

Article

Moving Motivation: A Mixed-Methods Study of Service Learning to Promote Physical Activity in Under-Resourced Youth

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Abstract

Guided by self-determination theory (SDT), this study aimed to examine the impact of All Stars Moving Together (ASMT), an 8-week school–university service learning program, on elementary children’s physical activity (PA), school-time behavior, and motivation. A concurrent theory-based mixed-methods study with 21 fourth graders from an under-resourced community (age 9–10) wore Moki PA trackers to capture step count and minutes of moderate-to-vigorous PA (MVPA) during school-time. Linear and generalized mixed-effects models examined school-day type on PA and benchmarks for meeting school-based PA (3000 steps; 20 min of MVPA). Self-efficacy and enjoyment were assessed using pictorial scales, and the focus groups explored program experiences thematically using the SDT framework. School day type showed significant main effects for steps ($F(5, 642) = 170, p < 0.001$) and MVPA ($F(5, 581) = 105, p < 0.001$), where school days with ASMT added an average of 2000–2400 steps and 10–12 min of MVPA compared to school days with no PA. Enjoyment of PA significantly increased ($p = 0.006, d = 0.75$). Thematic analysis revealed relatedness (support from peers, college students), competence (self-efficacy, positive feelings, perceived motor competence improvements), and autonomy through preferences and self-regulation of PA. ASMT significantly increased school-time PA and children’s enjoyment while fostering competence and relatedness among elementary children.

Keywords: service-learning programs; physical activity; elementary school students; mixed-methods study; under-resourced community; self-determination theory



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1. Introduction

Globally, it is estimated that 27.5% of adults and 81% of teens do not meet recommendations for physical activity [1]. Despite the well-documented benefits of physical activity (PA) for children’s physical, cognitive, academic, and mental health development [2–4], the most recent reports indicate that in the United States, only 21% of children ages 6–17 are meeting these recommendations [5]. PA national guidelines recommend that children between 6 and 11 years of age engage in at least 60 min of moderate to vigorous physical activity (MVPA) daily [6] and a range of 13,000 to 15,000 steps/day for boys and 11,000 to 12,000 steps/day for girls [7]. The Institute of Medicine [8] specifically calls for children to meet 30 min of MVPA during the school day, which includes time spent being active in physical education lessons. PA levels tend to decrease as children approach adolescence [9], and disparities are more pronounced among girls, children from lower-income households, and racial minorities such as African American and Hispanic children [10]. Children from

under-resourced communities also face persistent barriers to engaging in regular, structured PA [10,11]. Factors such as unsafe neighborhoods, limited access to recreational spaces, lack of financial means, or absence of adult support contribute to disproportionately low PA participation rates among youth from low-income and minority backgrounds [11].

Schools have been identified as ideal settings to promote equitable access to PA and provide additional opportunities for children to achieve recommended levels of MVPA and motor competence [2,12,13]. Despite public health recommendations, youth are not getting enough time in MVPA during regular elementary school PE classes [14] nor enough PE classes throughout the week [15].

In addition to increasing PA, school-based initiatives can foster self-efficacy and enjoyment, which are main affective behavior constructs known to be associated with improved PA behavior [16]. There is strong evidence supporting positive associations between regular PA and children's attitudes towards PA [17]. Motivation, particularly intrinsic motivation, is considered a central mechanism driving sustained PA engagement [17–19]. Self-Determination Theory (SDT) is a commonly used framework when considering motivation for PA [19]. SDT provides a strong theoretical lens for examining motivation in youth, highlighting the importance of satisfying three basic psychological needs: autonomy, competence, and relatedness [18]. This theory posits that the psychological satisfaction derived from autonomy, relatedness, and competence has positive outcomes, potentially increasing motivation and intention to be physically active [17–19]. School-based programs that successfully foster these needs are more likely to generate lasting behavioral change [20]. A better understanding of school-age children's attitudes and motivation towards PA can help both researchers and physical educators in the design of effective educational strategies [21].

Service-learning programs, where college students deliver PA sessions to school-age children, may be uniquely suited to promote motivation by offering personalized attention and positive role models to underserved minority communities [22]. However, there is a paucity of research regarding the potential of service learning school–university partnerships in delivering effective PA interventions [23,24]. Most research on service-learning scholarships in physical education teacher education programs has focused on preservice teacher outcomes rather than understanding if the service was effective in meeting the community needs [23]. Moreover, there is a lack of research examining the efficacy of service-learning programs on community participants' PA behavior and motivation [23]. Even fewer studies have applied a theory-driven, mixed-methods approach to better understand the impact and experiences of under-resourced communities, despite being the recommended research design for evaluating service-learning programs [24].

The purpose of this mixed-methods study was to evaluate the impact of the program All Stars Moving Together (ASMT), an 8-week school–university service-learning program, on children's PA school-time behavior and motivation. Specifically, we aimed to assess the program's efficacy on increasing MVPA and step count during school-time, intrinsic motivation, and gain insights about the experiences of youth grounded in SDT. We hypothesized that the ASMT program would be beneficial in increasing the number of children meeting school-based step count and MVPA recommendations, as well as developing positive attitudes towards PA. This study contributes to the limited body of literature examining the efficacy of service-learning models in physical education teacher education programs. Further contributions to the literature include findings from a theory-driven mixed methods study about PA that shares the insights and experiences of children from an under-resourced community.

2. Materials and Methods

2.1. Participants and Study Design

This study used a concurrent, theory-driven mixed-methods design. Guided by the SDT, we collected quantitative (MVPA, step counts, self-efficacy, and enjoyment questionnaires) and qualitative data (focus group discussion) to evaluate the experiences associated with the ASMT program. The quantitative and qualitative data were collected and analyzed separately but merged to enrich the understanding of participants' experiences. We used the Mixed Methods Article Reporting Standards (MMARS) to ensure reporting was appropriate and complete [25]. This study was approved by the Institutional Review Board of Monmouth University (FA2118). Written parental or legal guardianship was obtained, and for all children, verbal assent was obtained prior to any data collection.

A convenience sampling method was used to recruit participants for this study. In collaboration with school leadership, all fourth-grade students (aged 9–10 years) enrolled in a parochial school serving a predominantly low-income Hispanic population were invited to participate in the study. Since the inception of the ASMT program in 2017, the objectives have been to address the ongoing needs for increased PA opportunities at the school while developing motor skills and an appreciation for exercise and sports practice [26]. This study was conducted in Asbury Park (NJ, USA). Baseline assessments for this study were performed in October 2023. A total of 21 children participated in this study, supported by 13 college students enrolled in the service learning program. The lead researchers performed all assessments.

2.2. Program

The AMST sessions were facilitated by trained undergraduate students, known as college coaches, who enrolled in an experiential-service learning college course entitled School-Based Physical Activity during the fall semester of 2023. Under the guidance of a faculty member with expertise in physical education teacher education, sessions were designed and implemented by undergraduate students trained in health and PA promotion. Each college coach developed a PA session, which was reviewed by faculty before their session to ensure the content of their lessons was developmentally appropriate. The program lasted 8 weeks. A total of 12 PA sessions were delivered, consisting of 50-min sessions held twice weekly on Mondays during school time (10:15 to 11:05 a.m.) and Thursdays after school time (3:00 to 3:50 p.m.) in the parochial school gymnasium. PA sessions were structured as follows; (a) Introduction: name tag distribution, college coaches connections through social-emotional learning activities and review of program expectations “play safe, be kind, try hard, have fun” (5 min); (b) Warm-up: fun fitness movement activities (10 min); (c) Main part: three 10 min stations targeting fundamental motor skills and game tactics (30 min); (d) Final cardiovascular activity: a large group game including tag variations and sport-based games (5 min). A cool-down, including self-reflection and peer compliments, ended the PA session. See Supplementary Materials for detailed ASMT session topics (Table S1) and session plan template (Table S2).

2.3. Quantitative Instruments

Socio-demographic characteristics such as age, gender, and nationality were gathered from school records. A wearable PA monitoring device Moki Technology® (Moki Technology Ltd., Melksham, UK) [27], was used to measure school-based daily step count and MVPA. Data collection occurred over 12 intervention sessions from October to November 2023. Each participant was assigned a pre-labeled Moki to record PA during school days from 8:00 a.m. to 2:00 p.m., except for Thursdays, when the after-school ASMT session (3:00 to 4:00 p.m.) was also recorded. Instructions were to wear the pre-assigned Moki on

the non-dominant wrist immediately upon arriving in class and remove it before leaving school premises with the assistance of the school teacher and research members. The Moki device was designed specifically for use in school-based interventions [27]. Moki consists of an activity-tracking wristband monitor and a software application. The wristband exclusively records data and sends users' step counts and MVPA to the software application. The data were uploaded via a contactless reader to the software, which returns step counts and minutes of MVPA in 30 min aggregated intervals. In contrast with common PA trackers, the Moki device does not display information to users. A validity study [28] of the Moki revealed more accurate estimates of incidental walking in youth than the Fitbit Ace, supporting its use for step count and school-based interventions. At the time of the study, Moki trackers were already being implemented at scale in more than 500 primary schools across the UK [27]. We defined a valid day as a day with ≥ 5 h of recorded wear time within the designated measurement window (school time: 8:00–2:00 p.m.; after-school program: 3:00–4:00 p.m. on Thursdays). During the school day, there was one recess period (11:35 to 11:55 a.m.), and only one physical education class was offered once per week on Thursday mornings. Non-school hours and after-school periods on non-intervention days were excluded as well. As a secondary outcome, we categorized school-based threshold PA attainment of total MVPA and steps during the school period for children aged between 6 and 11 years of age following updated recommendations established by Fromel et al. [29]. Achievement of the minimum recommendation of school-based PA was established as ≥ 3000 steps and ≥ 20 min of MVPA [29].

To assess the psychological construct of self-efficacy and enjoyment, we used the PA self-efficacy scale and the PA enjoyment pictorial scales for children, which are instruments adapted for elementary school children [21]. This instrument has demonstrated validity for use in elementary school-age children [21]. A salient feature of these scales is their pictorial format, which makes them easily understandable and administered for children. For both scales, participants are required to think of themselves when playing or performing physical education exercises. They are then asked to indicate for each item the response that best represents their personal feelings. Self-efficacy item scores ranged from 1, indicating low efficacy (e.g., "I run very slow") to 4, representing high efficacy (e.g., "I run very fast"). Enjoyment scale items' scores ranged from 1 (not at all) to 5 (very much) [21]. A higher score represents higher self-efficacy and enjoyment.

2.4. Qualitative Instruments

Three lead authors (A.H., T.R.R., S.R.D.) facilitated six focus group discussions with a maximum of three children per group at the end of the study. One focus group was run in Spanish, by a native Spanish-speaking author (T.R.R.), and the rest in English. Focus group discussions lasted between 20 and 30 min. The focus group discussion and interviews used a semi-structured format with open-ended questions to facilitate follow-up questions in a quiet school room. Discussions were audio-recorded using three handheld digital voice recorders. Figure 1 shows the study flowchart.

2.5. Statistical Analysis

Quantitative data were summarized using basic descriptive statistics (means, standard deviations, median, range, and 95% confidence intervals). To account for the repeated daily measures within participants, linear mixed-effects models (LMM) assessed the effect of school day type on step count and MVPA. A generalized mixed-effects model (GMM) with a binomial distribution estimated the probability of meeting recommended school-day PA guidelines (≥ 3000 steps and ≥ 20 min of MVPA between 8:00 a.m. and 2:00 p.m.). Paired-sample t-tests compared pre- and post-intervention scores on enjoyment and self-efficacy.

Normality of difference scores was checked using the Shapiro–Wilk test, and if normality assumptions were not met, Wilcoxon signed-rank tests were also conducted. Effect sizes were calculated using Cohen’s *d* (0.2 = small, 0.5 = medium, 0.8 = large). All statistical analyses were conducted using Jamovi (version 2.6.44) [30] and the package GAMLj3 for mixed models [31]. *p*-values < 0.05 were the cutoff for reporting statistical significance.

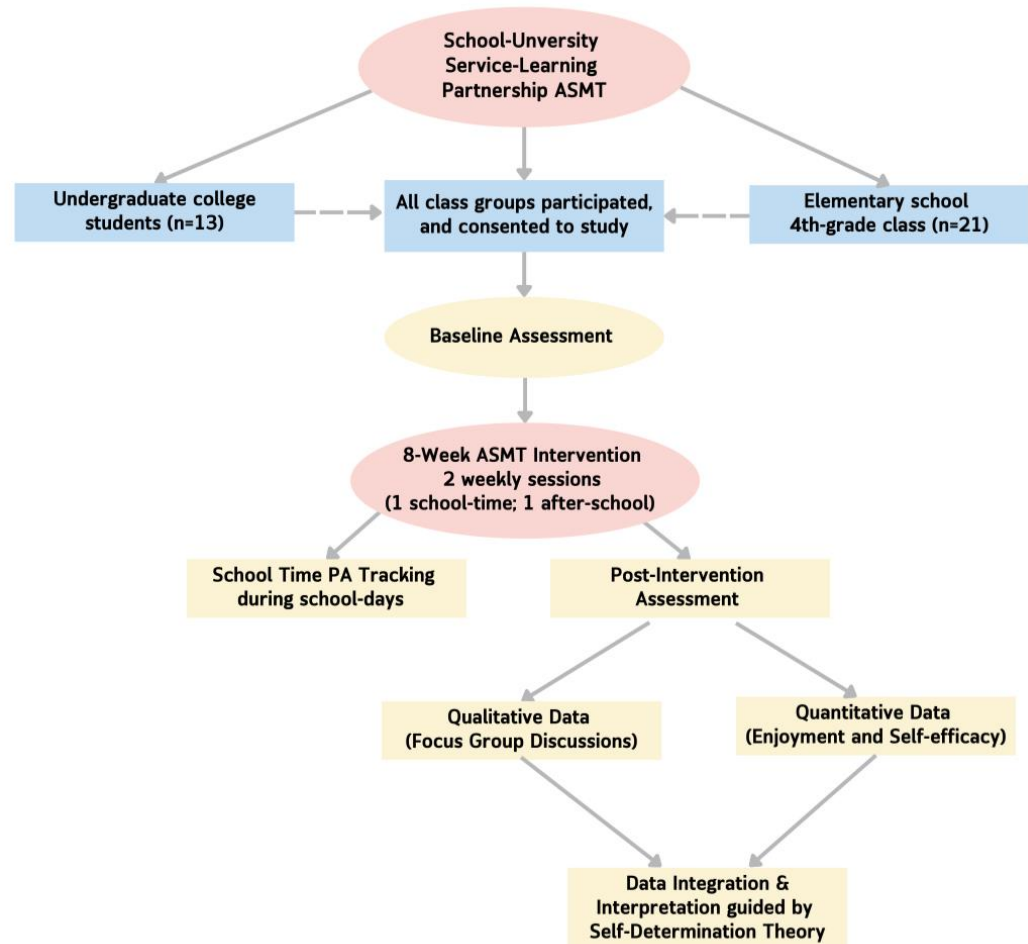


Figure 1. Study Flowchart.

Qualitative data from participants’ focus group discussions were analyzed using thematic analysis, following the six-phase process outlined by Braun and Clarke [32,33]. Audio recordings were transcribed verbatim and deidentified using numeric codes. Three researchers with diverse disciplinary backgrounds—physical education (T.R.R.), occupational therapy (R.J.M.), and health education (A.H.)—independently reviewed the transcripts (Phase 1) and generated initial codes (Phase 2). In phase 3, codes were compared and refined collaboratively through iterative discussions to identify potential themes and subthemes. During phase 4, the team met regularly to review and interpret the thematic structure and resolve discrepancies. Final themes were defined and named in phase 5, with reflective discussion supporting investigator triangulation and analytical rigor [34]. Following this inductive thematic analysis, a deductive, theory-informed phase was conducted to map constructed themes to SDT psychological constructs as recommended by methodological research [35,36]. In phase 6, themes were synthesized into a coherent narrative aligned with the study aims. Throughout the step process, investigator triangulation ensured credibility and trustworthiness [33,34].

3. Results

3.1. Quantitative Results

Table 1 displays the participants' sociodemographic characteristics. A total of 21 children completed the study, where 100% of the sample was from low-income homes, 95% were from diverse racial/ethnic backgrounds, and English is a second language for 76% of the sample. There was 96% attendance throughout the entire program. There were some occasions when students had minor injuries and did not participate fully in that day's activities. There were 4 falls, where 3 had no additional complications and one resulted in a nosebleed. No other adverse events occurred.

Table 1. Socio-demographic characteristics of participants ($n = 21$).

Characteristic	<i>n</i> (%)
Sex	
Male	8 (38)
Female	13 (62)
Ethnicity/Race	
Hispanic	14 (66.7)
Black/African American	6 (28.6)
White	1 (4.7)
Home Language	
English Primary	5 (23.8)
English not Primary (ESL)	16 (76.2)
Socio-economic status	
Eligible for free/reduced lunch price	21 (100.0)

The total number of valid school-based Moki wear days was 33 (12 intervention days and 21 non-intervention days). During the school period (08:00 a.m. to 2:00 p.m.), children accumulated significantly more PA on the days the intervention was delivered (Mondays during school time and Thursdays after school) compared with the rest of the school weekdays (Table 2). On Mondays with ASMT, the average step count was 5072 (SD = 2002) with 18.3 (SD = 11.4) minutes of MVPA, while on Thursdays with physical education class (10:30 to 11:10 a.m.), average steps were similar, 5269 (SD = 2253) steps and 20 (SD = 12.4) minutes of MVPA. When the Thursday program was extended with an afterschool ASMT session (3:00 to 4:00 p.m.), PA behavior increased further to 7631 (SD = 3214) and 31.2 (SD = 17.4) minutes of MVPA. In contrast, PA remained substantially lower on the rest of the school days (Tuesday, Wednesday, and Friday).

The LMM analysis confirmed a significant main effect of school day type on PA behavior for both total step counts ($F(5, 642) = 170, p < 0.001$) as well as total MVPA minutes ($F(5, 581) = 105, p < 0.001$). The conditional R^2 values indicate that 72% of the variance in steps and 63% of the variance in MVPA were explained by the models and therefore reflect large effects of school day type on participants' PA behavior. Estimated marginal means further confirm these effects, indicating that school days with a PA intervention, such as Mondays (ASMT) or Thursdays with physical education, were significantly higher ($p < 0.001$) than all other school days (Tuesday, Wednesday, and Friday). When an added ASMT session was delivered after school, a significantly greater increase in PA behavior occurred compared to all other days ($p < 0.001$). On average, days with a PA intervention during the school period added an extra 2000 steps and 10–12 min of MVPA, compared to control days, and when an afterschool program is present, an additional average of 2400 steps and 11 min of MVPA are added (see Figure 2).

Table 2. School-based total steps and MVPA accumulated by day type during the intervention period.

School-Day Type	Total Steps Mean (SD)	% ≥ 3000 Steps	MVPA Minutes Mean (SD)	% ≥ 20 min MVPA
Monday (ASMT)	5072 (2002)	86%	18.3 (11.4)	36%
Tuesday (control)	3262 (1568)	44%	9.6 (7.5)	12%
Wednesday (control)	2849 (1600)	35%	7.6 (6.8)	6%
Thursday (control + PE)	5269 (2253)	85%	20.0 (12.4)	43%
Friday (control)	3321 (1602)	48%	9.6 (6.6)	9%
Thursday + (after-school ASMT)	7631 (3214)	–	31.2 (17.4)	–

ASMT = All Stars Moving Together; SD = Standard Deviation; MVPA = moderate to vigorous physical activity; PE = Physical Education. Note: school-time threshold recommendations apply only for school-time (8:00–2:00 p.m.). Therefore, percentages are not shown for Thursday after-school ASMT which included an additional session beyond school time.

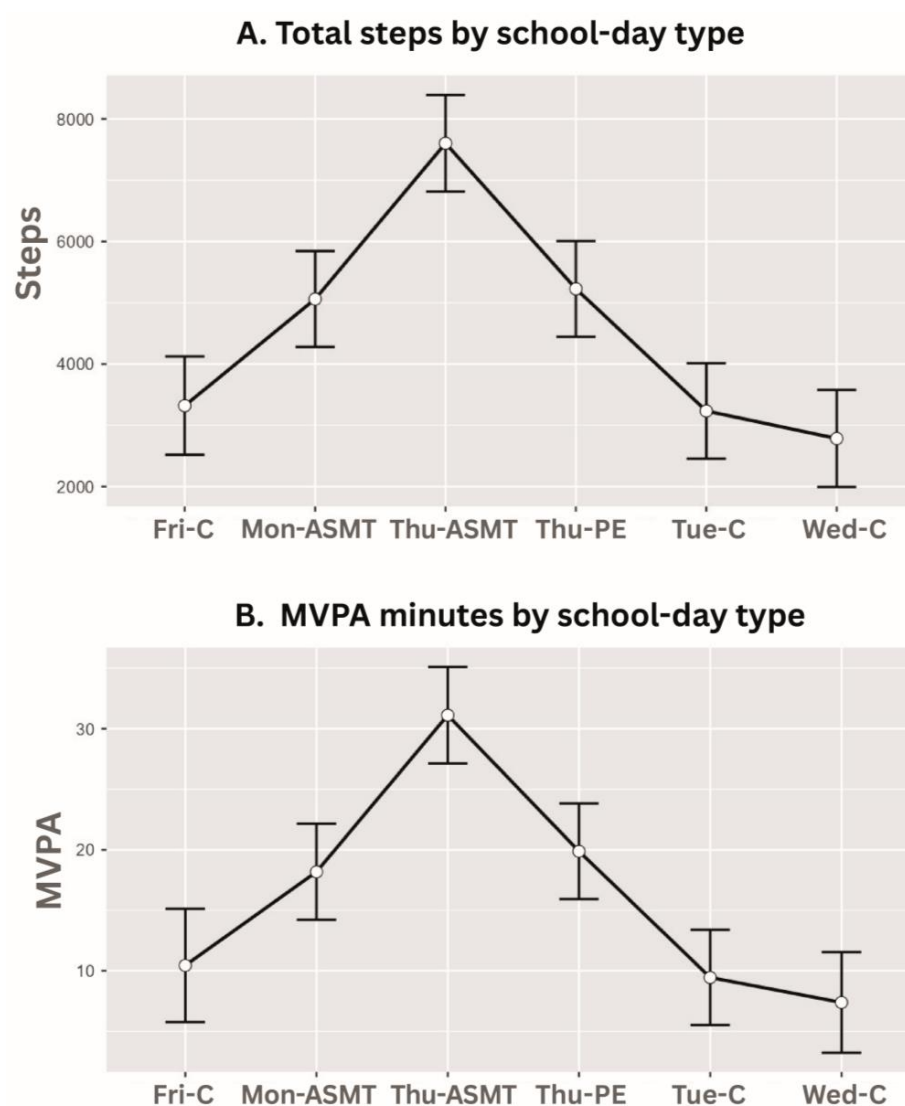


Figure 2. Panels show estimated marginal means with 95% confidence interval of (A) steps and (B) minutes of moderate to vigorous physical activity (MPVA) accumulated during school time (08:00–14:00) by school day types. Abbreviations: Fri-C: Friday Control day; Monday ASMT: Monday with intervention program during school-time; Thu-ASMT: Thursday with school and after-school intervention program; Thu-PE: Thursday school-time with physical education; Tue-C: Tuesday Control; Wed-C: Wednesday Control.

Compliance with recommended school time PA thresholds was also greater on intervention days. At least 86% and 85% of participants achieved 3000 steps when an ASMT or physical education session was present during the school period, compared with less than half of participants (35–48%) meeting step recommendations during the rest of the school week. GMM analyses show consistent predicted probabilities of meeting PA thresholds during school time (see Table 3). Similarly, an increased percentage of participants achieved MVPA compliance on Mondays (36%) and Thursdays (43%) compared with 12% on the rest of the school days. The GMM analysis of predicted probabilities closely mirrors these proportions, which confirms the robustness of these probabilities (Table 3).

Table 3. Estimated marginal means for steps and MVPA and model-predicted probabilities of meeting school day thresholds based on school day type.

School-Day Type	Total Steps EMM (95% CI)	MVPA EMM (95% CI)	% ≥ 3000 Steps (95% CI)	% ≥ 20 min MVPA (95% CI)
Monday (ASMT)	5061 (4278–5843)	18.2 (14.2–22.1)	86% (74–93)	36% (17–59)
Tuesday (control)	3234 (2455–4012)	9.5 (5.5–13.4)	44% (31–58)	12% (5–25)
Wednesday (control)	2784 (1994–3575)	7.4 (3.2–11.5)	35% (23–49)	6% (2–16)
Thursday (control + PE)	5228 (4446–6009)	19.9 (15.9–23.8)	85% (73–92)	43% (22–66)
Friday (control)	3320 (2518–4122)	10.4 (5.8–15.1)	48% (35–62)	9% (3–21)
Thursday + afterschool ASMT	7603 (6816–8391)	31.1 (27.1–35.1)	–	–

EMM = estimated marginal means; CI = Confidence Intervals; MVPA = moderate to vigorous physical activity; PE = physical education. Note: school-time threshold recommendations apply only for school-time (8:00–2:00 p.m.). Therefore, percentages are not shown for Thursday after-school ASMT which included an additional session beyond school time.

Participant enjoyment significantly increased from baseline mean score of 15.9 (SD = 3.5) to 18.1 (SD = 2.0) after the program ($t(11) = -3.17, p = 0.006$). On the other hand, self-efficacy scores showed no significant change ($t(11) = -1.00, p = 0.33$), increasing minimally from 12.7 (SD = 1.8) to a score of 13.0 (SD = 2.4). The moderate-to-large effect size for enjoyment ($d = 0.75$) suggests that the intervention meaningfully enhanced children's enjoyment of PA after the program, while the small effect size in self-efficacy ($d = 0.24$) suggests a limited impact on the participants' perceived competence.

3.2. Qualitative Results

Four major themes emerged from the thematic analysis, which were deductively mapped to the SDT constructs of autonomy, competence, and relatedness (see Table 4). The integration revealed that while all three constructs were represented, competence and relatedness emerged most frequently, with autonomy appearing more subtly through expressions of choice, preference, and self-regulation. Table 4 presents the themes and subthemes along with their description, aligned primary and secondary SDT constructs exemplified with illustrative quotes.

Table 4. Summary of themes, subthemes, aligned self-determination construct, and illustrative quotes.

Theme and Subtheme	Brief Description	SDT Construct	Illustrative Quote
Theme 1. The Program's Impact on Psychological and Emotional Health			
Positive Self-esteem	PA fostered self-efficacy from mastery and goal achievement.	Competence	(ID20) "It makes me feel like I accomplished something".
Negative self-esteem	Discouragement when comparing abilities to peers and feelings of social exclusion.	Competence	(ID02) "I fall behind everyone else because I'm not the best at running. . ."
		Relatedness	(ID17) "There's people better than you, or there's mean people, if you miss a kick, they make fun of you".
Psychological Arousal	PA increased alertness and focus, and was used as an energy self-regulation strategy.	Competence	(ID08) "...it makes me feel energized and wide awake".
		Autonomy	(ID19) "...get your energy out with the activities to focus on other things".
Positive emotions	PA generated emotions of happiness, security, and well-being.	Relatedness	(ID07) "...makes you...feel good and secure"
		Competence	(ID17) "...you actually try hard, and you feel good".
Theme 2. The Program's Impact on Social Support			
College Coaches	College coaches' involvement increased motivation and connection.	Relatedness	(ID16) "I liked to be with coach Blank and Blank and they really understand me and I enjoy being with them".
Peers and friends	Enjoyment from playing with peers and friends.	Relatedness	(ID16) "...and like to play with friends to feel better".
Family	Enjoyment from family involvement in PA.	Relatedness	(ID02) "...and started playing with brothers more".
Loneliness	Reduced enjoyment when being physically active alone.	Relatedness	(ID19) "...I don't have anyone to be with".
Theme 3. The Program's Impact on Learning and Activity Preferences			
Motor skills preferences	Development of motor skills and preferences for certain skills.	Competence	(ID19) "...it was kind of hard to kick the ball, and it was really hard to throw the ball".
		Autonomy	(ID07) "...didn't want to touch the ball, just wanted to score".
Sport skills preferences	Development of sport-specific skills and preferences for certain sports.	Competence	(ID14) "I liked badminton and tennis because they were new skills I never learned before".
		Autonomy	(ID16) "I liked soccer because I like to be goalie. . ."
Skill acquisition engagement	Enjoyment of knowledge Acquisition	Competence	(ID21) "Liked learning to do stuff. . ."
Theme 4. The Program's Impact on Physical Health			
Acute response to vigorous PA	Mixed feelings of increased heart rate and fatigue due to increased PA intensity.	Competence	(ID14) "...heart is beating faster, want it to beat fast because it makes us energetic".
		Autonomy	(ID01) "...if you're tired, take a break and you can get your energy back, drink water, and then you can play again".
Injury and Safety	Concern and awareness of injury or pain limiting enjoyment, and of safety.	Autonomy	(ID12) "...Cramps, hurts my ribs, and when you want to keep playing but you need a break".
		Competence	(ID15) "...playing safe and trying hard".
Health and Physical Fitness Improvements	Perception of improvements and awareness of PA regularity for fitness and health gains	Competence	(ID17) "I got faster and jumped way higher than before. . ."
		Autonomy	(ID19) "...doing it, it might seem hard, but you can make it easier on yourself".
PA behavior	Encouragement and understanding of increased PA levels during school or after-school hours.	Autonomy	(ID17) "...and it encouraged me to exercise more".
		Competence	(ID15) "...to be more active to get your body moving..."

3.2.1. Impact of ASMT Program on Psycho-Emotional Health

This first theme encompassed the psychological and emotional impact the ASMT program had on the participants. Children in the program describe both feelings of achievement and discouragement, psychological arousal, as well as emotional well-being, aligning most strongly with the competence and relatedness aspects of SDT. Participants frequently described pride in mastering activities, which enhanced their sense of competence (ID11) "...and makes you feel proud of yourself, instead of feeling negative, you feel positive about yourself". This quote illustrates how the fulfillment of competence is associated with improved self-efficacy. Conversely, negative social comparisons sometimes reduce perceived competence and relatedness (ID17) "There's people better than you, or there's

mean people, if you miss a kick, they make fun of you". These narratives are both tied to their belief or disbelief in their own capacity to achieve what they set out to achieve.

The ASMT program also provided psychological arousal with participants reporting feelings of increased energy and focus after PA, suggesting heightened readiness and capacity (competence), (ID19) get your energy out with the activities to focus on other things" and also, self-regulation of energy levels (autonomy) (ID21) "...calms you down when you're excited for the day".

Positive emotions such as happiness, warmth, and security often emerged from participants' reflections, underscoring the impact of PA on uplifting emotional states. These emotions were linked to both competence and relatedness, as one participant framed it (ID19), "It makes me feel nice and cozy and happy". It was clear throughout the narratives that the ASMT program influenced psychological and emotional health.

3.2.2. Impact of ASMT Program on PA Enjoyment Through Social Support

It was apparent throughout the narratives that one of the biggest benefits of the ASMT program is the social support provided to encourage and enjoy PA. This second theme reflects unanimously the role of relatedness through the need to feel connected and supported in shaping participants' enjoyment of PA. Relatedness was evident in how interactions with college coaches reinforced a socially supportive climate, with one participant noting, (ID12) "...the first coach I ever hung out with and talked to". Such relationships with class peers and college coaches were frequently cited as motivating and enjoyable aspects of the program (ID07) "...it's fun because you get to meet friends and play with friends". Participants frequently discussed applying what they learned about PA and their enjoyment of being physically active to interactions with their family members (ID20) "My cousin... I like exercising together" and an increased motivation towards increasing PA behaviors (ID02) "...and started playing with brothers more". Narratives made it clear that the ASMT program provides social support that not only affected children during the program hours but also outside of school. The increased social support impacted participation and enjoyment in PA during and outside of school hours with the college coaches, peers, friends, and family.

While the narratives in this theme were mostly positive, some participants shared that the absence of social connectedness can also reduce PA engagement. For example, one participant shared (ID19) "I don't have anyone to be with", underscoring how the lack of relatedness may hinder the desire to engage in PA. Although not shared in the narratives, there are instances when children with fewer skills or other barriers may feel excluded or too embarrassed to participate in PA opportunities. Together, these accounts highlight how positive social interactions with the social support network of the school, program staff, and family members can satisfy the need for relatedness and impact motivation towards PA, while feelings of isolation may undermine the motivation to be physically active.

3.2.3. Impact of ASMT Program on Learning Preferences

This theme explored the impact of the ASMT program on learning and activity preferences. Narratives described participants' reflections on their skill acquisition, exposure to new sports, and their preferences for particular activities. One participant summarized this theme (ID17) "...knowing stuff, and dribbling, and soccer". Competence was evident when children described how they developed new motor and sport skills. Participants also described enjoyment through learning new skills (ID14) "I liked badminton and tennis because they were new skills I never learned before". Autonomy emerged in the narratives when participants expressed clear preferences towards specific skills they were exposed. For example, (ID16) "I liked soccer because I like to be a goalie" illustrates personal prefer-

ences influencing their engagement, while (ID07) *“Didn’t want to touch the ball, just wanted to score”* reflects a desire to control participation style. Developing physical literacy through opportunities for skill development was a source of satisfaction that reinforced competence, while learning new skills provided autonomy through choice.

However, the practice of specific skills was sometimes associated with frustration (ID14) *“...and soccer, it was sometimes frustrating when you miss”*. Despite the negative emotions and preference for specific skills, participants demonstrate tenacity through the challenge of mastering new skills (ID17) *“Didn’t like volleyball, hard to understand, frustrated, but trying to get through. . .”* It was apparent when reading the narratives that the ASMT program impacted the acquisition, engagement, and preferences of motor and sports skills.

3.2.4. The Impact of ASMT on Physical Health

The fourth theme describes the influence that the ASMT program had on changes in PA behavior and the physiological impact of those changes. Narratives described a range of physiological experiences associated primarily with competence, autonomy, and, to a lesser extent, relatedness. While for some participants higher intensity activity was associated with enjoyment, (ID13) *“I also like the feeling of my heart thumping hard”*, for others, it was a less enjoyable experience (ID18) *“...when your heart races”*. The acute response to PA was frequently mentioned not only for the cardiovascular changes but for the fatigue or exhaustion after an intense bout of exercise (ID14) *“...I get tired and feel like I don’t have a lot of energy...”*.

Another subtheme revolved around awareness of the possibility of getting injured, (ID10) *“Everything’s fun unless you get hurt”*. or developing painful events (ID06) *“I want to get over being exhausted, cramping in belly”*. While this subtheme highlights a negative impact on competence due to injury or fear of injury it also denotes the development of autonomy through prevention strategies (ID07) *“Getting your body warmed up; helps your body to wake up, and you don’t get cramps, stiff”* and choosing to play safe to reduce injury risk (ID15) *“...playing safe”*. This specific subtheme of fatigue and injury prevention highlighted participants’ self-regulatory behaviors, such as (ID12) *“...if you’re tired, take a break and you can get your energy back, drink water, and then you can play again”*.

Another important subtheme was constructed over participants’ recognition of improved physical fitness (competence) (ID07), *“...I’m building up my muscles”*, through perceived improvements. This theme was well captured by a participant who noted how their perceived increase in motor competence increased their motivation towards PA (ID17) *“I got faster and jumped way higher than before and it encouraged me to exercise more”*. Autonomy was also evident through self-initiated PA behavior beyond program sessions (ID15) *“...instead of sitting in the classroom being lazy”*. The narratives were rich with examples of how the ASMT program impacted PA levels and resulted in acute physiological responses as well as physical adaptations to regular exercise. Figure 3 illustrates a conceptual map of the thematic analysis, coded by colors, corresponding to the SDT constructs and to developmental dimensions of health (social, psycho-emotional, physical, and cognitive).

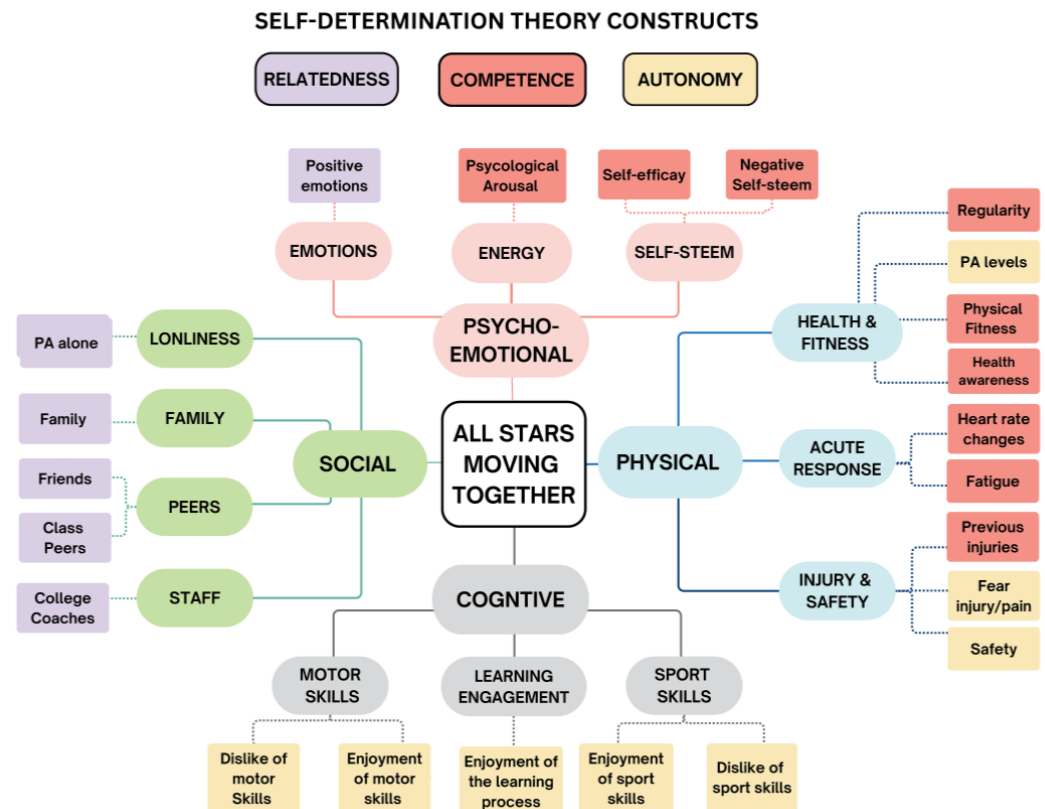


Figure 3. Conceptual map of thematic analysis.

Overall, the integration of themes with SDT demonstrated that participants' experiences in the ASMT program predominantly fostered competence through skill development and mastery and perceived improvement in physical fitness, while autonomy emerged more subtly through preferences for specific motor skills, self-directed PA, and regulation of physical exertion. Relatedness with college coaches, peers, friends, and family contributed significantly to social support and PA enjoyment during and outside of school hours. The dynamic interplay between these physiological needs appeared to shape enjoyment and engagement in PA among participants.

4. Discussion

This mixed-methods study examined the impact of ASMT, a school–university service learning program, on elementary school children from an underserved community, focusing on school-time PA, enjoyment, and self-efficacy through the SDT perspective. Results showed that ASMT significantly increased PA behavior on intervention days while increasing enjoyment of PA. However, no statistically significant changes in self-efficacy were observed after the program. Integration of qualitative findings provided an expanded perspective, reinforcing the ASMT program's impact. Grounded in SDT, the qualitative data furthered our understanding of children's experiences of enjoyment (through relatedness), development of competence, and enhanced psychological arousal. Autonomy emerged more subtly. These results highlight the potential of service learning programs to expand school-based PA opportunities for youth in under-resourced communities.

4.1. Competence Through PA Behavior and Motor Skill Development

Erwin et al. [37] recommended school–university partnerships as a means to increase supervised and structured PA opportunities for children throughout the school day. Our results demonstrated how a substantial percentage of recommended children's PA during

school time can be provided through a service learning program. The addition of ASMT sessions, either during the school day or after school, showed consistently higher numbers of steps and MVPA counts. In comparison, in the days without intervention, a large proportion of children failed to meet recommended school PA thresholds.

Moreover, these results align with prior physical education teacher education service learning programs and recommendations. Dauenhauer et al. [38] identified preservice teachers as ideal partners for facilitating PA programs in school settings under the supervision of a qualified professional. Galvan et al. [39] reported improved cardiorespiratory fitness and a similar theme of self-efficacy in the underserved community of elementary children after a 10-week program. Wilson et al. [40] were successful in increasing PA levels on the days their after-school program took place compared to the days the program was not offered by adding motivational and behavioral skills in their program.

The qualitative theme of improved PA, health, and skills reinforces these results. Participants' reflections about speed and motor skills contribute to perceived motor competence. Simultaneously, frustration occurred in some children when practicing challenging skills or when comparing themselves with peers. These experiences may have influenced levels of self-efficacy. Moreover, the short duration of the intervention or time spent on skill acquisition might have influenced perceived motor competence. Enjoyment may be more strongly related to sustained PA behavior due to immediate reinforcement. A recent study in low-income elementary school students [41] showed a significant relationship between PA enjoyment and PA behavior, as well as the key role that motor competence plays in predicting PA enjoyment. PA interventions that prioritize youth enjoyment and achievement, "Fun and challenge", might enhance their motivation towards PA practice and their perceived physical abilities. An increased focus on PA activities that derive feelings of pleasure, fun, and accomplishment should be prioritized in PA promotion programs for motor skill development.

4.2. Relatedness Through Enjoyment of Social Support

A significant increase in enjoyment was noted by the quantitative data and prominently reinforced throughout the qualitative themes. Children expressed enjoyment in participating in activities through positive emotions and social support. Qualitative data highlighted relatedness through the role of the college coaches who served as positive role models by providing children with individualized attention and positive reinforcement. Service-learning programs serve a dual purpose by increasing the teaching competencies of college students while also enhancing feelings of relatedness. Although some comments reflected negative feelings through peer comparison, the overall pattern of increased enjoyment and emotional well-being supports the social dimension as a key factor in understanding how youth experience motivation in service-learning programs.

Exploring themes surrounding self-efficacy and enjoyment are critical when developing PA programs for children, as they are strong correlates for motivating children to be and stay physically active [16]. Meta-analytical data show how SDT has become an accepted lens to frame the relationship between motivation and PA during childhood and adolescence, where intrinsic motivation and identified regulation are associated with higher levels of PA in youth [17].

4.3. Autonomy Through Self-Selected PA Choices

Autonomy was the least prominent SDT construct when reviewing narratives and themes. This suggests further exploration about why children might be less willing to engage in PA on their own or incorporate PA into their identity. Richards et al. [42] encouraged practitioners to select culturally relevant activities, based on student needs and

interests, to encourage PA engagement. Certain activities might have been too challenging or competitive, as some participants expressed dislike for specific sports skills they perceived as too challenging. Providing activities that offer children the ability to take more ownership in future interventions might be a suitable educational strategy to improve autonomy and subsequently their engagement and enjoyment.

Wearable fitness trackers to increase PA behavior in school settings have yielded mixed evidence to increase step count and MVPA [43,44]. Kerner & Goodyear [45] found that the use of the PA tracker Fitbit was associated with decreases in all SDT constructs as well as reduced motivation towards PA, where competition and comparison to peers and social expectations generated by the tracker negatively impacted PA motivation in adolescents. In contrast to traditional PA trackers, the Moki lacks a real-time display feature, which might be an advantage for improving intrinsic motivation towards PA in the younger populations. In this sense, only intrinsic motivation was shown to be positively and significantly related to objectively measured MVPA in adolescents [46]. These results reinforce the need to further assess the possible motivational role Moki's can play from the SDT perspective in the younger generations.

4.4. Strengths and Limitations

A strength of our study is the mixed-methods theory-driven approach, including objective PA monitoring throughout the 8-week intervention period. The continuous wear of the Moki across all school days allowed us to capture a complete and real-life view of habitual school-day PA. This repeated-measures design enabled within-participant comparisons, reducing inter-individual variability. The Moki is a child-friendly and low-cost PA tracker practical for school settings. The Moki technology is novel and, to the best of the authors' knowledge, no published interventional data has been reported with this technology. This also limits literature comparisons with Moki PA trackers. PA guidelines for youth recommendations are based on continuous-time accelerometers like ActiGraph for MVPA. The Moki's coarse time resolution poses comparability challenges. Additionally, there is a lack of MVPA sensitivity evidence on how the 30-minute interval data recorded with Moki could misclassify and underestimate MVPA measurements in free-living settings such as the ASMT program. Although prior lab-based evidence shows acceptable step count accuracy under controlled conditions [28], the lack of studies assessing how interval aggregation could affect the detection of short bouts of high-intensity PA compared with continuous accelerometers warrants future research.

Despite the use of child-appropriate pictorial and validated scales of self-efficacy and enjoyment of PA [19], their use may be conditioned by social desirability. Due to the nature of service-learning programs embedded within existing class cohorts, enrollment and participation determined the maximum feasible sample size. The lack of an a priori powered sample and the absence of a control group limit the generalizability of results. However, effect sizes and confidence intervals were reported to provide precision of estimations. Additionally, while qualitative data provided rich insights into the psychological impact of PA, future research could benefit from triangulating self-reports with additional physiological data, such as heart rate measurement.

The short duration of the program is another limiting factor in understanding PA behavior and motor competence. Future ASMT interventions should follow up to examine potential year-long changes. Longitudinal ASMT studies examining how changes in motivation and self-efficacy evolve over a school year or across diverse school settings are also warranted. Extending ASMT to year-round programming across multiple schools while implementing autonomy supportive strategies could better capture the longitudinal development of self-efficacy and motivation towards increased PA behavior.

4.5. Future Implications

Integrating structured fundamental skill development with emotionally supportive experiences may offer a more comprehensive strategy to enhance both motivational and self-efficacy outcomes in youth PA programs. To improve levels of autonomy, the ASMT team can provide students with more opportunities and options within skill development and fitness activities. Encouraging students to self-pace PA tasks or intensity is another way for students to feel more in control of their PA. Within the ASMT program, students play a large group game at the end of each session. Allowing students to pick the end-of-the-session games, such as “Simon Says”, “Sharks and Minnows”, or “Dance-Offs”, may encourage ownership. Following each PA session, faculty, college coaches, and the young friends huddle together for 5 min. It is during these huddles that ASMT practitioners may reinforce concepts like self-pacing and peer compliments.

Young friends could be prompted to share how they adjusted their energy during work and rest periods, in addition to identifying a peer who worked hard, played fair, or shared equipment. Efforts to develop social-emotional competencies at the conclusion of each ASMT session may increase PA enjoyment for children.

From an applied perspective, the ASMT program provides preliminary data that a service-learning approach may help increase PA behavior during school segments. Future service-learning programs that embed SDT principles could be scaled to promote sustainable PA in schools. The Comprehensive School Physical Activity Program [12,47] framework identifies during school and after school as critical opportunities to integrate PA experiences throughout the day to help children achieve recommendations for 60 min of daily MVPA. While our results are encouraging, further studies across larger school settings and samples could extend these findings through service-learning models.

5. Conclusions

This mixed-methods study provides preliminary findings on how the service-learning ASMT program can increase school-time PA and enhance enjoyment of PA among elementary school children from an under-resourced community. Guided by the SDT, the program encouraged competence and relatedness to improve intrinsic motivation while autonomy emerged more subtly. This study underscores the potential of school–university partnerships as a cost-effective and scalable school-based approach to promote PA.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/app151910489/s1>: Table S1: ASMT Physical Activity Session Topics; Table S2: ASMT Physical Activity Session Plan Template.

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Abbreviations

The following abbreviations are used in this manuscript:

ASMT	All Stars Moving Together
PA	Physical Activity
MVPA	Moderate to Vigorous Physical Activity
SDT	Self-Determination Theory
LMM	Linear Mixed Methods
GMM	Generalized Linear Mixed Methods

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