

Cultivating 21st century Learning Skills: The Effect of Song-based Music and Movement on Elementary-age Children's Kinesthetic Skills

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ABSTRACT

Kinesthetic skills play a crucial role in young children's growth development, yet this development had received less attention. The purpose of this study was to investigate the effect of song-based music and movement intervention on kinesthetic skills among elementary-age children. Ancillary purposes of this study were to investigate the contribution of kinesthetic abilities to 21st century learning skills. The participants for this study consisted of 60 students with ages ranging from 7 to 9 years from four different daycare centers in Malacca. This study conducted a randomized pre-post-test between-subjects experimental designs and participants were exposed to no treatment, song-based, music and movement, and song-based music and movement interventions. The treatment sessions were 30-minute session per week for an eight-week duration. The kinesthetic skills were assessed through researcher-adapted measurement forms, Kinesthetic Skill Test (KST). The results indicated that the song-based music and movement intervention significantly improved kinesthetic skills and the kinesthetic variables contributed to critical thinking and creativity skills. The suggested intervention is highly beneficial in preparing young children to become successful learners.

Contribution/Originality: The result of this study provides the education industry awareness on importance of multiple intelligences including kinesthetic, social, and linguistic skills which contribute to the 21st century learning skills.

1. Introduction

21st century learning skills bring a new transformation of teaching approach to lead the learner to engage knowledge through exploratory method. The traditional teaching method which involves "3Rs" as writing, reading and arithmetic has no longer led the individual to be a mature and active competitor in the future working industry ([Alismail](#)

& McGuire, 2015). Various researchers have identified the importance of implementing 21st- century learning skills in the education industry (Kim et al., 2019; Laar et al., 2020; Stehle & Burton, 2019). The 21st century learning skills involve the complex processes that have been categorised into critical thinking, communication, collaboration, creativity, culture, and connectivity, i.e., the 'six Cs' skills (Anugerahwati, 2019). A learner-centered approach has been widely utilised by designing project- and problem-based tasks for the individuals to develop new skills and knowledge through classroom experiences (Ali, 2019; Allen et al., 2010).

Kinesthetic skills play a crucial role in a young child's development. Children learn to successfully control body movements as they mature. Babies start to discover and experience their surroundings through body movement and sensations, Piaget (1970) categorizes this stage as sensorimotor. Infants respond to music more actively through body movement after age six months. Infants and toddlers lack fine motor control in comparison to elementary school-age children. Toddlers can, however, follow instructions that incorporate gross motor activities such as hopping and running. Moog (1976) identified that children at age two respond more actively, maturely, and dramatically to music as they can control gross motor such as foot movements, head nodding, and raising/lowering heels. They can imitate teachers and transform body movements into recognizable dance steps. Berger and Cooper (2003) also noted movement as the main component with children learning music.

Music and movement interventions have been explored for decades and many researchers have focused on the contribution of music and movement to the 21st century learning skills (Benedict et.al, 2014; Chua & Ho, 2017; Davidova, 2019). Researchers have infused both approaches by providing music and movement lessons that include critical thinking and creative thinking activities (Meyer, 2021; Murillo, 2017). These lessons allow learners to experiment, imagine, and explore various content and ideas (Meyer, 2021).

2. Literature Review

Music and movement have always been intertwined. Babies begin to learn music and dance by singing and moving with their mothers. Music helps babies to express their emotions, intentions, and interests (Pelosi & Henderson, 2010). Plato and Aristotle associated the importance of music with the gymnasium. The "gymnasium" method can be characterised as physical training (Burkholder et al., 2019; Stamou, 2002). Kolodziejski et al. (2014) provided evidence that music and movement interventions have allowed educators to design the music curriculum according to the classroom setting, participant ages, and intended lesson outcome. Thus, there are variety of music and movement interventions that have been utilized such as the Orff Approach, Dalcroze's Eurhythmic, Kodaly's method and Suzuki methods (Tabuena, 2021).

Music lessons infused various activities such as singing, body movement, group activities, and dancing promote student engagement (Welch et al., 2020). Play strategies have also been widely infused in music and movement intervention by providing children a relaxed, engaging learning environment to improve knowledge and skills (Mathur, 2021).

Singing provides the foundation of song-based intervention. People from different backgrounds can make music together by singing in a choir. People can communicate emotions, experiences, and moods through singing (Cabaleiro et al., 2017; Juslin, 2013).

Welch (2012) further elaborated that choral singing improves social awareness, self-efficacy, self-confidence, and a sense of belonging to a group. Both Governor (2011) and Jensen (2005) also posited that singing can be a useful teaching strategy for imparting information. Music can help students to memorise information more effectively and recall it later. In a recent study, Dowling et al. (2020) noted a mothers' singing of rhymes and lullabies for young children as highly beneficial to early exposure, growth, and development. Children can learn and relax through the social activity of singing. As a result, numerous scholars have proposed and modified different song-based methodologies.

Kinesthetic intelligence is the ability to control gross and fine motor movements to accomplish certain goals. Vancea (2017) states that students with kinesthetic intelligence can develop muscle control and body awareness, allowing them to overcome challenges within their environment. The criteria of kinesthetic measurements include speed, balance, fluency, and flexibility when problem-solving (Berenden et al., 2002; Gardner et al., 1998). Kinesthetic intelligence can be assessed through measurement tools and methods, and should include creativity to evaluate the different dimensions of kinesthetic intelligence (e.g., rhythm awareness, motor control, expressiveness, creativity, and music appreciation). Subjects are tested through different tasks that include basic motor actions, problem-solving, and complex cognitive functioning. They may be given new tasks, which are more complex and require advanced motor control after the basic test (Berenden et al., 2002).

Various researchers have identified different approaches to investigate young children's kinesthetic abilities. Michelaki and Bournelli (2016) conducted a study in Athens, Greece which involved thirteen students participating in a creative dance session. Project Spectrum has been utilized to assess kinesthetic intelligence and is an observational-based tool to investigate preschool children's performances over time. Michelaki and Bournelli (2016) further claim that the five abilities of body control, sensitivity to rhythm, expressiveness, generation of movement ideas, and object manipulations can be observed throughout the treatment sessions. Students are observed longitudinally, which is supported by Gardner (1993) who noted children should be evaluated through daily activities rather than brief tests. The children participated in seven lessons that were recorded and then rated by two experts. However, the researcher only evaluated children's creative dance movement and not physical skills. Triana (2017) states that kinesthetic intelligence can be measured through attitude. The study uses a purposive sampling technique which involved 17 students enrolled in dance and choreography lessons. Triana (2017) requested subjects to design dance movements within a set time duration. Students were tested on gross and fine motor control, and evaluated on dance arrangement instruments, kinesthetic skills, movement communication, and movement perception.

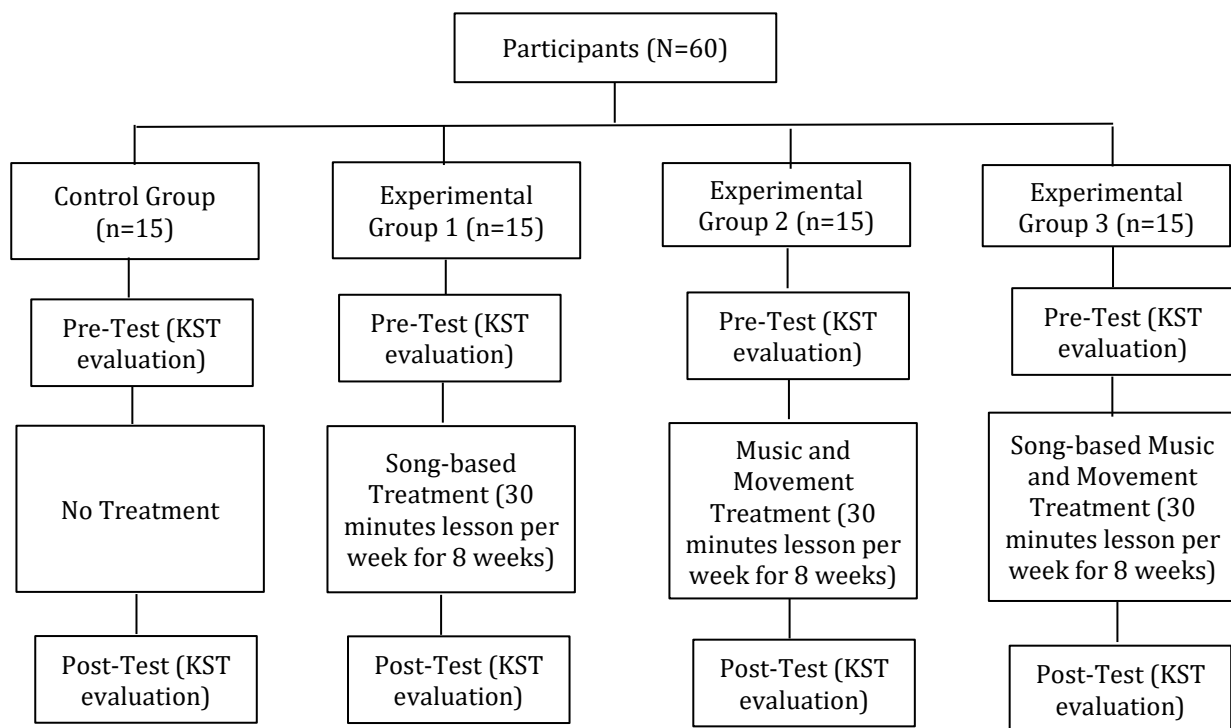
Many researchers have investigated the effectiveness of music-based intervention on different abilities and intelligences such as mathematic skills (Bakar & Samsudin, 2012; Samsudin et al., 2019), linguistic skills (Palupi et al., 2019; Latham, 2018), and social skills (Ozturk & Can, 2020; Yanko & Yap, 2020). Although many studies have explored the effectiveness of music and movement intervention on kinesthetic skills (Kolodziejski et al., 2014; Mueller, 2003), there is limited data on the effectiveness of singing activities on kinesthetic skills. Most studies involved kindergarten-age children (Luen et al., 2019; Michelaki & Bournelli, 2016).

Therefore, this study aimed to investigate the effects of song-based music and movement intervention on kinesthetic skills among children from seven to nine years of age. The experimental design examined the causal effect of song-based music and movement on elementary-age children's kinesthetic abilities. The study hypothesised that the song-based music and movement intervention can improve the elementary-age children's kinesthetic skills.

3. Method

A quantitative causal-effect research project was designed to investigate the effectiveness of a song-based music and movement intervention on kinesthetic skills among children ages 7–9. The study was conducted at a childcare centre in Malacca, Malaysia. The intervention was comprised of eight 30-minute sessions within a three-month data collection timeframe. Figure 1 shows the procedure of the data collection.

Figure 1: Assignment path of variables, measurements, participants numbers, and treatment duration



3.1. Participants

Participants (N=60) in this study were children ranging in age from seven to nine. Participants did not have previous music lesson experiences. The children were randomly divided into four groups: Group One with no treatment (n=15), Group Two with song-based intervention (n=15), Group Three with music and movement intervention (n=15), and Group Four with a song-based music and movement intervention (n=15).

3.2. Independent Variables

The independent variables for this study were the four different treatment interventions: (1) control group, (2) song-based intervention, (3) music and movement intervention, and (4) song-based music and movement. The control group did not receive any

treatment. The song-based intervention participants were required to sit in a circle and sing the songs, with the instructor providing background information on the song ("story telling") for context and group discussions. The music and movement intervention required participants to incorporate body movements with music activities. Singing was not included in this treatment. The song-based music and movement intervention included musical activities such as roleplaying, dance, storytelling, playing unpitched percussion instruments, and playing musical games while simultaneously singing the new song.

3.3. Dependent Variables

The dependent variables evaluated were: (1) gross motor skills, (2) fine motor skills, and (3) balancing skills. The gross motor dimension involved two variables: (1) catching the ball with two hands and (2) throwing the beanbag on the mat. The fine motor dimension contained three variables: (1) placing the pegs with preferred hand, (2) placing the pegs with non-preferred hand, and (3) threading lace. The balancing dimension included five variables: (1) preferred-leg balance, (2) non-preferred leg balance, (3) preferred-leg jump, (4) non-preferred jump, and (5) walking heel-to-toe forward.

3.4. Instrumentation

The Kinesthetic Skill Test was adapted from existing kinesthetic skills measurement rating forms, Movement Assessment Battery for Children- Second Edition (MABC-2). Three experienced primary school teachers were invited for two 60-minute discussion sessions, in which they gave professional suggestions and advice to improve the test's content validity.

The KST used a 10-point scale to measure participants' gross motor skills by calculating the amount of the goals. The fine motor skills were evaluated based on the time required for participants to complete the tasks. The balancing test for preferred- and non-preferred-leg balance were evaluated on the length of time participants were able to balance on one leg. The preferred- and non-preferred-leg jumps, and the walking heel-to-toe activities, were evaluated on the number of steps participants completed.

3.5. Materials

The song-based and song-based music and movement intervention sessions involved traditional children's songs such as *If You're Happy*, *Changing Partners*, *I'm a Little Tea Pot*, and *The Captured Bird*. Students learned the songs with piano accompaniment. The music and movement intervention and song-based music and movement intervention utilised body movements combined with props and unpitched percussion instruments (e.g. triangle, wooden T-shape block with heater, castanets).

3.6. Data Collection Procedure

The interventions were conducted in eight 30-minute sessions for each experimental group. Both pre- and post-test evaluations shared the same procedures to measure participants' kinesthetic skills. Participants were assigned to participate to every tests. The whole process of pre- and post-test evaluation was videotaped to record participants' achievements.

3.7 Data Analysis Procedure

The results were analysed in two ways—descriptive and inferential. The descriptive analysis included mean scores, the mean difference, and standard deviation. These dimensions included different scales to convince the accuracy of the data for each dimension.

4. Results

The data were analysed using SSPS software to investigate the effectiveness of different interventions on elementary-age participants' kinesthetic skills. The participants' kinesthetic skills were measured in three main dimensions: (1) gross motor skills, (2) fine motor skills, and (3) balancing skills.

Table 1, Table 2, Table 3, Table 4, and Table 5 display the pre- and post-tests' means, standard deviations, and the mean difference of the raw scores for kinesthetic skills achievement of gross motor, fine motor, and balancing for the control group and the three experimental groups. The Gross Motor Test (GMT) consisted of two items evaluated on a 10-point scale, yielding a maximum possible score of 20. The Fine Motor Test (FMT) consisted of three items. The placing of peg items and threading lace items were evaluated the length of time to complete the task. The Balancing Test (BT) consisted of 3 items. The one-leg balance items were evaluated by recorded the length of time to maintain with a maximum score of 30 seconds per leg. The walking heel-to-toe in a forward motion was evaluated by number of steps completed with a maximum score of 15 steps. The hopping on mats item was evaluated by hops completed with a maximum score of 6 hops on each leg.

Table 1 shows the data of the gross motor variables for the Kinesthetic Skill Test (KST). The pre-test gross motor mean scores for the two individual items ranged from 4.93 (*Gross Motor 1*) to 7.53 (*Gross Motor 2*) for the Control Group (CG), ranged from 5.64 (*Gross Motor 1*) to 7.93 (*Gross Motor 2*) for Experimental Group 1 (EG1) (song-based only), ranged from 6.87 (*Gross Motor 1*) to 7.47 (*Gross Motor 2*) for Experimental Group 2 (EG2) (music and movement), and ranged from 4.13 (*Gross Motor 1*) to 6.87 (*Gross Motor 2*) for Experimental Group 3 (EG3) (song-based music and movement). The post-test's mean scores ranged from 5.00 (*Gross Motor 1*) to 7.60 (*Gross Motor 2*) for the CG, ranged from 6.73 (*Gross Motor 1*) to 7.40 (*Gross Motor 2*) for EG1 (song-based only), ranged from 7.13 (*Gross Motor 1*) to 9.00 (*Gross Motor 2*) for EG2 (music and movement), and ranged from 6.27 (*Gross Motor 1*) to 7.67 (*Gross Motor 2*) for EG3 (song-based music and movement). By comparing the pre- and post-test, the mean difference for CG and EG 1, 2, and 3 ranged from 0.07 (*Gross Motor 1*) to 0.07 (*Gross Motor 2*), -0.53 (*Gross Motor 2*) to 1.09 (*Gross Motor 1*), 0.26 (*Gross Motor 1*) to 1.53 (*Gross Motor 2*) and 0.80 (*Gross Motor 2*) to 2.14 (*Gross Motor 1*) respectively.

The results shown in Table 1 illustrate higher mean differences for the song-based music and movement intervention (EG3) than the CG, music and movement intervention (EG 2), and song-based intervention (EG1) in the Gross Motor 1. For the Gross Motor 2, the music and movement intervention (EG2) scored a higher mean value and mean difference than the CG and the EG 1 and 3. Yet, EG 3 scored the highest mean difference average among the three groups.

Table 1: Pre- post-test mean, standard deviation and mean difference for gross motor variables in Kinesthetic Skill Test for CG, EG 1, EG 2 and EG 3.

KST Test												
Variable	Control Group (n=15)			Experimental Group 1 (n=15)			Experimental Group 2 (n=15)			Experimental Group 3 (n=15)		
	Pretest	Posttest	MD	Pretest	Posttest	M D	Pretest	Posttest	MD	Pretest	Posttest	MD
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Gross Motor 1	4.93 (1.75)	5.00 (1.77)	0.07	5.64 (3.09)	6.73 (1.98)	1.0 9	6.87 (3.68)	7.13 (2.47)	0.26	4.13 (2.95)	6.27 (2.25)	2.14
Gross Motor 2	7.53 (1.55)	7.60 (1.88)	0.07	7.93 (1.75)	7.40 (1.55)	- 0.5 3	7.47 (1.92)	9.00 (1.60)	1.53	6.87 (1.92)	7.67 (1.54)	0.80
Mean Difference Average			0.07			0.2 8			0.90			1.47

Note: MD = Mean Difference

Table 2 data reveals that the fine motor variables of Kinesthetic Skill Test (KST), the pre-test mean scores for the three individual items ranged from 0.48 (*Fine Motor 1*) to 0.89 (*Fine Motor 3*) for the CG, ranged from 0.40 (*Fine Motor 1*) to 0.64 (*Fine Motor 3*) for EG1 (song-based only), ranged from 0.38 (*Fine Motor 1*) to 0.72 (*Fine Motor 3*) for EG2 (music and movement), and ranged from 0.52 (*Fine Motor 1*) to 1.00 (*Fine Motor 3*) for EG3 (song-based music and movement).

Table 2: Pre- post-test mean, standard deviation, and mean difference for three individual items for fine motor in Kinesthetic Skill Test for CG, EG1, EG2 and EG3.

KST Test												
Variable	Control Group (n=15)			Experimental Group 1 (n=15)			Experimental Group 2 (n=15)			Experimental Group 3 (n=15)		
	Pretest	Posttest	MD	Pretest	Posttest	MD	Pretest	Posttest	MD	Pretest	Posttest	MD
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Fine Motor 1	0.48 (0.23)	0.54 (0.27)	0.06	0.40 (0.08)	0.41 (0.09)	0.01	0.38 (0.07)	0.36 (0.08)	-0.02	0.52 (0.16)	0.49 (0.06)	-0.03
Fine Motor 2	0.68 (0.32)	0.68 (0.30)	0.00	0.55 (0.21)	0.60 (0.28)	0.05	0.46 (0.18)	0.42 (0.19)	-0.04	0.70 (0.25)	0.60 (0.31)	-0.04
Fine Motor 3	0.89 (0.38)	0.90 (0.45)	0.01	0.64 (0.37)	0.58 (0.31)	-0.06	0.72 (0.76)	0.58 (0.54)	-0.14	1.00 (0.38)	0.68 (0.40)	-0.32
Mean Difference Average			0.02			0			-0.06			-0.13

Note: MD = Mean Difference

The post-test mean scores ranged from 0.54 (*Fine Motor 1*) to 0.90 (*Fine Motor 3*) for the CG, ranged from 0.41 (*Fine Motor 1*) to 0.60 (*Fine Motor 2*) for EG1 (song-based only),

ranged from 0.36 (*Fine Motor 1*) to 0.58 (*Fine Motor 3*) for EG2 (music and movement), and ranged from 0.49 (*Fine Motor 1*) to 0.68 (*Fine Motor 3*) for EG3 (song-based music and movement). By comparing the pre- and post-tests, the mean difference for CG and EG 1, 2, and 3 ranged from 0.00 (*Fine Motor 2*) to 0.06 (*Fine Motor 1*), -0.06 (*Fine Motor 3*) to 0.05 (*Fine Motor 2*), -0.04 (*Fine Motor 2*) to -0.14 (*Fine Motor 3*), and -0.32 (*Fine Motor 3*) to -0.03 (*Fine Motor 1*) respectively.

The results shown in Table 2 illustrate lower mean values and mean differences for the song-based music and movement intervention (EG3) than the CG, song-based intervention (EG1), and music and movement intervention (EG2) in the fine motor scores for Kinesthetic Skill Test (KST).

The data in Table 3 shows that for the balancing variables of Kinesthetic Skill Test (KST), the pre-test mean scores for the two individual items ranged from 19.56 (*Balancing 2*) to 21.80 (*Balancing 1*) for the CG, ranged from 20.86 (*Balancing 2*) to 22.53 (*Balancing 1*) for EG1 (song-based only), ranged from 19.19 (*Balancing 2*) to 20.66 (*Balancing 1*) for EG2 (music and movement), and ranged from 18.10 (*Balancing 2*) to 18.89 (*Balancing 1*) for EG3 (song-based music and movement).

Table 3: Pre- post-test mean, standard deviation, and mean difference for two individual variables of balancing in Kinesthetic Skill Test for CG, EG1, EG 2, and EG 3.

KST Test												
Variable	Control Group (n=15)			Experimental Group 1 (n=15)			Experimental Group 2 (n=15)			Experimental Group 3 (n=15)		
	Pretest	Posttest	MD	Pretest	Posttest	MD	Pretest	Posttest	MD	Pre test	Posttest	MD
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Balancing 1	21.80 (9.43)	22.15 (8.92)	0.35	22.53 (8.44)	23.63 (9.50)	1.10	20.66 (9.79)	22.14 (9.05)	1.48	18.89 (11.83)	21.10 (9.89)	2.21
Balancing 2	19.56 (10.56)	20.55 (8.27)	0.99	20.86 (10.80)	22.53 (8.71)	1.67	19.19 (11.45)	25.20 (5.96)	6.01	18.10 (10.68)	26.74 (5.18)	8.64
Mean Difference Average			0.68			1.39			3.75			5.43

Note: MD = Mean Difference

The post-test's mean scores ranged from 20.55 (*Balancing 2*) to 22.15 (*Balancing 1*) for the CG, the mean ranged from 22.53 (*Balancing 2*) to 23.63 (*Balancing 1*) for EG1 (song-based only), the mean ranged from 22.14 (*Balancing 1*) to 25.20 (*Balancing 2*) for EG2 (music and movement), and ranged from 21.10 (*Balancing 1*) to 26.74 (*Balancing 2*) for EG3 (song-based music and movement). By comparing the pre- and post-test, the mean difference for CG, EG1, 2, and 3 ranged from 0.35 (*Balancing 1*) to 0.99 (*Balancing 2*), 1.10 (*Balancing 1*) to 1.67 (*Balancing 2*), 1.48 (*Balancing 1*) to 6.01 (*Balancing 2*), and 2.21 (*Balancing 1*) to 8.67 (*Balancing 2*) respectively.

The data in Table 3 indicates higher mean values and mean differences for the song-based music and movement intervention (EG3) than the CG, song-based intervention (EG1), and

music and movement intervention (EG2) in the balancing scores for Kinesthetic Skill Test (KST).

The data in Table 4 illustrates the balancing variables of Kinesthetic Skill Test (KST). The pre-test's mean scores for the two individual items ranged from 3.60 (*Balancing 4*) to 3.93 (*Balancing 3*) for the CG, ranged from 4.33 (*Balancing 4*) to 4.80 (*Balancing 3*) for EG1 (song-based only), ranged from 3.93 (*Balancing 4*) to 4.07 (*Balancing 3*) for EG2 (music and movement) and ranged from 4.33 (*Balancing 4*) to 3.53 (*Balancing 3*) for EG3 (song-based music and movement). The post-test's mean scores ranged from 3.47 (*Balancing 4*) to 3.93 (*Balancing 3*) for the CG, the mean ranged from 4.20 (*Balancing 4*) to 5.13 (*Balancing 3*) for EG1 (song-based only), ranged 5.00 (*Balancing 4*) to 5.47 (*Balancing 3*) for EG2 (music and movement), and ranged from 5.00 (*Balancing 3*) to 5.47 (*Balancing 4*) for EG3 (song-based music and movement). By comparing the pre- and post-test, the mean differences for CG and EG 1, 2, and 3 ranged from -0.13 (*Balancing 4*) to 0.00 (*Balancing 3*), -0.13 (*Balancing 3*) to 0.33 (*Balancing 4*), 1.07 (*Balancing 4*) to 1.40 (*Balancing 3*), and 0.67 (*Balancing 3*) to 1.94 (*Balancing 4*) respectively.

The results in Table 4 show higher mean and mean differences values for the music and movement intervention (EG2) and song-based music and movement intervention (EG3) than the control group and song-based intervention (EG1) in the KST balancing scores. Yet, the EG 3 scored the highest mean difference average among the three groups.

Table 4: Pre- post-test mean, standard deviation, and mean difference for two individual variables of balancing in Kinesthetic Skill Test for CG, EG1, EG2, and EG 3.

KST Test												
Control Group (n=15)				Experimental Group 1 (n=15)			Experimental Group 2 (n=15)			Experimental Group 3 (n=15)		
Variable	Pretest	Posttest		Pretest	Posttest		Pretest	Posttest		Pretest	Posttest	
	Mean (SD)	Mean (SD)	MD	Mean (SD)	Mean (SD)	MD	Mean (SD)	Mean (SD)	MD	Mean (SD)	Mean (SD)	MD
Balancing 3	3.93 (1.28)	3.93 (1.53)	0.00	4.33 (1.54)	4.20 (1.37)	-0.13	4.07 (1.49)	5.47 (0.83)	1.40	4.33 (1.59)	5.00 (1.20)	0.67
Balancing 4	3.60 (1.59)	3.47 (1.81)	-0.13	4.80 (1.61)	5.13 (0.99)	0.33	3.93 (1.79)	5.00 (1.36)	1.07	3.53 (2.00)	5.47 (0.83)	1.94
Mean Difference Average			-0.07			0.10			1.24			1.31

Note: MD = Mean Difference

Table 5 shows the data of balancing variables for Kinesthetic Skill Test (KST). The pre-test mean score for the individual items scored with 8.73 (*Balancing 5*) for the CG, scored with 11.40 (*Balancing 5*) for EG1 (song-based only), scored with 13.40 (*Balancing 5*) for EG 2 (music and movement), and scored with 8.73 (*Balancing 5*) for EG3 (song-based music and movement). The post-test's mean scored with 9.87 (*Balancing 5*) for the CG, scored with 13.13 (*Balancing 5*) for EG1 (song-based only), scored with 14.27 (*Balancing 5*) for EG2 (music and movement), and scored with 13.60 (*Balancing 5*) for EG3 (song-based music and movement). The mean difference of the walking heel to toe forward variable

between pre-test and post-test scored for CG, EG 1,2, and 3 score with 1.14, 1.73, 0.87, and 4.87 respectively.

The results in [Tables 5](#) showed higher mean differences for the song-based music and movement intervention (EG3) than the CG, song-based intervention (EG1) and music and movement intervention (EG 2) in the KST balancing scores.

Table 5: Pre- post-test mean, standard deviation, and mean difference for an individual variable of fine motor in Kinesthetic Skill Test for CG, EG 1, EG 2 and EG 3.

KST Test												
Control Group (n=15)				Experimental Group 1 (n=15)			Experimental Group 2 (n=15)			Experimental Group 3 (n=15)		
Variable	Pretest		MD	Pretest		MD	Pretest		MD	Pretest		MD
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Balancing 5	8.73 (5.78)	9.87 (5.83)	1.14	11.40 (5.30)	13.13 (2.72)	1.73	13.40 (1.84)	14.27 (1.16)	0.87	8.73 (4.99)	13.60 (3.20)	4.87

Note: MD = Mean Difference

5. Discussion

Based on existing data, the following conclusions were derived from this study on the effectiveness of song-based music and movement interventions for kinesthetic skills development among primary school children (aged 7–9). Although music and movement and song-based music and movement interventions had significantly improved all variables of kinesthetic skills, The song-based music and movement intervention was significantly scored the highest for gross motor, fine motor and balancing variables in kinesthetic skills. As such, the results reveal song-based music and movement intervention as more effective for improving elementary-age children's kinesthetic skills.

The findings corroborate that previous researcher who identified that song-based music and movement intervention improves kinesthetic skills ([Derri et al., 2001](#); [Janzen et al., 2022](#); [Likesas & Zachopoulou, 2006](#)). In comparing the four groups, children exposed to the song-based music and movement intervention significantly achieved the highest improvement in kinesthetic skills. [Izumi-Taylor et al. \(2012\)](#) noted that a music and movement approach encouraged children to play by moving, listening, singing, and were encouraged to express their emotions. When learning through song-based music and movement, children are asked to experiment and explore gross and fine motor movements to synchronize their emotions to music. Music paired with movement helps children develop and improve kinesthetic skills. [Michelaki and Bournelli \(2016\)](#) identified that the music and movement approach has a close connection with the kinesthetic intelligence. Kinesthetic activities allow learners to explore body movement through class objects such as hoops, scarves, and balls. Exposure to song-based music and movement intervention develops students' kinesthetic skills. In a recent study, [Imankhah et al. \(2018\)](#) noted that play learning strategies were widely infused in the song-based music and movement intervention and directly and indirectly improved children's kinesthetic skills. Children are able to coordinate their body movement responses to the music by following the rhythm and pitch of the music.

The song-based music and movement intervention of this study supports previous researchers' findings and encouraged children to react to the music with voices and movements. Engaging in kinesthetic awareness helps children control the direction and weight of movement ([Seitz, 2005](#)). The brain directs the body to control pressure, muscle stretching, and positions to achieve certain goals. Children can identify their body parts by balancing and creating body movements ([Zachopoulou et al., 2004](#)). The music-based approach helps students control their speed, flow, force, and movement to music (e.g., walking rhythmically while singing and then running as the music accelerates).

The song-based music and movement intervention also scored higher in the Fine Motor Test (FMT) than the other three interventions. The three evaluations in FMT are placing pegs (preferred hand), placing pegs (non-preferred hand), and threading lace into cardboard. All tasks required the children to utilize fine motor skills for successful completion. This supports previous data from researchers. [Ay et al. \(2018\)](#) state that music and movement learning motivated children to be purposeful movers through body intelligence. Teachers have also transformed the teaching approach into a creative process that helps students learn to use their bodies effectively to solve problems. Children learning through music and movement utilize their bodies to convey emotions and ideas while coordinating the eyes and hands. The song-based music and music and movement interventions also included fine motor training such as finger tapping, finger crawling, and finger pointing.

When comparing the music and movement intervention to the song-based music and movement, although both groups improved scores, the song-based music and movement intervention revealed higher achievement. Few researchers have compared the effectiveness of song-based music and movement intervention to music and movement intervention on kinesthetic skills. Most researchers explored the effectiveness of a specific intervention ([Martins et al., 2018](#); [Venetsanou, et al., 2014](#)). Therefore, this research compared different music interventions on kinesthetic skills. The results indicate that combining singing and movement is more effective than movement only. The song-based music and movement intervention teaches children to engage in a new song for every session before being introduced to musical activities. The teacher tells the story of the song and teaches children the lyrics. Children learn to sing and add body movements by imitating the teacher. Singing teaches children to match pitch and tempi while express emotions through singing. According to [Latukefu \(2010\)](#), singing helps learners develop body awareness and coordinate muscles and bones to perform quality singing. [Mejzini \(2016\)](#) also stated that singing helps provide a pleasant learning environment that motivates students to participate in classroom activities. Students enjoy spontaneous changes in a song's dynamics and speed, and are able to coordinate the speed, force, and flow of their body movement while singing. Therefore, although singing does not train children's muscle control skills directly, children engage in kinesthetic experiences when participating.

The kinesthetic variables' tasks in this study evaluated kinesthetic skills and required students to analyze, interpret, and problem solve simultaneously. These results support the findings of previous researchers. Critical thinking involves mental processes which include identifying, analyzing, evaluating an argument, and integrating information to overcome problems ([Bassham et al., 2011](#)). The given tasks were reality-based projects which support researchers who identified that reality-based projects require students to learn from mistakes and establish personal enthusiasm ([Kivunja, 2014](#); [McCoog, 2008](#); [Norahmi, 2017](#)). For the gross motor measurement, students were allowed two trials

before being evaluated. They learned to react and correct mistakes spontaneously. [Birgili \(2015\)](#) noted that critical thinking helps learners to think autonomously and take action systematically to problem solve. Thus, kinesthetic variables contribute to critical thinking skills. The song-based music and movement intervention group significantly improved the three variables, which contributed to critical thinking skills.

The kinesthetic variables contributed to children's creativity. According to [Kampylis and Berki \(2014\)](#), creativity creates challenges and improves personal growth by creating ideas, questions, and hypotheses. Learners take responsibility through experimentation and evaluating personal and peers' ideas. After students realize the problem, they start to think of a good solution. How high do I have to bounce the ball? How much weight do I need to throw the bean bag to the goal? Then they experiment and analyze the results. Creative thinking skills are used simultaneously with muscle coordination. [Birgili \(2015\)](#) posits that creative thinkers can imagine and utilize their intelligence to create new ideas, and be trained to evaluate problems and find new solutions. Throughout the kinesthetic measurements, students were also thinking creatively. Therefore, kinesthetic variables contribute to creativity. In conclusion, the improvement of kinesthetic skills contributed to enhanced critical thinking and creativity among elementary-age children.

6. Implications of the Study and Recommendations Future of Research

According to the study's findings, learner-centered delivery strategies can replace one-way learning with a suitable song-based music and movement intervention. Children were not allowed to interact and play with peers with the suggested intervention during the pandemic. They were not allowed to experiment and enhance their kinesthetic skills because they could only attend classes online. The song-based music and movement intervention is recommended to unite children to enjoy music and exercise their kinesthetic skills within a classroom setting. In order for elementary-aged children to improve their kinesthetic skills, educators and parents are extremely important. Undoubtedly, the kinesthetic ability is essential for the children's growth developmental.

Children from various cultures and backgrounds might not be able to learn using the suggested instructional methods. It is advised that researchers use larger sample sizes and longer intervention periods in subsequent studies to examine the intervention's long-term efficacy. Along with looking at musical achievement, music researchers are urged to look at how song-based music and movement affect other skills (such as spatial and logical-mathematical). Additionally, it is advised that quantitative and qualitative designs be used by researchers because the qualitative data in this study enhanced and clarified the quantitative data.

Children's kinesthetic abilities can be improved by putting song-based music and movement intervention into practice. Children's memorization is improved thanks to their improved skills, and they become more curious about learning new things as a result.

Ethics Approval and Consent to Participate

The researchers used the research ethics provided by the Research Ethics Committee of University Malaya (UMREC). All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional

research committee. Informed consent was obtained from all participants according to the Declaration of Helsinki.

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Conflict of Interest

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

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