



ORIGINAL SCIENTIFIC ARTICLE

CIRCUIT GAME DEVELOPMENT: IMPLICATIONS ON BALANCE, CONCENTRATION, MUSCLE ENDURANCE, AND ARROW ACCURACY

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Abstract

Study purpose. Balance, concentration, muscle endurance, and accuracy are very important for archery athletes, but there are still limited game models to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes. The aim of this research is to develop a circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in proper and effective archery athletes.

Materials and methods. The development model used in this study is based on Lee & Owens theory which uses five phases in a cycle, namely ADDIE. The effectiveness test was carried out on archery athletes aged 10-13 years, totaling 30 people. Treatment was given for 18 meetings.

Results. The conclusion of the research is that the circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes is feasible. The circuit game model is effective in improving balance, concentration, arm muscle endurance, and accuracy in archery athletes. The circuit game model consists of 6 posts.

Conclusions. For coaches, the circuit game model can be used to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes. Suggestions for further researchers are that this circuit game model needs to be developed again to be better.

Keywords: circuit game, balance, concentration, arm muscle endurance, accuracy.

Introduction

Archery has been loved by many from early childhood, teenagers, and adults. Archery is also one of the leading sports in Indonesia and as a culture from Indonesia. The hope is to be able to reach the international level through the training programs that have been planned. The characteristic of the sport of archery is releasing arrows through a certain trajectory towards the target at a certain distance (Sarro et al., 2021; Kim et al., 2021; Ortiz et al., 2020).

Archery is a precision sport that requires consistency and stability of a steady movement for accurate shooting of arrows (Simsek et al., 2019; Serrien et al., 2018; Musa et al., 2019). Archery in terms of components that affect the performance of archery athletes are physical, tactical, technical, and mental. The physical components needed in

archery include: physical condition, muscle strength, muscle endurance, and technique (Taha et al., 2018).

The most basic problems for adolescents may occur in physical and psychological components, including physical, which contains arm muscle endurance and balance, and from the psychological aspect, namely concentration. One of the mental factors that determine the accuracy of archery is concentration (Savvides et al., 2020; Verawati & Valianto, 2020; DeVoe et al., 2019). Concentration is needed, especially for sports that require high concentration, one of which is archery, because this sport requires accuracy, precision, consistency, and constancy in every action of every arrow that is fired. The higher the concentration level of an archery athlete, the better and more consistent the results will be. On the other hand, the lower the concentration level of an archery athlete, the results will not be maximal and will be seen in the inconsistency of the scores he gets (Swann et al., 2017).

Archery is a statistical sport that requires good physical condition, strength, and endurance, especially in the upper body's muscles. One indication of the athlete's physical

condition that greatly influences archery achievement is the endurance of the arm muscles (Lau et al., 2020; Al-Jaber & Shandal, 2021). In the sport of archery balance is needed because it must be able to hold the body while on the other hand aim to open a shot (Kim, 2018). Several studies have shown that balance has an effect on archery outcomes (Lee et al., 2019; Ziebell et al., 2019).

Due to the lack of balance, concentration, and endurance of the athlete's arm muscles, this has implications for the low accuracy of archery. On this basis, an exercise model is needed in the form of a game that can be a stimulus for athletes to improve skills, physically (muscle endurance and balance), and mentally (concentration). Through exercises that are modified into the form of games and there are elements of play, children do not get bored quickly in doing so.

The development assumption in this study is the lack of a circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes. The goal to be achieved in this research is that the product produced in the future can add insight to the trainer as an alternative to developing an archery coaching program.

Materials and methods

Study participants

The subjects of the validation test were 6 experts with professors and doctoral degrees, and 1 archery trainer practitioner. After the product is produced in the form of a circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes, the effectiveness of the product is tested. The effectiveness test was carried out on archery athletes aged 10-13 years, totaling 30 people. Treatment was given for 18 meetings.

The study was conducted in accordance with the ethical principles of the Helsinki Declaration for human research and was approved by the Research Ethics Committee of the Yogyakarta State University.

The instrument of the feasibility test used a questionnaire. The feasibility test of the material is based on the aspects of the feasibility of the material, the feasibility of the content, and the feasibility of the language. Media feasibility test based on aspects of size, cover design, and content design.

The instrument for testing the effectiveness of the archery accuracy test is the archery accuracy test, namely by shooting at a distance of 30 meters, by means of an archer shooting 36 arrows and the total number of results for each arrow. The balance test used the stork stand test. The concentration test used the Grid Concentration Test. The arm muscle endurance test is the Holding Bow Digitec Test (Prasetyo et al., 2022).

Study organization

This type of research is research and development (Research and Development). In the research and development procedure, there are several stages that must be done in a research based on the theory of several experts. The development model used is based on Lee & Owens theory which uses five phases in a cycle, namely ADDIE (Analysis, Design, Development, Implementation, and Evaluation) (Samri et al., 2020).

Statistical analysis

The data analysis technique used in this research is quantitative analysis. The feasibility test uses descriptive analysis. Testing the effectiveness using t-test paired sample test.

Results

The results of the development of a circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes were then validated by material experts and media experts to determine the quality of the products developed. The assessment is carried out by material experts using a questionnaire. The measurement scale used is a modified Likert scale. The results of the material expert's assessment of the circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes are presented in Table 1.

Table 1. Data of material expert assessment results

Aspect	Earned Score	Maximum Score	Percentage	Category
Learning materials	53	60	88,33%	Appropriate
Contents	74	84	88,10%	Appropriate
Language	32	36	88,89%	Appropriate

Based on Table 1, the results of the material expert's assessment of the circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes, the material aspect of 88,33% is in the appropriate category. The content aspect is 88,10% in the appropriate category, and in the language aspect of 88,89% included in the appropriate category.

The results of the media expert's assessment of the circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes are presented in Table 2.

Table 2. Media expert assessment results data

Aspect	Earned Score	Maximum Score	Percentage	Category
Size	20	24	83,33%	Appropriate
Cover Design	95	108	87,96%	Appropriate
Content Design	198	228	86,84%	Appropriate

Based on Table 2, the results of the media expert's assessment of the circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes, namely the size aspect of 83,33% is in the feasible category; the cover design aspect is 87,96% in a category is appropriate, and the content design aspect of 86,84% is included in the appropriate category.

The resulting circuit game model consists of 6 posts; Pos 1 consists of walking with heels, walking tables, releasing arrows, Pos 2; climbing the block, walking bow, releasing arrows, Pos 3; toe walk, walking bottles, releasing arrows, Heading 4; bosu ball, bench push-ups, releasing arrows,

Pos 5; ankle zig-zag, take a walk hola hoop, releasing arrows, Pos 6; marble ankle, lifting bench body, releasing arrows. As in Figure 1.

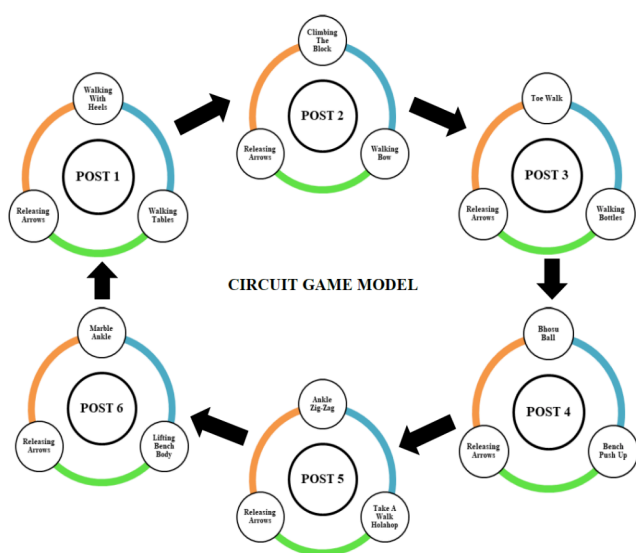


Fig. 1. Circuit game model

The effectiveness test in this study was conducted to determine the effectiveness of the circuit game model in improving balance, concentration, arm muscle endurance, and accuracy in archery athletes. The effectiveness test was carried out for 18 meetings with 30 athletes.

At each meeting, the athlete's time in completing each post is always recorded; it is hoped that with each session, there will be an increase in the time in completing each post. The training process is carried out in a fun way; the coach provides educational rewards and punishments, and always provides motivation and evaluation at the end of the exercise.

The results of the pretest and posttest data on balance, concentration, arm muscle endurance, and accuracy in archery athletes are presented in Table 3.

Table 3. Results of pretest and posttest

Variable	Pretest	Posttest
Balance	21.47±2.15	23.07±2.44
Concentration	13.63±2.25	15.90±3.29
Muscle Endurance	14.53±1.55	15.77±1.74
Archery Accuracy	243.60±10.82	249.60±11.32

Furthermore, paired sample test analysis was carried out to determine whether there was an increase in balance, concentration, arm muscle endurance, and accuracy after being given a circuit game model for 18 meetings. The results of the effectiveness test between the pretest and posttest data are in Table 4.

Based on the results of the pretest-posttest analysis in Table 4, a significance value of $0.000 < 0.05$ was obtained, indicating a significant difference between the pretest and posttest. Based on the analysis results, it can be concluded that the circuit game model effectively improves balance, concentration, arm muscle endurance, and accuracy after being given a circuit game model for 18 meetings.

Table 4. Analysis of paired sample test

Data	Mean	t count	Sig	
Balance	Pretest	21.47	8.339	0.000
	Posttest	23.07		
Concentration	Pretest	13.63	7.779	0.000
	Posttest	15.90		
Muscle Endurance	Pretest	14.53	7.223	0.000
	Posttest	15.77		
Archery Accuracy	Pretest	243.60	8.939	0.000
	Posttest	249.60		

Discussion

The circuit game model developed is one post that uses Bosu. Bosu is used as a stimulus in training archery athletes' balance. The flat side of the Bosu ball is often used to increase muscle tone, improve posture and improve balance. The ball side is mainly used to increase reaction speed and control the motor. Bosu exercise applications are used for the development of balance (Lubetzky-Vilnai et al., 2015; D. Badau et al., 2018), development of strength and postural control (A. Badau, 2017), and development of motor skills (Zemkova et al., 2017). In addition, Bosu, which has a large area of use, can not only be used standing on it in a vertical position but also a horizontal position (Saeterbakken et al., 2019).

The results of the study showed that training using a Bosu ball for eight weeks could improve balance (Gidu et al., 2022; Saikhanzul et al., 2022). Rebound training using a trampoline and a BOSU ball provides proprioceptive and vestibular stimulation and improves postural control and balance (Abd-Elmonem & Elhady, 2018). Exercise (BOSU ball) for ten weeks can improve the balance (static and dynamic) (Elfateh, 2016). There was a significant change in left balance in a 16-year-old basketball player after being given Bosu ball training treatment (Nugraha et al., 2022).

The circuit game model developed has several movements in the post to increase concentration. Concentration is a condition in which a person's awareness is focused on a particular object at a specific time. Concentration is needed, especially for sports that require high concentration, one of which is archery. This sport requires accuracy, precision, consistency, and constancy in every action of every arrow fired (Camus, 2020).

The circuit game model developed has several movements in the post to increase muscle endurance, such as walking tables, walking bottles, bench push-ups, taking a walk hola hoop, and lifting the bench body. This exercise is effective in increasing muscle endurance. The results of this study are supported by several studies that carried out weight training to increase muscle endurance (Grgic et al., 2020; Schoenfeld et al., 2019; Fragala et al., 2019).

The circuit game model developed is effective in increasing accuracy in archery athletes. This happens because the athlete repeats with arrows or releases arrows at the end of each post in the circuit game model. Releasing arrows is done with ever-increasing repetitions and sets. The increase in ability is due to the association of knowledge obtained by children at previous meetings with new knowledge, and the association is more robust when done repeatedly. This is

based on the law of exercise learning theory. That principle of the law of exercise shows that the main focus in learning is repetition; the more often the subject matter is repeated, the more mastered it will be (Tomprowski & Pesce, 2019). Without repeated practice, skills for mastery of technique and stability cannot become an automatic movement (Bompa & Buzzichelli, 2019).

Conclusions

Based on the study's results, it was concluded that the circuit game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes was feasible. The circuit game model improves balance, concentration, arm muscle endurance, and accuracy in archery athletes.

The product contains the procedure for implementing the exercise model, text, and images. This development product has components that allow coaches and athletes to learn it more easily because it is accompanied by: (1) instructions for use, (2) objectives to be achieved, (3) presentation of material, (4) attention-grabbing materials in the form of pictures and explanatory texts.

For coaches, the circuit game model can improve balance, concentration, arm muscle endurance, and accuracy in archery athletes. Suggestions for further researchers, namely the game model to improve balance, concentration, arm muscle endurance, and accuracy in archery athletes, need to be developed again to be better.

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Conflict of interest

We know of no conflicts of interest associated with this publication, and there has been no significant financial support for this work that could have influenced its outcome. As the corresponding author.

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РОЗРОБКА ЦИКЛІЧНОЇ ГРИ: ВПЛИВ НА РІВНОВАГУ, КОНЦЕНТРАЦІЮ, М'ЯЗОВУ ВИТРИВАЛІСТЬ І ТОЧНІСТЬ СТРІЛЬБИ З ЛУКА

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 6 с., 4 табл., 1 рис., 34 джерела.

Мета дослідження. Рівновага, концентрація, м'язова витривалість і точність дуже важливі для спортсменів, які займаються стрільбою з лука, але досі існує обмежена кількість ігрових моделей для покращення рівноваги, концентрації, витривалості м'язів рук і точності у спортсменів-лучників. Метою цього дослідження є розробка належної та ефективної моделі циклічної гри для покращення рівноваги, концентрації, витривалості м'язів рук і точності у спортсменів, які займаються стрільбою з лука.

Матеріали та методи. У цьому дослідженні використовували модель розробки на базі теорії Лі та Оуенса, яка використовує п'ять фаз у циклі, а саме: аналіз, проектування, розробка, впровадження, оцінка. Перевірку ефективності проводили на спортсменах-лучниках віком 10-13 років загальною кількістю 30 осіб. Процедура проводили протягом 18 зустрічей.

Результати. За результатами дослідження було зроблено висновок, що модель циклічної гри для покращення рівноваги, концентрації, витривалості м'язів рук і точності у спортсменів-лучників є доцільною. Ця модель циклічної гри показує свою ефективність у покращенні рівноваги, концентрації, витривалості м'язів рук і точності у спортсменів, які займаються стрільбою з лука. Ця модель циклічної гри складається з 6 позицій.

Висновки. Тренери можуть використовувати цю модель циклічної гри для покращення рівноваги, концентрації, витривалості м'язів рук і точності у спортсменів-лучників. Рекомендації для подальших дослідників полягають у тому, що ця модель циклічної гри потребує повторної розробки з метою її покращення.

Ключові слова: циклічна гра, рівновага, концентрація, витривалість м'язів рук, точність.

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