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Effectiveness of the Proposed Skill Exercises on Reaction Speed and Learning Skills on the Gymnastics Balance Beam for Female Students of Department of Physical Education and Sports Sciences

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ABSTRACT

Aim: The research aims to investigate the impact of the proposed exercises on reaction speed and learning skills related to the artistic gymnastics balance beam among female students. It also seeks to determine which group performed better, the control group or the experimental group. **Method:** Employing an experimental methodology pertinent to the research conditions, the study was conducted on a sample of twelve female students from the Department of Physical Education and Sports Sciences at the College of Basic Education, University of Diyala, during the academic year 2022-2023. The sample was divided into two groups: control and experimental. Data were collected and analysed using appropriate statistical methods. **Results:** The findings indicate that the proposed exercises positively influenced the reaction speed of the experimental group, revealing significant differences in favour of this group. **Implications:** The study offers novel implications, as prior research has not addressed the specific conditions examined. Additionally, the study discusses its limitations and suggests directions for future research.

Introduction

Speed is a critical factor in executing motor tasks across various contexts, particularly in sports (Ritter et al., 2023). It is quantified in seconds, often extending to fractions of a second. A key component of speed is reaction speed, which is influenced by the neurological stimuli relayed from the brain to the nervous system, the system responsible for executing the motor task (Ede, Yeadon, & Hiley, 2024). A quicker reaction speed correlates with improved execution of motor tasks, as muscles respond swiftly and efficiently to stimuli (Bürger et al., 2022). Research indicates that enhanced speed during performance leads to significant changes in outcomes, including the achievement of

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results, alterations in movement trajectories, and the completion of motor tasks within designated time frames for athletes or students (Small & Neptune, 2024). Moreover, increased speed cultivates a heightened state of preparedness and motivation among students, fostering a consistent and vigorous rhythm that significantly boosts their intrinsic motivation and enhances the functionality of the systems facilitating the learning process.

The more positive an individual's energy, the greater their performance level, both in sporting contexts and in daily responsibilities (Busquets et al., 2021). Achieving optimal sporting performance necessitates high levels of motivation, which facilitates the learner's progression from simple to complex motor tasks and enables them to confront obstacles encountered during the learning process (Čeklić, Šarabon, & Kozinc, 2022). Daytime exercises and reaction speed play crucial roles in developing these capabilities among learners, particularly when skill exercises and reaction training are organised and sequenced in alignment with the activity type (Anderson, Button, & Lamb, 2022). Additionally, the characteristics of the exercise environment, the age of the learner, and the timing of the exercise implementation are significant factors that influence learning outcomes. Attention to feedback timing is also critical. Moreover, the quantity of exercises provided to learners affects their engagement, allowing teachers or trainers to effectively monitor errors and strive to mitigate factors that may hinder the learning process, especially for beginners (Kenville et al., 2021; Takahashi et al., 2023). Female students are generally more susceptible to injuries during the learning process and the execution of motor tasks (Moffa et al., 2020). Therefore, enhancing reaction speed is essential to ensure their readiness and vigilance (Pau, Laconi, & Leban, 2021). Errors in performance can lead to injuries and hinder the learning process (Muehlbauer et al., 2022). Consequently, it is crucial for female students to adhere to proper techniques and structured repetitions in their movements (Skopal et al., 2020). Additionally, the effective delivery of information and instructional methods by the subject teacher is vital for successful implementation (Glynn et al., 2022).

Individual differences in reaction speed lead to varying performance levels, with some students completing kinetic tasks more quickly and learning at faster rates (Allen et al., 2020). In gymnastics, where both general speed and the transmission of commands are essential, reaction speed is vital for executing sequences accurately and progressing through skills while minimising errors (Opala-Berdzik, Głowacka, & Juras, 2021). This is particularly important for female students using the gymnastics balance beam, which poses challenges due to its height and the need for concentration, accuracy, and speed (Moeskops et al., 2022). The elevated nature of the apparatus can induce fear and anxiety, making rapid and precise execution of movements crucial (Cabrejas et al., 2023). Performance in sports varies according to technical aspects, degrees of difficulty, the characteristics of the performer, and the type of apparatus used (Farana et al., 2023). In gymnastics, performers often encounter fear, difficulty, and confusion during execution. Notably, the nature of performance among female students differs from that of their male counterparts, with the balance beam apparatus introducing elements of fear, confusion, and anxiety (Mizutori et al., 2021). The narrow space available for movement on the balance beam, coupled with its height above the ground, diminishes the effects of gravity (Peker et al., 2021). Consequently, this apparatus necessitates a high level of precision in speed and balance, which are essential for executing movements from the initial to the final stages.

The restricted movement area on the balance beam can exacerbate feelings of confusion and fear among students while they attempt to perform skills.

The effectiveness of exercise implementation significantly enhances students' responses to the learning process, thereby improving their performance (Gavanda et al., 2022). In the educational unit, students initially practise the exercises and motor tasks without apparatus before progressing to performance on the equipment. This transition necessitates that the teacher or trainer provides exercises in a comprehensive manner and allows for complete freedom of movement, which facilitates more natural performance by the students. With repeated practice, the coordination of body movements becomes more refined through intensive and appropriately distributed training, leading to improved performance on the balance beam (Goisbault et al., 2022). Consequently, the objective is to enhance and develop the reaction speed of female students when executing kinetic tasks on the gymnastics balance beam.

This research has two primary objectives. The first objective is to design proposed skill exercises aimed at enhancing reaction speed and the acquisition of specific skills on the balance beam apparatus for female students in the Department of Physical Education and Sports Sciences at the College of Basic Education, University of Diyala. The second objective is to examine the impact of these proposed skill exercises on reaction speed and skill acquisition on the balance beam for the same group of female students. The study is organised into several sections, including a review of the literature, methodology, findings, discussion, conclusion, implications, and future directions.

Review of Literature

The study by Busquets et al. (2021) emphasises the significance of exercise in enhancing athletic performance, highlighting its positive effects on both physical and mental health. The interplay between physical and mental well-being is crucial for optimising player performance. When athletes engage in regular exercise, it becomes essential for them to focus on performance improvement (Elrayah, 2022; Jung et al., 2022; Sunaryo et al., 2023). Effective training programmes aimed at enhancing both mental and physical health are key to facilitating optimal performance among players. Various types of exercises are recommended to bolster the physical health of athletes (Hajam, 2023; Höög & Andersson, 2021), which in turn motivates them to enhance their overall learning and performance. When mentors and trainers inspire student-athletes to strive for their health objectives, it fosters a strong work ethic and commitment to achieving their performance goals (Čeklić et al., 2022). Additionally, improved physical health contributes to enhanced reaction times during competitive play.

Mental health is a crucial factor in enhancing athletes' overall well-being. Access to mental health training is essential for players (Brtva, Irwin, & Farana, 2024), as it significantly improves their behaviour and performance (Ede et al., 2024). Regular exercise plays a vital role in promoting both physical health and strategic performance (Ritter et al., 2023). Instructors are encouraged to support students in advancing their mental health, which is critical for performance development. Additionally, Böge and Patlar (2022) noted that exercise enhances athletes' response times during competitions. Thus, focused efforts to improve athletes' performance are strongly recommended (Chien et al., 2022).

There is a growing need for innovative methods to enhance athletic performance (Broumi et al., 2022; Pereira et al., 2021). It is recommended that instructors utilise modern equipment to improve athletes' performance, a practice commonly adopted by college and university teams in developed countries (Alqasa & Al Qahtani, 2022; Moffa et al., 2020). Consequently, sharing knowledge and upgrading equipment are essential for enhancing athletes' strategic performance. According to Gavanda et al. (2022), newly developed techniques focused on improving mental and physical health are crucial for enhancing players' reaction times, particularly as they respond to actions during gameplay (Choi, Jung, & Park, 2021). Additionally, teamwork and support from external sources significantly influence athletic performance. Thus, fostering collaboration and performance enhancement among players is essential for improving their overall strategic effectiveness (Bürger et al., 2022).

Conversely, the speed of reaction among players is a critical factor in enhancing their performance (Caballero & Giménez, 2022; Ehmann et al., 2022). It is essential for players to be highly motivated to adapt to new training methodologies, which are crucial for improving response times during games. While established training techniques are important, the development of innovative training tools is also significant for enhancing player performance (Shrom, Cumming, & Fenton, 2023). Moreover, it is necessary for sports administration at colleges and universities to upgrade training modules for students, as this can positively impact their performance (Coker, Cotterill, & Griffin, 2022; Wang et al., 2024). Players are encouraged to cultivate a positive mindset, as this can influence their overall behaviour within a team context (Small & Neptune, 2024). Additionally, access to reliable work opportunities that align with market trends is vital for students' performance (Faka et al., 2023; Kim, 2022). Based on this discussion, the following two hypotheses are proposed to achieve the research objectives.

H1: *The proposed skill exercises have a positive effect on reaction speed and learning certain skills on the balance beam apparatus for female students.*
H2: *The skill exercises have a clear advantage over the traditional method in learning certain skills on the balance beam apparatus for female students.*

Research Methodology

The study was conducted from November 1, 2022, to December 15, 2023, employing an experimental method deemed appropriate for addressing the research problem and achieving the stated objectives. The research design comprised two equivalent groups: the experimental group and the control group. According to Tong, Uyen and Ngan (2022), the experimental method is defined as "a controlled change in the specific conditions of the reality or phenomenon being studied and observing the effects of this change in that reality or phenomenon." This method is prevalent in the field of sports, as it facilitates direct and realistic engagement with various phenomena through observation, experimentation, and comparison among the research groups, thereby demonstrating the existence of causal relationships between the research variables. Table 1 presents the experimental design for the research sample.

Table 1

Experimental Design of the Research Sample

Groups	First Step	Second Step	Third Step	Fourth Step	Fifth Step
	Pre-Test	Independent Variable	Post-Test		
Experimental Group	Front Balance Ball Forward Roll	Guided Imagination Strategy	Front Balance Ball Forward Roll	The difference between the pre- and post-tests for the experimental and control groups	The difference between the experimental and control groups in the post-test
Control Group	Front Balance Ball Forward Roll	Method Used	Front Balance Ball Forward Roll		

The research sample comprised second-year female students from the Department of Physical Education and Sports Sciences at the College of Basic Education, University of Diyala, during the academic year 2022/2023. The sample consisted of 12 students, randomly divided into two groups: a control group and an experimental group, with 6 students in each. Data collection employed supportive team methods. Additionally, the study utilised various apparatus, including low and high balance beams, speed indicators, coloured circles for focus, and coloured strips in the form of lines. The evaluation of the research skills was conducted by four judges for both groups, ensuring a high degree of accuracy in the assessment process. Each student was allowed two attempts, with only the successful attempt being counted. Scores were awarded on a scale of 10 points for each student. Calculating points for motor skill performance is crucial in the sports field, relying on the scientific evaluator's expertise to assess performance (Anderson et al., 2022). To evaluate the skill level of the research sample on the balance beam, a team of certified experts was employed. They assessed each student's performance based on the movement requirements established by the Iraqi Central Gymnastics Federation. The assessment took place on a specified date and the average scores from the judges for both the experimental and control groups were recorded (de Oliveira et al., 2021).

The judges evaluated the skills of both the experimental and control groups using a questionnaire developed by the researchers. The accuracy of this method relied on the evaluator's expertise in assessing technical skills. Each student had two attempts, with the best attempt being counted. Evaluators conducted the assessment according to the International Gymnastics Arbitration Law, calculating scores to one-tenth and determining the final score as the average of the two scores from four judges. According to Douda, Laparidis and Tokmakidis (2002), the forward roll on the balance beam involves bending the head toward the chest and slightly flexing at the hip joints. The movement begins by releasing the grip, allowing the body to fall forward, with the arms reaching for the beam quickly. This technique aids in extending the body at the hips to achieve a greater swing by optimizing the distance between the centre of gravity and the point of rotation. Additionally, early grip on the beam is crucial to extend the body and prevent falling after surpassing the vertical level.

The educational steps for executing a forward roll begin with rolling forward from an open sitting position, followed by transitioning from a standing position to an open sitting posture. Finally, students should learn to roll forward from standing onto the beam, ensuring protective support is in place throughout the process. Regarding front balance skills, this movement entails maintaining a straight body position supported by the upper body, which can be achieved from both still and moving states. It is crucial for the arms and shoulders to serve as a support base, stabilising the body and preventing falls. The centre of gravity should align at the shoulders, pelvis, and metatarsals to achieve the required straight position. Common mistakes, such as excessively moving the head forward, can cause body curvature and loss of balance. To effectively execute the swing position, players should avoid rushing the placement of the shoulders and manage the swinging force of their legs, using their arms to maintain control while moving forward. This position can be sustained or transitioned while keeping the body in motion.

Several educational steps are essential for teaching this swing technique, as performing it from a fixed position is generally easier than executing a full swing. Thus, instruction should progress gradually from simpler to more complex tasks. Initially, players should practice on low parallel bars, ensuring they can hold the position with support. The next step involves the player beginning from an open sitting position on the low apparatus, with their arms extended in front and nearly aligned with their thighs. They should then bend their torso forward at a suitable distance while gently pushing against the apparatus to elevate their pelvis to head level, simultaneously creating an angle with their legs. Once stability is achieved, the player can begin to straighten and close their legs to reach the intended position. In the subsequent exercises, the player should start from an open sitting position on the bars with their arms positioned behind their body. They will then raise their legs while closing them in front, allowing the swing to continue backward to complete the movement. This is followed by a similar exercise that incorporates an easy swing with support. Finally, the movement should be performed smoothly, ensuring the various body parts work in coordination throughout the process. The support and assistance method involves the supporter positioning themselves beside the device, placing one hand near the player's chest to provide upward momentum toward the movement, ensuring that this hand remains below the device level and positioned from the inside. The other hand may be extended forward for added support. An exploratory study was conducted on Sunday, October 30, 2022, involving 12 participants from the research population, aimed at identifying the difficulties encountered by students during the experiment.

Research Experiment Implementation

The pre-tests for the research sample were conducted on Monday, October 31, 2022, in the gymnastics hall, adhering to specific conditions required for the testing process. The educational unit was explained and clarified to the participants in the presence of the support team, and all test results were systematically recorded.

Sections of Rhythmic Gymnastics Exercises

In this study, rhythmic gymnastics exercises are categorized into three distinct sections. The first section is the preparatory phase, which focuses on physical exercises essential for developing fundamental, structural, special, and acrobatic movements. The second section constitutes the main phase, where the learner's performance emphasizes harmonious movements associated with skills such as walking, running, jumping, flexibility, and agility. The third section is specialized and emphasizes the rhythmic qualities of music.

Main Experiment

The primary experiment took place in the gymnastics hall of the College of Basic Education during the first semester of the 2022-2023 academic year, from November 1, 2022, to December 15, 2023. All necessary conditions and procedural steps related to testing, performance, and exercises were implemented, ensuring that students were adequately prepared while considering both internal and external variables within the hall.

Post-Tests and Scientific Foundations for Tests

The post-tests were conducted on Sunday, December 18, 2022, in the gymnastics hall, subsequent to the completion of six educational units. All conditions were maintained consistently with those of the pre-tests. The presence of scientific foundations in testing is a fundamental requirement; thus, the researcher established the coefficients of validity, reliability, and objectivity for the tests prior to initiating the main experiment. This assessment was necessary to ascertain the appropriateness of these tests for the research sample.

Test Validity

The validity of a test is a critical practical criterion that must be established in the selected assessments, as it determines the test's capacity to measure its intended physical, skill-related, or psychological attributes (Leandro et al., 2017). To enhance the validity of the test, the researcher employed multiple data types, thereby ensuring that the test is both reliable and adequately designed to accurately assess the desired characteristics. Consequently, the validity coefficient for the test was determined as follows:

Apparent Validity

To assess the validity of the selected tests aimed at measuring motor speed, agility, and skills, the researcher utilized apparent validity by consulting a panel of experts and specialists in motor learning, testing, and measurement. Experts selected the appropriate tests for each characteristic and skill. While validity encompasses various definitions, they converge on a fundamental concept: the test must accurately measure what it was intended to assess, as well as the specific field or phenomenon under investigation.

Self-Validity

To ensure test validity, the researcher also calculated the self-validity coefficient, equating it to the stability coefficient under the square root. This reflects the validity of the experimental test scores in relation to the actual scores. The analysis indicated that the tests possess a high degree of self-validity.

Test Objectivity and Statistical Methods

A key characteristic of an effective test is its objectivity. Objectivity refers to the consistency of performance evaluations across multiple judgments, thereby minimizing self-assessment. It involves the exclusion of personal biases, preferences, and subjectivity from the evaluator's assessment, ensuring that individuals are described based on their actual performance rather than the researcher's expectations. The tests employed in this study are designed to eliminate subjective evaluation and bias, as they are clearly defined and comprehensible to the participants. They utilize standardized measurement tools, and the results were assessed by judges who provided two average scores based on their evaluations. The SPSS statistical software was utilized to analyse the research results.

Results and Discussion

Experimental Group Results

The findings revealed significant improvements among female students in the experimental group, with notable differences between pre-tests and post-tests. These results indicate that the proposed exercises effectively enhanced the students' reaction speed and learning skills on the balance beam apparatus. Improvements were attributed to repeated practice, external instructor guidance, and internal self-feedback, which motivated students to engage enthusiastically. The challenges posed by the narrow balance beam relative to the students' body size added difficulty and anxiety, necessitating precision and speed for consistent skill execution. Kenville et al. (2021) noted that practice and attention to mistakes enable learners to adjust their performance, while feedback enhances their ability to identify errors, resulting in more realistic and confident execution of kinetic tasks. Patra et al. (2022) emphasized the importance of the teacher's approach in shaping students' personalities and achieving learning objectives. The results are presented in Table 2.

Table 2

Arithmetic Means and Standard Deviations for the Front Balance and Forward Roll Skills Test for the Experimental Group Between Pre-Tests and Post-Tests

Deviations	Pre-Tests		Post-Tests	
	M	SD	M	SD
Front Balance	1.141	0.391	7.916	0.70
Forward Roll Skills	1.05	0.116	7.652	0.644

It is important to emphasize that students' enthusiasm for applying the required skills significantly contributed to their learning outcomes, driven by the excitement and confidence fostered by the equipment. The learning process was designed to facilitate a gradual and smooth integration of skills, with motor perception being enhanced through observation and imitation of technical performance. The modelling method, combined with explanations, is essential in gymnastics instruction, as it helps athletes establish trust in their execution of the correct motor pathways. In skill performance modelling, it is crucial to recognize that motor elements must be executed directly, ensuring that skills are performed before students engage with the more challenging aspects of the movements (Skopal et al., 2020).

Glynn et al. (2022) noted that athletes must possess a correct perception of the skill and understand its components; teaching gymnastics is ineffective if motor perception is disregarded. Therefore, the researcher posits that utilizing equipment and auxiliary tools plays a vital and effective role in guiding students through the organized and coordinated learning of skills within gymnastics, particularly on the parallel bars. This approach serves as a mechanism for transitioning between different sections and skill components, adapting according to the complexity and significance of the performance, ultimately facilitating skill execution by breaking down the movement into manageable parts. The researcher attributes the observed improvement in

performance to the effective and systematic use of devices and tools, along with adherence to the correct procedures. This approach fostered student enthusiasm and a strong desire to engage with the exercises designed by the researcher. Moreover, it incentivized students to undertake challenging and somewhat complex movement tasks, despite the inherent risks associated with being novice learners. The significant number of organized repetitions, combined with effective utilization of resources, ongoing feedback, error correction, and the concerted efforts of both the instructor and the students, contributed to an enhanced learning rate.

Control Group Results

According to Table 3 and the accompanying data, the mean difference and standard deviation are higher than the tabulated values, indicating significant differences that favour the post-test results in the control group, albeit at a lower level than required. This improvement can be attributed to the instructor's monitoring and the students' adherence to scheduled class times. The structured lesson plan and organised steps implemented by the instructor, which took into account individual performance differences throughout the educational unit, played a crucial role in this enhancement. This aligns with the assertion of Farana et al. (2023), who emphasise that such methods serve as strategies employed by physical education instructors to elucidate all aspects of the skill through effective information transfer and application procedures tailored to the learner's abilities and potential. Furthermore, the tailored approach of each instructor in presenting scientific material and the fundamental principles related to skills, as noted by Mizutori et al. (2021), highlights that the instructor's methodology constitutes an organised process of collecting and structuring data and information within the lesson. This approach not only facilitates the renewal and development of knowledge but also assists the instructor in achieving educational objectives and making informed decisions. Additionally, it fosters a conducive teaching environment that supports students in reaching their goals and simplifies the scientific material.

The study concludes that the traditional method, involving explanation and demonstration, employed with the control group positively impacts skill acquisition. This observation clarifies and elucidates the performance of the skills learned. The researcher attributes these results to the active presence of the subject teacher, who explained the skills, provided consistent feedback, monitored student progress, and corrected errors. Additionally, the commitment of the control group members to the educational units facilitated effective learning through this explanatory and demonstrative approach. This finding aligns with Muehlbauer et al. (2022), who assert that the physical education teacher is a crucial factor in the educational process, guiding sports activities for female students and instilling in them the motivation to work diligently and accurately to achieve the objectives of the educational unit. Furthermore, Allen et al. (2020) note that an effective teacher is one who prepares, organises, and structures lessons progressively from simple to complex, while considering individual differences during the lesson implementation. Similarly, Peker et al. (2021) highlight that a proficient teacher possesses the ability to select appropriate teaching methods and styles, diversifying their application to meet the specific requirements of the learning objectives.

Table 3

Arithmetic Means and Standard Deviations for the Front Balance and Forward Roll Skills Test for the Control Group Between Pre-Tests and Post-Tests

Deviations	Pre-Tests		Post-Tests	
	M	SD	M	SD
Front Balance	0.82	0.402	5.875	0.842
Forward Roll Skills	1.094	0.382	6.395	0.907

Post-Tests for Control and Experimental Groups

Table 4 illustrates that the calculated t-values exceed the tabulated t-values, indicating a significant difference favouring the experimental group. This difference can be attributed to the effective engagement of students with the proposed exercises designed to enhance reaction speed. These exercises have notably improved the students' performance, particularly in the rapid transfer of kinetic tasks and their execution on the balance beam, as highlighted by Brtva et al. (2024). Furthermore, Moeskops et al. (2022) emphasise that the height of the apparatus and its narrow base, relative to the student's centre of gravity, are instrumental in alleviating fear, anxiety, confusion, and tension during the performance of selected skills, particularly regarding the speed of students' movements. This execution involves elements of kinetic transfer, balance, stability, and attentiveness. The height of the balance beam reduces gravitational pull, aiming to mitigate these factors through systematic repetition (Pau et al., 2021). This structured approach serves to motivate students to execute skills methodically, adhering to sequential steps, as affirmed by Ritter et al. (2023). They indicate that exercises focused on reaction speed enhance concentration, repetition, and attentiveness through various body positions, including sitting, standing, jumping, and running in different directions. Consequently, this approach renders learners more proactive compared to their peers (Cabrejas et al., 2023).

Table 4

Arithmetic Means for the Post-Tests of the Control and Experimental Groups for the Front Balance and Forward Roll Skills in Artistic Gymnastics

Deviations	Control Group		Experimental Group		Calculated T-Values	Tabled T-Values	Statistical Significance
	M	SD	M	SD			
Front Balance	5.875	0.842	7.625	0.644	7.74	0.57	Significant
Forward Roll Skills	6.395	0.907	7.916	0.701	12.467		Significant

Opala-Berdzik et al. (2021) assert that instructor feedback—whether internal or external—and a focus on correcting errors during exercises on or off the beam facilitate efficient problem-solving, thereby conserving time and effort in the learning process. Additionally, Höög and Andersson (2021) underscore that systematic kinetic performance prioritises efficiency, reduces effort, and enhances fluidity through repetition and feedback. Structured and repeated exercises, combined with sustained concentration, support students who exhibit slower response times compared to their peers. Moreover, an emphasis on timing and motivational strategies can significantly enhance performance

and learning methods. Takahashi et al. (2023) further emphasise that organised repetition of exercises confers advantages in performance attainment and movement precision. The instructor's focus on time management and effort optimisation is crucial for enhancing students' learning effectiveness.

Conclusions and Implications

The findings indicate that both hypotheses of the study were accepted. The study concludes that enhancing reaction speed among students is a critical factor for facilitating rapid responses in skill acquisition. Moreover, it provides evidence that the proposed exercises were advantageous for skill development on the balance beam, as they alleviated the students' effort during the learning process. Additionally, the study revealed that a diverse range of exercises and the integration of reaction speed elements contributed to elevated learning rates among students. The effective organisation of the educational unit, alongside structured repetitions, resulted in a marked improvement in learning outcomes. Consequently, it is essential for students to engage in training with appropriate equipment and exercises, which can positively impact their overall learning and quick response capabilities in various situations.

Theoretically, this study contributes to the existing literature by underscoring the vital role of reaction speed in skill acquisition, particularly within the context of physical education and balance beam training. It enhances our understanding of the interplay between cognitive and motor responses during the learning process, positing that swift reactions are not solely an athletic advantage but a fundamental mechanism of learning. The findings highlight the importance of diverse exercises that incorporate elements of reaction speed, demonstrating their effectiveness in fostering cognitive engagement and enhancing skill retention. This supports theories of kinaesthetic learning, which advocate for varied, responsive, and well-structured educational experiences. Furthermore, the study illustrates how a well-organised educational unit—characterised by appropriate structuring and repeated practice—can significantly improve learning outcomes. As such, it enriches pedagogical models that prioritise learner-centred approaches and flexible instructional methodologies. This research contributes to the broader discourse on active learning and experiential education, where student engagement through physical responses is linked to deeper comprehension and mastery of skills.

This study provides actionable insights for educators, particularly in physical education, on structuring training programmes to enhance learning outcomes. It advocates for the integration of reaction speed exercises as a vital component of skill development, emphasising the need to improve both physical dexterity and cognitive response times. By incorporating a variety of exercises and ensuring proper organisation of educational units, with adequate repetition and progression, educators can significantly boost student engagement and learning efficiency. The research also stresses the importance of using appropriate equipment to support learning objectives. Schools and institutions can leverage these findings to design curricula that promote skill mastery and cognitive readiness for quick decision-making and situational responses, highlighting the need for investment in effective training environments to cultivate engaged learners.

Future Directions

Despite the significant implications of this study, it is important to acknowledge certain limitations. Firstly, the research utilised a limited sample drawn from a single university, which constrains the generalisability of the findings. Future studies should aim to gather data from multiple universities to enhance the applicability of the results. Secondly, the study's methodological limitations stem from the exclusive use of IBM SPSS for data analysis. Other analytical tools, such as Smart PLS and JASP, could provide a more comprehensive analysis. Therefore, future research is encouraged to incorporate these additional tools and statistical methods to enrich the understanding of the findings, thereby contributing to the scholarly literature and expanding the body of knowledge.

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