, jumping, kicking, and running, can supply blood to the child's brain and cause natural chemicals that support a greater number of neuron connections.[26] Additionally, children's physical activity can also increase by 22 % when designed in OLA.[25] So it is hoped that in the future there will no longer be any restrictions on physical activity;[35] the trend of schools reducing break times, eliminating physical activities in OLA, and limiting the scope of physical movement in the learning environment[4]; schools in America that reduce or even eliminate recess[40]; as well as policymakers, teachers, and parents who underestimate the benefits of OLA under the pretext of improving the quality of learning.[41]

The results of a survey of 481 childcare centers in Texas show that the most needed improvement for the quality of OLA is to create an environment with nature, vegetation, play paths, and learning arrangements. However, early childhood educators have not provided students with the opportunity to learn through outdoor learning activities every day for various reasons[42] including concerns about the risk of injury[36] and the lack of teacher knowledge on how to utilize space and play elements.[37] Therefore, educators need to be equipped with education about OLA that contributes to the developmental aspects of children, namely motor skills, language, cognitive, and socio-emotional development of preschoolers.[43]

The development of the OLA model based on Javanese culture is designed in activities such as playing Kubro Siswo dance, Engklek, and fun cooking. Based on the analysis of the N-Gain score, the results showed that the N-Gain Score reached 77,29 and 80,50, which means the N-Gain score value >76, thus categorized as effective[39] in improving the working memory of early childhood children. Based on the one-way ANOVA test conducted on the three treatments, the Engklek game produced the highest average, with a WM average of 47,03, followed by the Kubro Siswo dance game with an average of 45,65, and fun cooking with an average score of 44,24.

The stages of the child's memory process begin with the sensory register receiving uncoded information (input). Visual input is stored in visual form while audio input is stored in audio form, and the sensory register stores a lot of information at one time because it has a large capacity. Information is transferred to working memory, requiring the role of attention, which focuses mental processing on specific stimuli.[44] This Javanese culture-based OLA is one of the stimuli to enhance children's WM. Figure 4 shows a model of the human memory system.

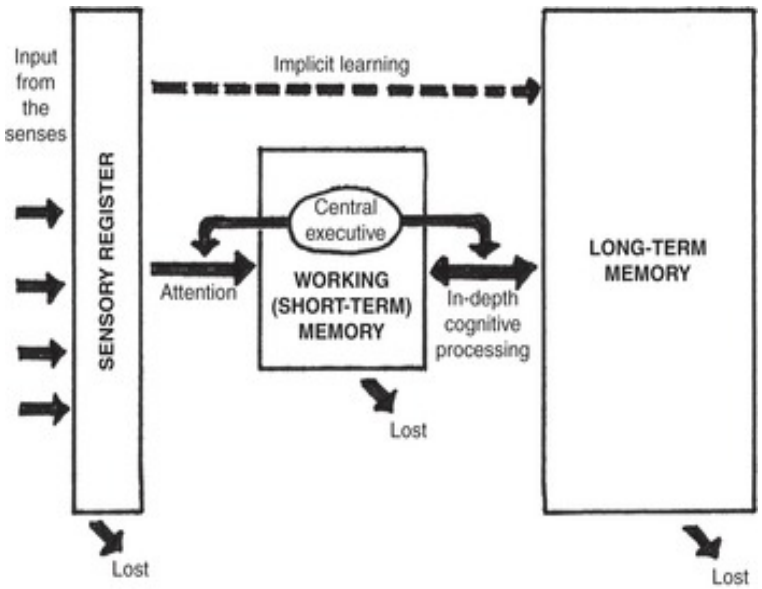

Figure 4. Model of the Human Memory System[44]

Through the Kubro Siswo dance, the balance of left and right brain abilities and functions is activated, enabling the development of children's intelligence, namely intellectual intelligence (IQ), emotional intelligence (EQ), creativity intelligence (CQ), spiritual intelligence (SQ), and multiple intelligence (MI).[45] The kubro siswo dance movements are more varied[46] and simple, making them easy for young children to imitate. The cultural educational value of Kubro Siswo dance can develop children's local cultural awareness by using Islamic-themed Javanese song lyrics, which can introduce the Javanese language to early childhood.[29]

Furthermore WM can improve because, through the Kubro Siswo dance, students' brains can remember the rhythm, movements, and music simultaneously. This is in line with the opinion of Gordon et al.[32] who argue

that a child's WM is demonstrated in their ability to remember, follow instructions, and recall to use certain strategies. Supported further by the kubro dance accompanied by gamelan, which can increase the production of endorphins. Endorphins are hormones produced by the pituitary gland, a small gland located in the brain, which are circulated throughout the body via the nervous system.[47] Through physical activity[48] and the music from the gamelan of the kubro dance, endorphin levels can be increased[48,49], which functions to induce feelings of happiness, comfort, and confidence in children, thereby balancing the functioning of the left and right brain and allowing for the development of many creative ideas.[49]

Engklek received the highest average score because, in the procedure of playing Engklek, the researcher also provided card media designed to stimulate working memory. Additionally, the game of Engklek can also stimulate children to understand the concept of numbers.[50] For instance, during the game, children are asked to throw a stone onto a geometric shape that has been numbered and are then asked to state the number where the stone landed. The game of Engklek stimulates children to remember a number concept when the stone is thrown and the teacher asks questions about the number concept and geometric shapes. The child's working memory is demonstrated in the child's ability to remember.[32]

Fun cooking traditional Javanese food, especially from Magelang, which is making Gethuk.[31] Gethuk is a flagship culinary product of the city of Magelang made from processed cassava.[51] The making of Gethuk begins with peeling the cassava, then steaming it. After steaming, the cassava is removed, sprinkled with salt and sugar, and then pounded using a pestle. After the dough is ready, food coloring is added and it is molded to enhance its appearance.[53,54] WM can improve because the child is stimulated to remember the sequence or steps of making Gethuk according to the order conveyed by the educator. This is in line with the opinion of Gordon et al.[32] who argue that a child's WM is demonstrated in the child's ability to remember and execute instructions.

CONCLUSION

The effectiveness of Javanese culture-based OLA is demonstrated by an N-Gain Score in the Experimental group >76, which means that the Javanese culture-based OLA model is effective in improving children's working memory. The analysis results show that the average working memory achievement in each OLA activity indicates the Kubro Siswo dance treatment at 45,65, Engklek at 47,03, and Fun Cooking at 44,24. It can be concluded that the Engklek treatment is the OLA treatment with the highest average working memory score, followed by the Kubro Siswo treatment and lastly the Fun Cooking treatment.

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