The effect of using an integrated technological physical activity program on improving fundamental movement skills of preschool children

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Abstract

This study evaluated the impact of an integrated physical activity (PA) program using a digital platform (GoMoodle®) to improve the fundamental movement skills (locomotor and object control skills) on preschool children. Quasi-experimental design is used to develop the current study with a single group pre and post test. The study sample comprised of 20 children (11 girls and 9 boys) between the age of 4 to 6 years. Participants completed pre-treatment test of growth motor development (TGMD-3) to determine their level of fundamental movement skills, then they participated in an integrated PA program using GoNoodle® for 6 weeks (3 times a week), then they performed a post-treatment test to determine the level of progress. Means, standard deviations, and t.test scores were used to assess before and after treatment fundamental movement skills. The results revealed significant improvement in the participants post-test scores; Locomotor subtest ($M = 5.0$, $SD = 0.86$, $p<0.008$), object control subtest ($M = 7.8$, $SD = 0.89$, $p<0.000$), and Total test scores ($M = 12.8$, $SD = 1.15$, $p<0.000$). findings suggest that using an integrated PA program using GoNoodle® will be beneficial in improving children's fundamental movement skills.

Keywords: Fundamental movement skills, Physical activity, Assessment, Motor development.

1) Introduction:

According to the world health organization (WHO) (WHO/Health and Well-being, 2022), healthy living requires a balance of many smart health choices such as; eating right, and daily physical activity (PA). Thus, promoting PA in a young age became essential. Simultaneously, research has proven the validity of different PA approaches to develop motor skills in school-setting (Demetriou et al., 2019). Therefore, researchers and health educators, prior, have classified PA activities into subcategories to meet standards of fundamental movement skills including object control (e.g. Kicking a ball), locomotor skills (e.g. Jumping), and gross motor skills (ex. Balancing) (Lima et al., 2022; Stodden et al., 2008). With that being said, studies shown the prevalence of sedentary behavior among children in young age, however the PA programs seemed promising and attractive. Some studies refer to those PA approaches as being boring and outdated. Therefore, looking into novel PA approaches became essential (Barnett et al., 2022).

While technology has been playing an empirical role in different sciences, physical educators tend to employ technological devices, tools, and curricula as integrated content to regular PA programs (Gao & Lee, 2019). Those novel technological patterns have included practicing PA through game-like exercises. Therefore, exergaming – which is a combination off games and exercise- has proven its validity in modernized PA programs (Gao et al., 2019), in addition, using devices such as virtual reality (VR) or meta-verse also considered essential in PA activities' content (Kiefer et al., 2017). However, some studies referred to the possibility of sedentary behavior occurrence due to using those new technological approaches as children will be isolated and less active when compared to traditional PA programs specifically in pre-school age.

Noteworthy, age appropriateness has been a trigger point in developing such technology in PA activities. While studies support the traditional activities to preschool children using out-door activities and games relying on movements, other studies support the notion that it is inappropriate to use technological devices with children in young age (Straker et al., 2018). Therefore, using such technology should always be monitored and observed with a pre-determined time frame for usage.

However, multiple technological-based activities have varied recently such as; exergaming (ex. Xbox), virtual reality (VR), and mHealth wearables (ex. Fitbit), the need to have an integrated PA program leaning toward educational curriculum is desired. GoNoodle ® has offered different learning skills through multiple platforms such as; Android ®, Apple store ®, and Microsoft ®(Whitney, 2016). In addition, they included different games to teach basic skills of various sciences, not only PA, but also English language skills, Math, science, etc. their PA skills, specifically, targeted body awareness, coordination, gross motor skills, fine motor skills, and locomotor skills. However, their educational games-like programs seemed professional and beneficial, the evaluation and assessment of the offered activities remain undiscovered and need more investigation (Dugger et al., 2020). With that being said, the aim of this research is to evaluate the effect of using an integrated PA program using GoNoodle ® application on improving fundamental movement skills on preschool children

2)Materials and Methods

2.1. Research design and setting

This research used the quasi-experimental design with a single group. Pre-test and post-test data were collected. Parental approvals were collected prior to the experiment. Ipad, overhead projector, and assistive devices were provided by the author and an assistant (AW). the experiment took place in the gym area. Sports equipment were provided by the daycare' s administration.

2.2. Participants

The sample comprised of 20 children (11 girls; Mage = 5.2, SD =0.83) recruited from Kinder care daycare, Saint Paul, Minnesota, USA. The inclusion criteria included the following; (1) children enrolled in the summer program; (2) no prior experience of GoNoodle; (3) healthy children only (no disability or disease detected); (4) age range from 4 to 6 years old.

2.3. Instrument

Test of growth motor development version 3 (TGMD-3) (Ulrich DA., 2016) was used to collect pre and post experiment data. The test has two subgroups (locomotor skills and object control skills). The locomotor skills comprised of the following; Running, Galloping, Hopping, Leaping, Horizontal Jumping and Sliding. While, the object control skills comprised of striking a stationary ball, stationary dribbling, catching, kicking, overhand throwing, and underhand rolling. Each group of skills was assessed individually and scores for each skill was collected as following; (0, for failure or 1, for success). The total of summation of each subgroup (24 performance criteria for locomotor; and 24 performance criteria for object control) was calculated then converted from raw score to standard score. Then, total score of both subgroups was calculated, likewise, the raw score was converted to standardized score. The maximum score achieved is 100; the greater the score, the better motor performance achieved.

2.4. procedures

Prior to experiment, all needed equipment and tools were collected at the test area as follows; playgroup ball, lightweight ball, basketball, tennis ball, soccer ball, softball, square beanbag, tape, 2 cones, plastic pat, and batting tee. Also, the author was certain of the assistant's capability to perform and understand the assessment. Each participant was assessed using TGMD-3 assessment. Both the author and the assistant have recorded failed and successful trials at the same time each assessment was performed. The time frame of each assessment was precise and firm as it should be completed within 20 minutes/one-time (no trials for each skill more than once).

The experiment lasted for 6 weeks (3 sessions/week), each session is 1 hour long. The

program targeted three main physical fitness components as follows; Endurance, Strength, and flexibility. Each component consists of three levels. In each level, assigned practices to develop motor skills such as; striking, kicking, foundation, advanced sports, walking, running skills. (Appendix A.). after the children choose their favorite cartoon character, the author played the videos using the Ipad and the overhead projector, then the teacher and the assistant helped the author to perform the activities included in the GoNoodle® platform. All children were certain to be engaged in the PA.

After the experiment, data were collected using the same assessment tool (TGMD-3) following the same procedures of data interpretation.

2.5. Data Analysis

Data analysis were conducted using SPSS 27.0 (SPSS Inc. Chicago, IL, USA). The raw data collected from pre-test and post-test were converted to standardized scores based on the TGMD-3 standardized table provided in the test manual. Then scores were used as descriptive analysis to determine means and standard deviations. Further, paired samples t-test was used to compare mean scores of test of growth motor development version 3 within scores retrieved from pre-test and post-test scores.

3)Results

Full demographic and anthropometric data were collected and presented in Table 1. The research sample comprised of 20 preschool children as following; (Female = 11; $Mean_{age}$ = 5.2 years, SD = 0.83; $Mean_{height}$ = 112.3cm, SD = 11.4; $Mean_{weight}$ = 18.6kg, SD =2.9).

Table 1. Demographic Characteristics of Participants (N=20)

Characteristics	N	% of total sample
Gender		
Male	9	45
Female	11	55
Ethnicity		
Caucasian	8	40
African-American	6	30
Hispanic or Latino	3	15
Asian	3	15
	Mean	**SD**
Age (years)	5.2	0.83
Height (cm)	112.3	11.4
Weight (kg)	18.6	2.9

When comparing between participants pre-test scores and post-test scores in locomotor subtest; the after-treatment scores (M = 5.0, SD = 0.86, $p<0.008$) were significantly higher than the before-treatment scores (M = 4.05, SD = 0.82). likewise, the comparison between pre and post test scores for object control subtest illustrated significant improvement between before-treatment scores (M = 5.9, SD = 0.72) and after-treatment scores (M = 7.8, SD = 0.89, $p<0.000$). consequently, the overall test scores illustrated significant improvement when compared the before-treatment scores (M = 9.95, SD = 1.05) to the after-treatment scores (M = 12.8, SD = 1.15, $p<0.000$). All subtest and overall test scores are presented in Table 2.

Table 2. Descriptive statistics and t-test of TGMD-3 subtests and total test score

	Pre-test		Post-test		Std. Error Mean	t	df	Sig. (2-tailed)
	Mean	SD	Mean	SD				
Locomotor skills	4.05	0.82	5.0	0.86	0.32	-2.96	19	0.008
Object Control Skills	5.9	0.72	7.8	0.89	0.23	-8.32	19	0.000
Total of Fundamental motor skills	9.95	1.05	12.8	1.15	0.36	-7.97	19	0.000

4) Discussion

The present study evaluated an integrated technological PA program using GoNoodle® platform. The results illustrated a significant improvement in fundamental movement skills. In details, children participated in the treatment had significant improvement in locomotor and object control skills which recorded by using the TGMD-3 assessment pre and post treatment.

In terms of fundamental movement skills, the study findings illustrated significant improvement in locomotor skills specifically after children performed the offered skills in the GoNoodle® platform. The results are in line with previous literature review which investigated similar integrated PA program but with different technological platforms. For instance, Webster et al., 2020, conducted a 2-arm intervention to evaluate a mobile-app to enhance fundamental movement skills through 12-week program. They used a physical fitness-structured app that included peer modelling and parent engagement. Their findings were inline with the feasibility and effectiveness of the mobile-app in enhancing motor skills. Following the same trend, He et al., 2021, conducted a systematic review and meta-analysis to determine the effectiveness of smartphone-based interventions on PA for children, the study outcomes indicated that using smartphone-based interventions is promising but should be implemented in regular PA programs. However, they only evaluated nine studies, but four studies of them used four different mobile applications in their interventions. Congruently, Bort-Roig et al., 2014, have systematically evaluated 26 articles to evaluate the effectiveness of using mobile-app on enhancing PA. Their outcomes implied that using smart apps is viable to promote PA among children. However, limited information about PA classification or motor skills presented in their study. In addition, Trost & Brookes, 2021, conducted a randomized controlled trial to evaluate the impact of using a digital application called Moovosity™ on promoting fundamental movement skills. Their study lasted for 8-weeks, their results illustrated the effectiveness of using Moovosity™, specifically, using the application has improved object control skills significantly. Also, the app has promoted locomotor skills but not to a significant level. With that being said, previous literature, approximately, supported the current study' results, indicating the effectiveness of using digital applications in promoting fundamental motor skills, however some studies support the notion that smart-apps should not be used solely but in parallel with the traditional PA programs.

5) Strengths and limitations

This study is the first according to the author's knowledge, specifically, it is the first study to use GoNoodle with preschool children. in addition, referring to the promising outcomes of the study, the GoNoodle might be a beneficial content to be integrated with the regular PA programs. However, those novel strengths, few limitations existed. First, GoNoodle content is not offering classified content according to sex, in other words, boys and girls will perform the same skills however they have different biological motor development. Second, sample size and demographic characteristics are limited, therefore including bigger sample size and representing different socioeconomic levels might develop different outcomes. Last, however, the GoNoodle content is offering wide range of skills and practices, but the curriculum is not sufficient enough

to be given as a sole content in a PA program.

6) Conclusion

The outcomes of this study suggest using GoNoodle content to promote fundamental motor skills of preschool children. Specifically, GoNoodle's content is considered a good source of an integrated program to be used with children in young age. Implications of this study will be beneficial to other researchers to compare and contrast between the current application and other PA applications, and for daycares to include GoNoodle content in their educational curricula.

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