

Effectiveness of simple motor skills training (SMST) and complex motor skills training (CMST) in young boxing students (aged 13–14) from a rural school in Kazakhstan

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ABSTRACT

Boxing sport requires an effective selection of strategies, skills, and techniques. Mastering skills ranging from simple motor skills (SMS) to complex motor skills (CMS) requires dedicated training and engagement. This study was designed to assess the association between complex motor skills training (CMST), simple motor skill training (SMST), and technical performance effectiveness (STPE) among boxing students of Terekti Village Sports School in Kazakhstan. The study included 160 male students aged 13–14 from 8th and 9th grade. They were divided into two groups, each consisting of four teams, with 20 boxing students per team. The association between SMST and CMST was statistically significant ($\beta = 0.313$). CMST has a strong positive and statistically significant ($p = 0.000$) association with SMST ($r = .620^{**}$). STPE has a strong positive association with SMST ($r = 0.781^{**}$) and with CMST ($r = 0.674^{**}$). Therefore, from the Pearson correlation analysis, we found that SMST, CMST, and STPE are all positively associated. The study findings showed that simple motor skills training (SMST) is positively associated with complex motor skills training (CMST). Both CMS and CMS are positively associated with students' technical performance effectiveness (STPE).

KEYWORDS

Boxing; Complex Motor Skills Training (CMST); Simple Motor Skills Training (SMST); Student Technical Performance Effectiveness (STPE); Kazakhstan

1. INTRODUCTION

The initial records of boxing date back to ancient Egypt (2000 BC to 1001 BC; Jordan & Herrera, 2008). Boxing sport evolved in terms of its techniques, skills, and training (Loudcher, 2007; Chaabène et al., 2015). Moreover, boxing is a tactical sport that requires balanced motor coordination through training (Lloyd et al., 2019; Li, 2023). Training for motor skills is the key aspect of boxing sport. The acquisition of motor skills is more prominent in younger children (Davis et al., 2007). The development of motor skills in children needs to be taught and practiced (Goodway & Branta, 2003). As well as, motor skills develop children's self-confidence and self-esteem (Bunker, 1991).

Goal-oriented activities in young children help them in the development of motor skills (Sutapa et al., 2021). Additionally, the development of motor skills during a child's development journey helps children to learn more effectively (Lloyd et al., 2019). There is plenty of evidence that highlights the importance of motor skill development as a prime aspect of performance in boxing sport (El Ashker, 2012).

Motor skills refer to the mastery of certain physical skills with a combination of sequence movements (e.g. bounce, burst, dab, dart, explode, fling, flick, jab, jitter, poke, etc.) that enables the player to participate in a competition against an opponent (Raiola, 2017). This includes player agility, balance, coordination, and reactions. Motor skills are the fundamental aspect of highly specialized sports and gymnastics (Logan et al., 2018).

Development of motor skills in children as it plays a critical role in children's physical activity behaviors (Stodden et al., 2008). Boxing sport is a form of highly complex motor activity. Due to the extreme nature of boxing sport, the role of training cannot be ignored as fatigue can significantly impact the performance of the boxer. Moreover, boxing requires continuous long-lasting training that consists of repeating actions, moments, and coordination that results in physical and psycho-emotional fitness (Sienkiewicz-Dianzenza & Maszczyk, 2019). Moreover, numerous studies have found an association between motor skills development and boxing performance (Mr, 2021).

Based on these backgrounds, the importance of training to improve simple and complex motor skills in young children right from the early stage of schooling to gain maximum advantage in future professional careers cannot be ignored. Moreover, training needs to be designed to overcome the challenges, restrictions and by keeping the aspect of future competition. Training helps players to develop their skills and abilities however, training needs to be designed concerning the requirement of the sport to gain maximum advantage in the competition.

1.1. Hypotheses Development

There are two main categories of MS, simple motor skills (SMS), and Complex motor skills (CMS). Simple Motor skills (SMS) are goal-driven body moments (Magill & Anderson, 2010). In boxing, SMS is a more common and predictable set of motor skills as boxers are agreed upon certain procedures and formats (Denny, 2010). SMS involves fewer variations (e.g., running and throwing). SMS can be acquired in a single practice session and it has one degree of freedom (Wulf & Shea, 2002). Conversely, complex motor skills (CMS) are an advanced set of mastery skills that cannot be learned in a single training session (Coker, 2017). CMS requires advanced levels of complex formation of body movements and coordination that demands constant training and practice therefore, CMS generates a higher level of neuro-motor fitness (Kraft et al., 2015). Furthermore, studies have found a positive association between the level of complexity and task difficulty. Students' performance in sport activities are linked with higher training exercises (Taras, 2005; Erwin & Castelli, 2008). Additionally, students' academic performance does not get negatively affected by sports training (Granacher & Borde, 2017). Students' long-term engagement in sports activities results in effective athletic performance (Balyi et al., 2013).

Simple motor skills (SMS) and complex motor skills (CMS) consist of a variety of differences from the core basic foundations to the applicability of each set of motor skills. SMS and CMS are not interchangeable and therefore, not generalizable. However, SMS learning enhanced the CMS (Wulf & Shea, 2002). Development of MS in young age is a very essential aspect of physical education (Lee et al., 2007). Moreover, many studies have been conducted to develop a framework for physical education development among children (Dyson, 2014; Petrie & Lisahunter, 2011). However, limited studies were associated with MS development in children through physical education (Goodway & Branta, 2003; Logan et al., 2012; Stodden et al., 2008). Based on this discussion we can formulate hypotheses on the SMS/CMS training with students' performance in boxing sport.

- **Hypothesis 1:** Simple motor skills training (SMST) is positively associated with students' technical performance effectiveness (STPE) in Boxing.
- **Hypothesis 2:** Complex motor skills training (CMST) is positively associated with students' technical performance effectiveness (STPE) in Boxing.
- **Hypothesis 3:** Simple motor skills training (SMST) is positively associated with Complex motor skills training (CMST) in Boxing.

Development of an effective physical education system requires an effective understanding of

MS and its association with children's abilities in boxing (Gallahue & Donnelly, 2007; Fogel et al., 2010). Effective training help boost children's SMS and CMS skills development requires an understanding of the MS phenomena in children (Sheridan, 2009; El-Ashker, 2018). In boxing the role of MS are critical as boxing requires a different combination of movements and coordination between physical and mental activities needs to be balanced to achieve maximum performance (Çetin et al., 2018; Bozdarov et al., 2022). In Kazakhstan, studies in this domain are very limited specifically there is no such study that explores the association between student technical performance effectiveness (STPE), Simple motor skills training (SMST), and Complex motor skills training (CMST) in Karaganda Region.

1.2. Theoretical Framework

In this study, we have developed a framework to assess the association between Simple motor skills training (SMST), and complex motor skills training (CMST) with students' technical performance effectiveness (STPE). We have organized boxing students into two groups each group consists of 8 teams with each team consisting of 20 male students (total 160) aged between 13-14 years from the 8th and 9th class from Terekti Village Sports School (Karaganda Region) (Figure 1).

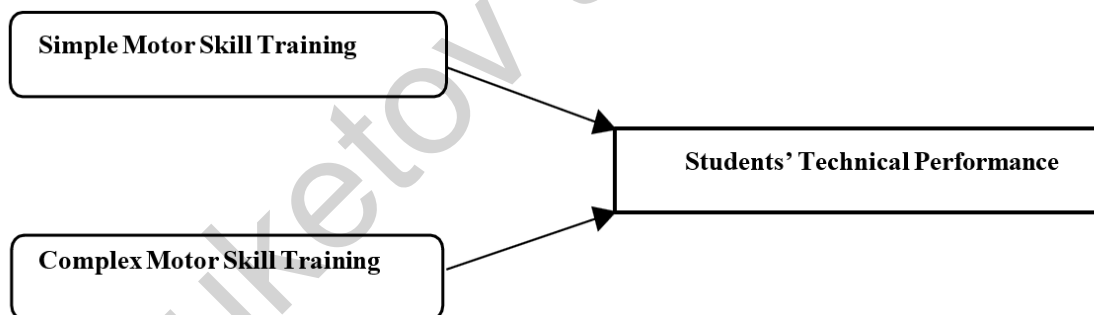


Figure 1. Theoretical Framework

Each group of boxing students' performance was measured on an interval of six months, we have identified the SMS that is required for boxing matches along with CMS. Furthermore, the training packages were designed separately for SMS and CMS. The boxing performance was assessed on the range of physical activities along with cognitive process and assessment.

2. METHODS

2.1. Participants

In this study, students were purposively selected from the 8th and 9th classes with an age bracket of 13-14 years from the Karaganda Region. The Terekti Village Sports School was selected for this study as this school had well-equipped instruments and facilities for boxing students. Only male students from physical education and training in Boxing were selected. In total 160 students were included in the study. These 160 students were divided into two groups each group consists of 8 teams, each team has 20 students. Simple motor skills (SMS) for boxing was first identified and based on the identification of simple motor skills training was specifically designed for boxing. Similarly, complex motor skills (CMS) for boxing was identified and training was designed to develop complex motor skills for boxing. Furthermore, participation in the study was voluntary and interest-based. Consent from students' parents was taken along with the medical history of each student to avoid any health-related issues. The data were collected in two stages that are pre-training and post-training for six months starting from August 2022 to February 2023. Additionally, each match was recorded and later analyzed using slow-motion technology where all teams participated under the supervision of coaches each move was explained.

2.2. Measurements

All constructs and items were measured on a Likert five-point scale anchored from 1 (strongly disagree) to 5 (strongly agree).

- Simple Motor Skills Training (SMST) effectiveness instrument: SMS training effectiveness was measured using a self-developed scale consisting of 15 items was used to measure the effectiveness of the training. The Cronbach's alpha value (α 0.89) is a well-accepted range as per social science standards (Shevlin, Miles, Davies, & Walker, 2000). A sample item example: "The SMS training program provided a clear and understandable explanation of the skills being taught."
- Complex Motor Skills Training (CMST) effectiveness instrument: CMS training effectiveness was assessed using an 18 items self-developed scale with Cronbach's alpha value (α 0.91). A sample item example: "The CMS training program improved my ability to perform complex motor skills."

- Student’s Technical Performance Effectiveness (STPE): STP was assessed using a 20 items self-developed scale with Cronbach’s alpha value (α 0.93). A sample item example: “The students were able to apply boxing techniques effectively in sparring and competition.”

2.3. Statistical analyses

The statistical analyses were carried out with the Statistical Package for the Social Sciences (SPSS) version 25. The statistical techniques that are described in the results section were applied. The statistical significance (p value) was set at $p < 0.05$.

3. RESULTS AND DISCUSSION

Results of the study are summarized based on correlations of three factors (Figure 2).

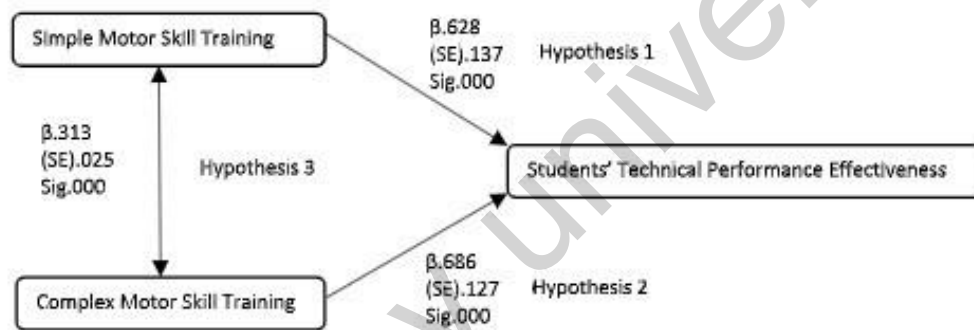


Figure 2. Hypothesis of study

Table 1 presents data indicating a statistically significant association between the variables studied. The association between SMST and STPE was statistically significant ($\beta = .628$; $p = 0.000$). The positive association represents a direct association. The direct association indicates that effective training for SMS leads to positive student performance and engagement (Table 1). Moreover, based on a significant positive association we accept Hypothesis 1 (Table 2).

The association between CMST and STPE was statistically significant ($\beta = .686$; $p = 0.000$). The positive association shows that an increase in CMST will positively impact the STPE (Table 1). Therefore, we accept Hypothesis H2 (Table 2). Moreover, from this direct association, we understood the importance of complex motor skills in students’ technical performance effectiveness (STPE). Therefore, the importance of training in developing students’ complex motor skills is critical for their

performance in the boxing profession (Table 2).

Table 1. Analysis of associations between measured variables

Paths	Estimate	Standard Error	f-value	Mean Square	p- value	R Square
Directly proportional SMST\propto CMST	.313	.025	155.600	14.055	0.000	.719 71.9%
Directly proportional SMST\propto STPE	.628	.137	27.247	40.918	0.000	.759 75.9%
Directly proportional CMST\propto STPE	.686	.127				

Note. Significance levels: *** $p < .001$; * $p < .05$; SMST = Simple Motor Skill Training; CMST = Complex Motor Skill Training; STPE = Students' Technical Performance Effectiveness.

Table 2. Hypotheses summary

Hypotheses	Findings	Findings
Hypothesis 1: Simple motor skills training (SMST) is positively associated with students' technical performance effectiveness (STPE) in Boxing.	Directly Proportional	Accepted
Hypothesis 2: Complex motor skills training (CMST) is positively associated with students' technical performance effectiveness (STPE) in Boxing.	Directly Proportional	Accepted
Hypothesis 3: Simple motor skills training (SMST) is positively associated with Complex motor skills training (CMST) in Boxing.	Directly Proportional	Accepted

Table 3 presents the Pearson correlation coefficients among SMST, CMST, and STPE.

Table 3. Pearson correlation matrix for SMST, CMST, and STPE

		SMST	CMST	STPE
SMST	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	160		
CMST	Pearson Correlation	.620**	1	
	Sig. (2-tailed)	0		
	N	160	160	160
STPE	Pearson Correlation	.781**	.674**	1
	Sig. (2-tailed)	0	0.001	
	N	160	160	160

Note. **. Correlation is significant at the 0.01 level (2- tailed); Simple Motor Skill Training; CMST = Complex Motor Skill Training; STPE = Students' Technical Performance Effectiveness.

CMST has a strong positive and statistically significant ($p .000$) association with SMST ($r = .620^{**}$). STPE has a strong positive association with SMST ($r = .781^{**}$) and with CMST ($r = .674^{**}$). Therefore, from the Pearson correlation analysis, we explore that SMST, CMST, and STPE are all positively associated (Table 3).

The boxing match assessment rubric was developed on 6 principles (Techniques, Strategy, Sportsmanship, Fitness and Conditioning, and overall performance) (Table 4).

Table 4. Boxing techniques criteria

1	Technique: The degree to which the students displayed proper boxing technique in their punches, footwork, and defensive maneuvers.
2	Strategy: The degree to which the students demonstrated effective strategies, such as movement, combinations, and counter-punching.
3	Sportsmanship: The degree to which the students displayed good sportsmanship, including respect for their opponents and officials, following the rules, and competing with integrity.
4	Fitness and Conditioning: The degree to which the students displayed proper fitness and conditioning, such as maintaining proper form, endurance, and stamina throughout the match.
5	Overall Performance: The overall performance of the student teams, including their ability to apply technical skills, strategy, sportsmanship, and fitness in the match.

Each group was evaluated based on the satisfaction criteria of 4 judges, these judges were knowledgeable in boxing rules and techniques. The mean score was used to assess the student's performance. Each team was evaluated as a whole team's performance and as individual players to assess the level of improvement individually and as a team. The results showed that SMST and CMST were highly effective in developing students' performance. Each match was recorded and later analyzed using slow-motion technology. Students were briefed about each move, strategy, and technique that was applied in each match. This helps students to understand their mistakes and learn and strengthen the techniques (Figure 3).

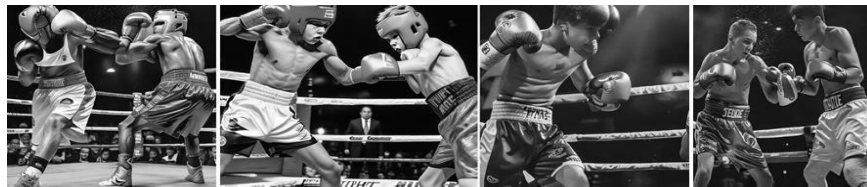


Figure 3. Sample reference image generated using AI to elaborate different boxing complex skills – No real image or footage was added to the study due to privacy

Table 5 shows the effectiveness of the training conducted for simple motor skills (SMS) and complex motor skills (CMS) and its impact on the student's technical performance effectiveness (STPE) in Boxing. The mean score was taken in two stages, 1- pre-training and 2-post-training. Moreover, the mean differences between the variables indicate significant improvement in technical skills and performance.

Table 5. SMST, CMST, and STPE variables mean score difference after 6 months

Variable	Controlled Mean - CM	Intervention Mean -IM	Mean Difference MD=CM-IM	p
SMST				
40 m sprint	4.1860	5.2312	-1.0452	<0.01
Push-ups 30 seconds	4.3256	6.1245	-1.7989	<0.01
Zigzag running 1 Minutes	4.8837	6.5375	-1.6538	<0.01
Moving and Pouching 5 Minutes	4.6279	5.0173	-0.3894	<0.01
Footwork Drill 5 Minutes	3.7907	6.3201	-2.5294	<0.01
Jumping Rope 5 Minutes	4.1860	5.3197	-1.1337	<0.01
Heavy Bag Drills 7 minutes	4.3256	6.8753	-2.5497	<0.01
CMST				
Triple Punch	4.5488	5.4183	-0.8695	<0.01
Jab, Cross, Left Hook (1, 2, 3) Combo	4.6023	5.3012	-0.6989	<0.01
Lead Uppercut, Cross (5, 2) Combo	3.2116	4.2945	-1.0829	<0.01
Lead Uppercut, Cross, Left Hook (5, 2, 3) Combo	3.9581	5.3453	-1.3872	<0.01
Jab, Right Hook (1, 4) Combo	4.1977	5.8769	-1.6792	<0.01
Cross, Left Hook (2, 3) Combo	4.4233	5.8907	-1.4674	<0.01
Cross, Left Hook, Cross (2, 3, 2) Combo	3.4023	6.4122	-3.0099	<0.01
Right Uppercut, Left Hook (6, 3) Combo	3.5481	6.2090	-2.6609	<0.01
STPE				
Techniques	4.9070	5.2366	-0.3296	<0.01
Strategy	4.5349	6.3912	-1.8563	<0.01
Sportsmanship	4.1860	6.2142	-2.0282	<0.01
Fitness and Conditioning	4.5349	5.3798	-0.8449	<0.01
Overall performance	5.3953	6.9123	-1.517	<0.01

*Control means: Pre-training mean; Intervention mean Post training mean

Based on present findings, specially summarized in Table 5, through training, boxing students gain valuable skills, and through constant practice students manage to master the skills in 13-14 age

range. As well as, students demonstrated innovation in generating new skills in boxing. In agreement to Rakha (2023), the technology assistance helps students to learn and identify mistakes as well as strengths for improvement on boxing.

This study has contended the existing knowledge by exploring the association between simple motor skills training (SMST), Complex motor skills training (CMST), and student's technical performance effectiveness (STPE) in Boxing, in continued of of El-Ashker et al. (2012) study which is focused on STPE on 15 aged students. Moreover, we have developed a set of training skills for SMS and SMS and their impact was separately measured to find the effectiveness of each domain, which proposed by El-Ashker et al. (2012 and 2018) in boxing. Additionally, the association between SMS and CMS was also explored, and found positive association which means SMS is the fundamental requirement for CMS, which these findings are in agreement with Laukkanen et al. (2014) who studied habitual physical activity and its relation with motor skills in 5-to 8-year-old children, and El-Ashker et al. (2012) study. Based on findings of present study, if students were only trained in CMS this will reduce the effectiveness of the training. Therefore, effective training in boxing requires a training design that includes the SMS and moves towards CMS this approach will positively impact students' boxing game.

4. LIMITATIONS

This study has a limitation, as only male students from grades 8 and 9, aged 13–14 years, from the Karaganda Region (Terekti Village Sports School) were included. This limits the generalizability of the study findings. Secondly, only a limited number of SMST and CMST techniques were included. It is recommended that future studies incorporate a wider range of SMS and CMS training techniques, as well as include mixed-gender samples to allow for separate performance analysis of males and females. Additionally, more factors such as self-esteem and self-efficacy could be added to the study framework. Cross-regional studies may also enhance understanding of the investigated variables.

5. CONCLUSIONS

The study was specifically designed to understand the importance of simple motor skills training (SMST), complex motor skills training (CMST), and their impact on the technical performance of students in boxing sport (STPE). The instruments were developed based on the skills required for boxing. Moreover, the STPE instrument was assessed by the coaches of each team. In total, there were 14 teams each team consists of 11 players. It was found that training in simple motor

skills and complex motor skills enables students to perform better in boxing competitions. Moreover, simple motor skills (SMS) are a basic fundamental requirement for complex motor skills (CMS). 14 teams were grouped into 2 groups and each group competed within the group. Leading to the final match between two top teams. The performances of each team were closely measured for six months and it was found that constant training and complex motor skills (CMS) gives students mastery and students were able to learn combinations of body-mind coordination to gain an advantage in fights. Moreover, students in later stages of training were able to innovate new combinations and skills.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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