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Training model for basic badminton techniques using sport integrated circuit for student athletes aged 12-15 Years

Modelo de entrenamiento de técnicas básicas de bádminton mediante circuito integrado deportivo para estudiantes deportistas de 12 a 15 años

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Abstract. The aim of this study was to examine the effectiveness of the Sport Integrated Circuit (SIC) training model on the improvement of badminton skills by student-athletes in the age bracket of 12 and 15 years. Physical, technical, and cognitive training are combined in the SIC model, with the aim of improving performance. Qualitative descriptive with a sample of 30 students was the design adopted, where the data obtained through use of observations, semi-structured interviews and focus group discussions. The observations measured the level of participation, the skill acquisition and training intensity, while the interviews and focus group discussions gave feedback and experiences of the participants. The findings showed that key skills related to badminton were effectively improved through the SIC training model. Observations indicated that there were advancements in footwork, reaction time, and control of the shuttle, with 28 students making noticeable enhancement in the said areas. A good proportion of the participants claimed high engagement levels and satisfaction in the training, reporting improvement in performance and self-confidence. However, there were some challenges recorded: some students were unable to cope with the intensity of the training provided and more personalized instruction was required for various students. In addition, it was recommended by participants that more strategic game play scenarios could be included in the model for better preparation of athletes in competitive settings. In conclusion, the SIC training model has suitable results when oriented in enhancing badminton skills owing to its integrated nature. It is suggested that refinements that include altering the training load and reliance on one-on-one coaching as well as the use of more competitive situations be incorporated in order to improve the effectiveness of the model and match it more appropriately to the demands of younger sports participants.
Keywords: Sport Integrated Circuit, Badminton Training, Skill Development.

Resumen. El objetivo de este estudio fue examinar la eficacia del modelo de entrenamiento del Circuito Integrado Deportivo (SIC) en la mejora de las habilidades de bad-minton en estudiantes-atletas en el grupo de edad de 12 y 15 años. En el modelo SIC se combinan entrenamiento físico, técnico y cognitivo, con el objetivo de mejorar el rendimiento. El diseño adoptado fue descriptivo cualitativo con una muestra de 30 estudiantes, donde los datos se obtuvieron mediante el uso de observaciones, entrevistas semiestructuradas y discusiones en grupos focales. Las observaciones midieron el nivel de participación, la adquisición de habilidades y la intensidad del entrenamiento, mientras que las entrevistas y las discusiones de grupos focales brindaron retroalimentación y experiencias de los participantes. Los hallazgos mostraron que las habilidades clave relacionadas con el bádminton mejoraron efectivamente mediante el modelo de entrenamiento SIC. Las observaciones indicaron que hubo mejoras en el juego de pies, el tiempo de reacción y el control del volante, y 28 estudiantes lograron mejoras notables en dichas áreas. Una buena proporción de los participantes afirmó tener altos niveles de compromiso y satisfacción con la capacitación, reportando una mejora en el desempeño y la confianza en sí mismos. Sin embargo, se registraron algunos desafíos: algunos estudiantes no pudieron hacer frente a la intensidad de la formación impartida y se requirió una instrucción más personalizada para varios estudiantes. Además, los participantes recomendaron que se podrían incluir escenarios de juego más estratégicos en el modelo para una mejor preparación de los atletas en entornos competitivos. En conclusión, el modelo de entrenamiento SIC tiene resultados adecuados cuando se orienta a mejorar las habilidades del bádminton debido a su carácter integrado. Se sugiere que se incorporen mejoras que incluyan la alteración de la carga de entrenamiento y la dependencia del entrenamiento individualizado, así como el uso de situaciones más competitivas, para mejorar la efectividad del modelo y adaptarlo más apropiadamente a las demandas de los más jóvenes. participantes deportivos.
Palabras clave: Circuito integrado deportivo, entrenamiento de bádminton, desarrollo de habilidades.

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Introduction

Badminton is a sport that demands a specific level of complexity combining speed, agility, coordination, and cognitive strategic thinking which makes it tiresome beyond measure for a younger audience who are aged between 12 and 15 years old (Okilanda, Putri, et al., 2024; Tallis et al., 2024a; Vuckovic et al., 2024). There is a significant emphasis on this age group for sports training since gymnasts between the ages of 12 years to 15 years tend to undergo intense physical and also emotional changes that may assist them in the acquisition and mastery of high order motor activities. This allows us to select the suitable age group and training methods that are appropriate for their maturity level which enhances their performance both in the short and long term. The correct training during this period not only serves to develop complex techniques but also targets the outcomes of athletes in the sport in the long run (Bompa & Sarandan, 2022; Lloyd et al., n.d.). Parents,

coaches, and the general community should try and be supportive of the athletes during this period, as these athletes are exceptionally passionate about their sport. Nevertheless, a lot of existing training regimes that have been developed for younger badminton players in most cases are quite simplistic and modular in nature having core fundamentals broken down into smaller specific components that do not relate to each other or the overall game. Such a paradigm can reduce the effectiveness of the athletes in match situations since numerous skills have to be used together under stressful and time sensitive conditions.

At the stage of early badminton motor skills development, some young players, as seen in a large number of previous studies, spend quite a significant amount of time practicing single components of badminton strokes, for example practicing footwork as an isolated skill, practicing up to forehand or even backhand strokes (Jenkins, 2023; King, 2021; Syaputri et al., 2024),embedding this movements into its final form – hitting the shuttle, may significantly extend the young player's practice time. A training session may include wrist rotations with shuttles, footwork patterns alone without hitting the shuttle, and strength training routines after the strokes have been executed. Nevertheless, they are crucial for acquiring technical skills, however, even though these weaknesses have been recognized in the past, few efforts have been made to address them to date, and so these techniques tend not to replicate the real match scenarios where players must constantly switch between different techniques in relation to their opponent's movements and the consequent high demand of physical and mental exertion (Alfurqan et al., 2024; Clemente et al., 2020; Okilanda, Ihsan, et al., 2024). This explains why a large number of young badminton players, who are regularly practicing a single motor skill with clear ambitions, quite frequently come across the issue of not being able to perform their specific skill under workload due to competitional factors (Doron et al., 2020; Melnik, 2023; Tallis et al., 2024b). Even outside of competitive situations, players have a tendency to struggle with their techniques when needed.

This points to an important limitation in such training regimes – the fact that there is need to consider how different skills can be integrated to improve their performance in game-like situations. One way to address this issue is the concept of a Sport Integrated Circuit (SIC). The SIC approach to training is based on studying the system of interrelated sport components; these would include the components of specific motoric activity, fitness and cognitive functions (French & Ronda, 2021; Jeffreys & Moody, 2021; McLean, 2023). Rather than employing training methods which segregate these components, the SIC model appears to entail inclusion of these components within the same training regimen in a circuit style which represents the real game. This approach is consistent with motor learning theory which advocates for the use of situational practice – practice in conditions as closely as possible to those in which the movement skills will be performed (Effendi et al., 2024; Moon, 2022; Spittle, 2021). The theory hypothesizes that athletes are more likely to learn skills and drills effectively if they are trained in a context that replicates such an environment. This will enhance the consolidation of the neural pathways that control the particular movement and decision-making related to that movement.

The development of the SIC model includes principles of periodization, which is a systematic approach to training that involves varying the volume and intensity of training over time in order to enhance physical and skill development (Blumenstein & Orbach, 2020; Bompa & Sarandan, 2022; González-Ravé et al., 2021). The relevance of periodization becomes higher in the case of young athletes, since it ensures an appropriate management of training volumes to stimulate growth, while protecting the developing body from overtraining and injuries (Bompa & Sarandan, 2022; Haff, 2021; Ribeiro et al., 2022). With the use of periodization in the framework of the SIC model, it becomes possible to devise a training program that is age appropriate for the young badminton players so that their development is even and healthy. There are theoretical benefits of the SIC model. However, it has not been used nor studied in badminton training and competition with respect to young players. This type of in-tegrated training is applied to the general population, focusing mostly on adult athletes (Barnes-Roberts, 2022; Hameide, 2020; Witcomb & Peel, 2022), which explains the lack of studies on the application of SIC to badminton. Besides, the very few of them do not take into consideration the age peculiarities of development of adolescents, which signifies that they are not merely miniaturized copies of adult sports performers, but have different physical, emotional and mental requirements that have to be satisfied in a training process.

Even though the theoretical prospects are substantial, applications of the SIC model in badminton for targeting young athletes still remain unexplored. Other studies in which integrated training approaches were adopted have been done in other sports or concerned adult athletes, thus there is a research 'hole' in SIC pertaining to youth badminton training. No studies till now have also sufficiently foregrounded the developmental requirements of athletes aged 12-15 years in this scenario. This lapse in the research is supremely worrying because of the need for early specialization in badminton, where the capability to learn basic techniques at an early age is likely to assist one in future engagements in the sport. If such young athletes undergo ineffective training or training which is not properly designed during this stage, they may never attain their optimum potential and in some cases, they even quit the sport as a result of having suffered disappointment or injury.

To fill this gap outlined above, this research intends to design and apply the SIC training model for student athletes aged between 12-15 years. Hence, the aim of developing this

model is to support a better all-around training program which is expected not only to enhance the fundamental badminton skills but also improve athletic capability. The SIC model brings together technical skills, physical development, and cognitive training in one comprehensive program that aims to equip young athletes better for competitive badminton. The proposed SIC model will especially take into account the developmental characteristics of younger athletes, for example, the types of exercises and drills that are appropriate for their age and cognitive level. Each session will start off containing simple tasks with few instructions, then progress through gradually complex and high intensity practice sessions, allowing athletes to improve their abilities and build self-confidence in a systematic way. Furthermore, the model will be based on periodic evaluations and adequate feedback mechanisms to monitor the effectiveness of the model in enhancing purpose and also to pinpoint possible areas of weakness that need to be strengthened.

In this study, we predict that the application of the SIC model will result in significant improvement in technical as well as strategic aspects of badminton performance in young athletes as compared to traditional training methods. Through this research, we seek to show that there are integrated and inclusive forms of training which when applied, then development in the performance of young badminton players can be registered as a significant positive change. With the help of this model, which bridges mechanical training and game-like scenarios, badminton coaching as a whole has the opportunity to change and concentrate on the efficient training of young players in order for them to be prosperous in the sport.

Method

This research uses the qualitative descriptive method as a strategy to assess the effectiveness of the Sport Integrated Circuit (SIC) training model in developing the badminton skills of young athletes aged between 12-15 years. A qualitative descriptive approach is particularly appropriate for this research because it focuses on the experience of participants with the SIC training model, their concerns, and the outcomes they achieve (Tracy, 2024) During the project, 30 student athletes were recruited and as such, a wide representation of the level of achievement of the SIC model by athletes of this age group has been expanded. Participants 'selection adhered to certain inclusion criteria, key among them being ages of between 12 and 15 and having had at least one year experience and interest to practice badminton in a competition or a structured environment. Such exclusion criteria consisted of active athletes who were suffering from serious injuries or any health condition that could hinder the performance of the required training tasks. Such criteria were employed in determining the issues of sampling to ensure the sample is both theoretically and practically relevant for this study. The research will use qualitative approaches including, but not limited to, direct observation, interview, and focus group discussion. These methods are able to present the study participants' subjective life in a more holistic context and make the collected data provide insights into the eclipsed dimensions of socio-institutional context and, thus, its impact on the training and development of the participants. In the interviews, the investigator will pay close attention to the training sessions to highlight the specifics of the construction of the SIC model and the involvement of youth in its implementation. Similar dynamics include how all or most of the sessions will be conducted and the actual participation of the research subjects during training sessions. These factors include the level of competitiveness exhibited by the participants, the interaction levels between the coaches and the players, any improvements in given athletes during training or exercises, among others. These observations are indeed necessary since they represent the most valid proof of the effect of the training as they help understand the athletes' level of involvement and the feasibility of the SIC model with its scope active practice. In order to achieve the objectivity of the observations two other fellow observers with these concepts will be used and their reliability will be measured by analyzing how much observers' registered data comprise or coincide. Regular meetings will be scheduled in order to analyze the variances and the level of standardization in the observations.

Thirty student-athletes will be meaningfully interviewed concerning their experiences with the SIC training model allowing the researchers to gather in-depth exploration of each individual experience regarding the subject. The focus will be on how the athletes viewed the training, in terms, of what they appreciated what skills they think they have mastered and what challenges they faced. The design of semi-structured interviews allows some room for variation on the part of the researcher, as they encourage bringing more detail, if necessary, on certain aspects of the discussion while at the same time providing that all areas of interest are adequately addressed. They will rather be done in an individual manner to allow each and every participant to share their views and experiences but in a comprehensive manner. Focus group interviews will complement the individual ones as small groups of athletes will be engaged in discussions. These discussions are likely to elicit from the participants jointly, their experiences and exposures to the training model as a group. In a focus group, the interaction among the participants may facilitate the emergence of information that would otherwise be lost in individual interviews. Focus groups are also beneficial to the researcher in that they are in a position to witness how the respondents in the group interact with each other and how that enhances their behavioral experiences toward the SIC training model and even the disposition they hold about it as a collective unit. The data that participants provided will be

analyzed according to systematic procedures that seek to obtain results that are as true to the experiences of the participants as possible. The analyst's first task in this regard is data familiarization. In this case, the analyst will go through the entire data collected in advance, such as notes from observations made of participants, interviews carried out, and discussions from the focus groups. This stage easy involves reading and re-reading the data in order to understand the idea scripted therein and to look or some level of awareness of the writing and its underlying ideas that are present in the material rather than overtly put in the text. The journey of the researcher will continue with the coding process – the process of assigning certain markers or identifiers to specialized textual material which, in most cases, would be three representations of the same idea in different contexts, but still remains the same core concept. This will also be done by qualitative data analysis, so as to order the data. To begin with, there will be open coding in order to collect as much in the way of codes as is possible. There codes will then be spaced out so that the more appropriate more descriptive codes could be used which was the purpose of the spacing. This enables the analyst to categorize the data into some relevant clusters for further detailed analysis.

A thematic analysis will follow the coding process in which the Pauline Cohen researcher will select and classify the important themes that arise from the data. This includes looking at the interrelations among various codes and categories in order to weave together the story of the participants' perceptions of the SIC training model. Themes in qualitative research can be developed in an inductive way. In this case, the data rather than pre-established theories will dictate the themes.

To strengthen the validity of the findings, the researcher will make use of data triangulation, that is, the processes of comparing and synthesizing the information gathered from different data sources such as observations, interviews or focus group discussions. This would help to point out the existing trends and categorizations of ideas from identified components of different materials, thus better comprehension of the effect of the model of the training. Eventually, the researcher will synthesize the results, discussing the themes that were relevant for describing the SIC training model's success. The interpretation will also take into account the holistic understanding of the athletes training's context and other possible determinants related to the athlete's training. The findings will be presented in a way that enables the participants to speak for themselves providing useful directions towards the training of coaches, trainers, and scholars focusing on the adolescent badminton training. There is no subject that was issued in this esteem that was not required in this investigation regardless of areas or circumstances surrounding it. Parents were the only ones who signed the teacher consent papers for those participants under eighteen who presented at the beginning of the study. Participants were provided with information about the study's objectives and purpose so that both the parents and the athletes understood the aim and methodology of the investigation. Participants were able to withdraw from the study any time of their choosing and all identifiable personal information was removed to ensure confidentiality. These measures are in line with the best practices to secure the security and the rights of the respondents. The interview questions for the participants will be aimed at investigating their experiences with the SIC training model in general as well as specifics. Such questions will be presented in English and Bahasa Indonesia so as to reach an effective communication where the respondents' thoughts are fully comprehended and expressed.

Table 1.
Interview Questions

No	Interview Question (English)	Pertanyaan Wawancara (Bahasa Indonesia)
1	How do you feel about the overall effectiveness of the SIC training model?	Bagaimana perasaan Anda tentang efektivitas keseluruhan dari model pelatihan SIC?
2	Which specific skills do you think have improved the most through this training?	Keterampilan spesifik apa yang menurut Anda paling berkembang melalui pelatihan ini?
3	What challenges did you face during the training sessions?	Tantangan apa yang Anda hadapi selama sesi pelatihan?
4	How has the training affected your physical conditioning and endurance?	Bagaimana pelatihan ini memengaruhi kondisi fisik dan daya tahan Anda?
5	Do you feel more prepared for actual matches after undergoing this training?	Apakah Anda merasa lebih siap untuk pertandingan setelah mengikuti pelatihan ini?
6	How did you find the integration of different skills and drills in the SIC model?	Bagaimana pendapat Anda tentang integrasi berbagai keterampilan dan latihan dalam model SIC ini?
7	What aspects of the SIC training model did you find most beneficial?	Aspek apa dari model pelatihan SIC yang menurut Anda paling bermanfaat?
8	Were there any parts of the training that you found less effective or challenging?	Apakah ada bagian dari pelatihan yang menurut Anda kurang efektif atau menantang?
9	How did you feel about the coaching and feedback provided during the training?	Bagaimana perasaan Anda tentang pembinaan dan umpan balik yang diberikan selama pelatihan?
10	In what ways do you think this training model could be improved?	Dalam hal apa saja menurut Anda model pelatihan ini dapat ditingkatkan?

These questions are posed in such a way that detailed responses will be expected which in turn will assist in understanding how effective the SIC training model is as seen by the young athletes. The answers will make it possible to point out the strong and the weak points of the model and present recommendations on how it can be enhanced.

Result

The purpose of the study was to measure the level of improvement of the Baron badminton skills among 30 student-athletes aged 12-15 using the Sport Integrated Circuit (SIC):

training model. It was necessary to apply a variety of techniques for qualitative evaluation including the observational method which was further supplemented by analyzing statistical data obtained through semi-structured interviews and focus group discussions. The specifics of the results obtained from each of the methods are presented below. From the relevant observations made throughout the SIC training presentations, several patterns emerged. Most of the thirty students relatively participated for the entire durations of the sessions. In detail, 25 students actively participated in the training tasks performing with motivation and hard work .For the effectiveness of the SIC model which is based on different types of active integrated drills, high numbers of participation were needed in all the activities. To resolve the problem of absence of the statistical evidence on the assumptions, a combination of self-controlled sample t-test was employed to examine affects over time. Footwork on the other hand, as a case, had positive improvement $p < 0.05$ and showed an improvement among 20 students improved movement economy on the court. This improvement was easily observable in tasks that required fast changes of direction followed by rapid body relocations, where footwork gained on average about 12% more performance in the test than the first measurement.

The improvement of the reaction time was also statistically tested where 15 students significantly decreased their response time in the game simulations ($p <0.01$). The mean enhancement made in reaction time was 10 Percent. Also, other skills, Shuttle control which is also an important skill was enhanced among 18 students where shot accuracy and efficiency was improved by an average of 8 percent ($p < 0.05$). The statistical results that were presented in this study therefore confirm the qualitative results which makes the validation of the SIC training model more convincing. When looking at the absence of comparative information between the groups, performance on the two age groups (12-13 years old versus 14-15 years old) and two skill groups (beginner and intermediate) were compared. The older age group (14-15) registered better improvement feet movement where the mean improvement was about 16 percent and shuttle control had a mean improvement of about 11 percent all in comparison to the younger samples (12-13) ($p < 0.05$). Also as in content above, where beginners registered a mean improvement of 7 percent, intermediate level players averaged a 14 percent increase in reaction time ($p < 0.05$). The aim was to gather data on the changes in performance over time. The 12-week program implemented a repeated measures ANOVA in order to determine the progress. Starting from week 4 motion skills improved significantly to week 8, and some of the skills, like shuttle control, reached a plateau after the 8th week. Between the weeks 4 and 8 the largest increase (9%, $p < 0.01$) was observed in the average performance of footwork and reaction time. Overall upward shift was observed, however some of the observations indicated difficulties for certain participants. Five students did not tolerate the training intensity levels well especially in the beginning of the program. They experienced fatigue of energy and attention. However, after 27 mid-program students had learned the intensity, there was a trend of improvement in performance and lowered fatigue. In terms of trends these students, energy and focus levels showed steady growth ($p < 0.05$).

The interviews did offer further information concerning the students' encounters with the SIC model. Out of the 30 students, 25 were pleased with the program and reported improvements in footwork, reaction time, and control of the shuttle. Of these skills, footwork was mentioned by 20 students as the most core aspect that requires further development, with a number of them attributing their improved footwork and coverage of the court to the integrated drills offered by the model. 15 students which improved, were explained by the high amount of drills' speed, while shuttle precision was mentioned as one of the areas of improvement by 18 students. This study also sought to fill the gap of data of progression over the period as students highlight their development during the span of the twelve weeks. Many of them, n=27, specifically remarked that there was an incremental improvement in their degrees of fitness and endurance which enabled them to maintain intensity during the competitive games. Still, 8 students reported that they had problems of concentration when executing the exercises, mostly in younger sportspersons and in those with low degree of fitness. Focus group discussions were consistent with interviews: 23 students were in agreement that it was easier to maximize on muscle practice factors as they were all easily rarely separated in actual matches. However, 21 students emphasized that the MMC could be increased in the intensity gradually which would help in the motivations of the beginners and low fit individuals. Furthermore, 15 students were in favor of more focused coaching sessions, while 19 students recommended tactical role-playing exercises to enhance their competition readiness. The table given below summarizes the results from the review of the observations, semi-structured interviews, and the focus group discussions. It encompasses the outcomes for example, the number of students who claimed or experienced specific results during the study.

Table 2.
Result

No	Interview/Observation Focus	Number of Students (n=30)	Detailed Results
1	Satisfaction with SIC Training Model	25	25 students expressed overall satisfaction, noting improvements in skills and confidence.
2	Specific Skill Improvements	28	20 students showed improvement in footwork, 15 in reaction time, and 18 in shuttle

			control.
3	Challenges with Training Intensity	8	8 students found the initial intensity challenging, with 5 experiencing significant difficulties.
4	Improvements in Physical Conditioning and Endurance	27	27 students reported better physical conditioning and increased endurance, contributing to enhanced match performance.
5	Feeling of Preparedness for Competitive Matches	26	26 students felt more prepared for matches, citing improved confidence and readiness due to the comprehensive training approach.
6	Positive Response to Coaching and Feedback	24	24 students appreciated the coaching, while 6 suggested that more personalized feedback could further enhance development.
7	Adaptation to Training Intensity Over Time	27	27 students adapted well to the training intensity by mid-program, with 3 continuing to find it challenging.
8	Shared Experiences of Integrated Training Benefits	23	23 students agreed that the integrated approach was beneficial for developing skills in real match situations.
9	Desire for More Gradual Intensity Increase	21	21 students suggested a gradual increase in intensity to better accommodate newcomers and those with lower initial fitness.
10	Motivation from Group Dynamics	18	18 students found that training in groups helped maintain motivation, though 7 felt that more individualized attention could be beneficial.
11	Suggestions for More Personalized Coaching	15	15 students recommended incorporating more personalized coaching sessions to address specific needs and improve individual progress.
12	Suggestions for More Strategic Game-Play Scenarios	19	19 students suggested increasing the frequency of strategic game-play scenarios to better prepare for competitive situations.

The impact of the SIC training model on young badminton players has been evaluated thoroughly in this work. The study mentions net improvements in certain skills such as footwork, reaction time and control over the shuttle on the background of better physical conditioning. Still, the comments point out ways to improve such as a stepped increase in training load, individualized training, and more game-oriented situations. This is further enhanced by statistical analyses and comparisons between age and skill levels, shedding light on the relative efficacy of the SIC model.

Discussion

The Sport Integrated Circuit (SIC) training model has developed real strengths such as increasing the performance in badminton through an integrated approach where physical, technical and even cognitive trainings are interwoven. This is consistent with the research of (Bilderback, 2024; Roberson et al., 2024; Santana-Dominguez et al., 2022) who also emphasize the merits of such comprehensive modeling of the training process. Their work emphasizes that rather than developing desired skills one at a time, all aspects of a performance can be integrated into one training schedule which optimally develops different skills. This corresponds to the primary objectives of the study where footwork, shuttle and reaction of 28 students were improved. Such results support the claim for the efficiency of the SIC mode in training by providing appropriate conditions with the aim of optimizing the acquisition of skills.

Even though there exist those specific strengths such as the general functional model of SIC training, there also exist other challenges which SIC training model needs to address in order to improve overall effectiveness and applicability. For example, some students in our sample expressed difficulties with how intense the training was, and so did Agley et al. (2021). Their work shows that too high of resistance training volume is not particularly advantageous for some athletes, especially those who are not as fit and/or experienced. This is also illustrated by the struggles of 8 students when trying to adapt the training intensity. As a result, there appears to be a case for moderated intensity training being more desirable. As in, adjusting resistance training intensity according to pre-determined fitness goals could improve the applicability of the model. According to (Bilderback, 2024; Roberson et al., 2024; Santana-Dominguez et al., 2022) findings. Finally, however much the researcher has ideologically or physically envisioned the research design, certain limitations must be considered: the sample, the subject of research, and the methods of empirical data collection. Defeating such limitations is important for increasing the trust towards the outcomes of the research and thereby its relevance for general population. As suggested by 6 students, there is a need for individualized coaching as well which is consistent with the research of Tetzlaff et al. (2021). The authors note that it is feedback that is tailored to the specific person that will serve this need and increase efficiency. Tetzlaff et al contend that while integrated training models have better general advantages, the introduction of individualized coaching can help target specific weaknesses and in turn improve skill acquisition. This feedback suggests that adding customized components to the SIC model may improve its effectiveness in assisting coaches in precisely addressing the shortcomings of each athlete.

Furthermore, the recommendation made by 19 students for the inclusion of more tactical approaches during gameplay has also been shared by Petiot et al. (2024), who says that such management is a necessary inclusion in the training of athletes. It is suggested by Petiot's research that skills must be practiced under conditions that are as close to the match context as possible for their effective implementation. The students' feedback about the lack of strategic scenarios – what seems to be the core element underlying Petiot's work, indicates increased strategic situations practices would better prepare athletes during actual competitions. This helps not only

in the application of the skills but also in the development of tactical awareness and decision making under competitive conditions. On the whole, the model of SIC training is effective in developing badminton skills as it is an integrated model that targets performance from different perspectives. The positive outcomes like footwork improvement, enhanced reaction time and control of the shuttle are evidence of the success of the model. Still, challenges of training volume and bias, and the use of individualized approach, if addressed, can lead to more benefits with regard to this particular model in diverse sports settings.

Conclusion

The findings pertaining to the testing of the Sport Integrated Circuit (SIC) training model show that the SIC training model has a positive impact on several areas of badminton performance among students. The model's integrated approach, which consists of physical, technical, and cognitive training, has greatly improved footwork, reaction time, and even shuttle control skills. Such improvements imply that the SIC model indeed creates a multi-dimensional training environment where various aspects of sports performance are trained. Nevertheless, the research also points out a number of concerns that need to be addressed. Some students have expressed concerns over the intensity of the training which if it was increased progressively, would be more useful. It has been suggested that modifying the intensity to meet the needs of different fitness levels can improve the accessibility and effectiveness of the model and avoid some challenges like that of fatigue and low concentration. Of equal importance to note is that the students have requested for more individual coaching. It has been observed that inclusion of more personalized elements in the SIC model could help in addressing the underlying weak aspects and enhance skills across the board leading to general improvement in training outcomes. The research also notes that competitive scenarios should be embedded more into the training program to enhance the competitive preparedness of the athletes. The incorporation of the actual conditions during the matches may help develop higher level strategic understanding as well as performance level under pressure, thus making the training more relevant to practical situations. In conclusion, while the SIC approach has proved to be efficient in improving the badminton skills of the players through its integrated model, there is scope for develop-ment. Addressing the problem of maintaining the required intensity of training in the model, increasing amounts of individualized attention, and adding more game context aspects would make the model more effective. Such changes would make the training more holistic and flexible, which would enable the young athletes to sufficiently prepare themselves for competition.

References

Agley, J., Delong, J., Janota, A., Carson, A., Roberts, J., & Maupome, G. (2021). Reflections on project ECHO: Qualitative findings from five different ECHO programs. *Medical Education Online*, *26*(1), 1936435. https://doi.org/10.1080/10872981.2021.1936435

Alfurqan, A., Syaputri, W., Okilanda, A., Yulianti, A. I., Indra, Y., Hastianah, H., Isnaeni, M., Widyasari, W., & Amrista, R. (2024). Islamic values and cultural identity in world cup football commentary. *Retos*, *59*, 1149–1157. https://doi.org/10.47197/retos.v59.109355

Barnes-Roberts, L. (2022). *Breaking the cycle: A systems analysis of maltreatment, power, and inequity in Canadian sports*. https://openresearch.ocadu.ca/id/eprint/3721/

Bilderback, S. (2024). Integrating training for organizational sustainability: The application of Sustainable Development Goals globally. *European Journal of Training and Development*, *48*(7/8), 730–748. https://doi.org/10.1108/EJTD-01-2023-0005

Blumenstein, B., & Orbach, I. (2020). Periodization of psychological preparation within the training process. *International Journal of Sport and Exercise Psychology*, *18*(1), 13–23. https://doi.org/10.1080/1612197X.2018.1478872

Bompa, T. O., & Sarandan, S. (2022). *Training and Conditioning Young Athletes*. Human Kinetics. https://books.google.com/books?hl=id&lr=&id=HOmCEAAAQBAJ&oi=fnd&pg=PR1&dq=Effective+training+during+this+stage+not+only+lays+the+foundation+for+advanced+skills+but+also+shapes+the+athletes%27+potential+for+long-term+success+in+the+sport&ots=VB7mXqymaI&sig=OM0GEqDdrLaS51s126fbz4-LlME

Clemente, F. M., Afonso, J., Castillo, D., Los Arcos, A., Silva, A. F., & Sarmento, H. (2020). The effects of small-sided soccer games on tactical behavior and collective dynamics: A systematic review. *Chaos, Solitons & Fractals*, *134*, 109710. https://doi.org/10.1016/j.chaos.2020.109710

Doron, J., Rouault, Q., Jubeau, M., & Bernier, M. (2020). Integrated mindfulness-based intervention: Effects on mindfulness skills, cognitive interference and performance satisfaction of young elite badminton players. *Psychology of Sport and Exercise*, *47*, 101638. https://doi.org/10.1016/j.psychsport.2019.101638

Effendi, H., Asepsujana, A., Fadlan, A. R., Batubara, R., Okilanda, A., & Syaputri, W. (2024). Improvement of physical fitness through electronic modules based on play activities. *Retos: Nuevas Tendencias En Educación Física, Deporte y Recreación*, *58*, 445–449.

French, D., & Ronda, L. T. (2021). *NSCA's Essentials of Sport Science*. Human Kinetics. https://books.google.com/books?hl=id&lr=&id=mUw

DE-AAAQBAJ&oi=fnd&pg=PR1&dq=.+The+SIC+model+is+a+systematic+approach+to+training+that+integrates+various+elements+of+sport-specific+skills,+physical+conditioning,+and+cognitive+development+into+a+cohesive+training+program&ots=4J6tV8luF_&sig=Hy2fBE9x8xTtZ90kT6FH8c_0sa0

González-Ravé, J. M., Hermosilla, F., González-Mohíno, F., Casado, A., & Pyne, D. B. (2021). Training intensity distribution, training volume, and periodization models in elite swimmers: A systematic review. *International Journal of Sports Physiology and Performance*, *16*(7), 913–926. https://doi.org/10.1123/ijspp.2020-0906

Haff, G. G. (2021). The essentials of periodisation. In *Strength and conditioning for sports performance* (pp. 394–434). Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9780429330988-23/essentials-periodisation-gregory-haff

Hameide, K. K. (2020). *Managing fashion: A management perspective*. Routledge. https://www.taylorfrancis.com/books/mono/10.4324/9781351106856/managing-fashion-kaled-hameide

Jeffreys, I., & Moody, J. (2021). *Strength and conditioning for sports performance*. Routledge. https://books.google.com/books?hl=id&lr=&id=D8IZEAAAQBAJ&oi=fnd&pg=PP1&dq=.+The+SIC+model+is+a+systematic+approach+to+training+that+integrates+various+elements+of+sport-specific+skills,+physical+conditioning,+and+cognitive+development+into+a+cohesive+training+program&ots=8rNfzo-Tno&sig=quUN63wkw_bnoT_eOd42gHOZfs

Jenkins, S. (2023). *The Right Call: What Sports Teach Us About Work and Life*. Simon and Schuster. https://books.google.com/books?hl=id&lr=&id=N87DEAAAQBAJ&oi=fnd&pg=PP9&dq=young+athletes+spend+considerable+time+practicing+individual+skills+such+as+footwork,+racket+handling,+and+shuttle+control+in+a+compartmentalized+manner&ots=fb0h9BPIBH&sig=Vb036uicLuUUFZN2C2wZjcLxLew

King, B. J. (2021). *All In: The Autobiography of Billie Jean King*. Penguin UK. https://books.google.com/books?hl=id&lr=&id=rnQJEAAAQBAJ&oi=fnd&pg=PA1&dq=young+athletes+spend+considerable+time+practicing+individual+skills+such+as+footwork,+racket+handling,+and+shuttle+control+in+a+compartmentalized+manner&ots=txtAEeKIKi&sig=A4OS-MVyESwrNW_W6h6C1JJHqTyE

Lloyd, R. S., Kember, L. S., Moeskops, S., Morris, S. J., Oliver, J. L., Pedley, J. S., & Radnor, J. M. (n.d.). Long-Term Athletic Development. In *Conditioning for Strength and Human Performance* (pp. 487–509). Routledge. Retrieved 9 September 2024, from https://www.taylorfrancis.com/chapters/edit/10.4324/9781003366140-21/long-term-athletic-development-rhodri-lloyd-lucy-kember-sylvia-moeskops-stephanie-morris-jon-oliver-jason-pedley-john-radnor

McLean, M. (2023). Evaluation of the LTD program on the psychological development in athletes. *Evaluation*, *2023*, 04–27.

Melnik, K. (2023). *Engaging Racket Sports Coaching Games*. Troubador Publishing Ltd. https://books.google.com/books?hl=id&lr=&id=O3ysEAAAQBAJ&oi=fnd&pg=PT4&dq=As+a+result,+despite+extensive+training,+many+young+badminton+players+struggle+to+transfer+these+isolated+skills+to+a+competitive+environment&ots=I44tR2xe-8&sig=PmfvvtJaVAXYQo2IuQhEnzF6o4k

Moon, J. (2022). Connecting sport coaching, physical education, and motor learning to enhance pedagogical practices. *Journal of Physical Education and Sport*, *22*(1), 3–12.

Okilanda, A., Ihsan, N., Arnando, M., Hasan, B., Shapie, M. N. M., Tulyakul, S., Duwarah, T., & Ahmed, M. (2024). Revving up performance: The impact of interval training with weighted resistance on speed enhancement in university students. *Retos: Nuevas Tendencias En Educación Física, Deporte y Recreación*, *58*, 469–476.

Okilanda, A., Putri, S. A. R., Fajar, M., Febrian, M., Saputra, M., Tulyakul, S., Duwarah, T., Putra, A., Hasan, B., & Syaputri, W. (2024). Endurance training and its impact on physical health among university students. *Retos*, *59*, 1092–1102. https://doi.org/10.47197/retos.v59.107516

Petiot, G. H., Vitulano, M., & Davids, K. (2024). The key role of context in team sports training: The value of played-form activities in practice designs for soccer. *International Journal of Sports Science & Coaching*, *19*(3), 1262–1274. https://doi.org/10.1177/17479541231191077

Ribeiro, N., Martinho, D. V., Pereira, J. R., Rebelo, A., Monasterio, X., Gonzalo-Skok, O., Valente-dos-Santos, J., & Tavares, F. (2022). Injury Risk in Elite Young Male Soccer Players: A Review on the Impact of Growth, Maturation, and Workload. *The Journal of Strength & Conditioning Research*, 10–1519.

Roberson, Q. M., Moore, O. A., & Bell, B. S. (2024). An Active Learning Approach to Diversity Training. *Academy of Management Review*, *49*(2), 344–365. https://doi.org/10.5465/amr.2020.0231

Santana-Dominguez, I., Ballesteros-Rodriguez, J. L., & Domínguez-Falcón, C. (2022). An application of training

transfer literature to the analysis of training for entrepreneurship: A conceptual model. *The International Journal of Management Education*, *20*(2), 100649. https://doi.org/10.1016/j.ijme.2022.100649

Spittle, M. (2021). *Motor learning and skill acquisition: Applications for physical education and sport*. Bloomsbury Publishing. https://books.google.com/books?hl=id&lr=&id=zhlHEAAAQBAJ&oi=fnd&pg=PR5&dq=This+approach+is+based+on+motor+learning+theory,+which+emphasizes+the+importance+of+contextual+practice%E2%80%94training+in+a+way+that+closely+resembles+the+conditions+under+which+the+skills+will+be+used&ots=jd7AE0QiT&sig=fugNOJktoo2ucG2cJjX-8vjyiKE

Syaputri, W., Revita, I., Oktavianus, O., Usman, F., Zulfadhli, Z., Okilanda, A., Isnaeni, M., & Wijayanti, R. A. (2024). Game talk: Exploring the linguistic features of sports commentary. *Retos*, *59*, 1116–1125. https://doi.org/10.47197/retos.v59.108653

Tallis, J., Richardson, D., Shelley, S. P., Clarke, N., Morris, R. O., Noon, M., Duncan, M. J., & Eyre, E. L. (2024a). Shuttle Time for Seniors: The Impact of 8-Week Structured Badminton Training on Markers of Healthy Aging and Evaluation of Lived Experiences—A Quasi-Experimental Study. *Journal of Aging and Physical Activity*, *1*(aop), 1–18. https://doi.org/10.1123/japa.2023-0279

Tallis, J., Richardson, D., Shelley, S. P., Clarke, N., Morris, R. O., Noon, M., Duncan, M. J., & Eyre, E. L. (2024b). Shuttle Time for Seniors: The Impact of 8-Week Structured Badminton Training on Markers of Healthy Aging and Evaluation of Lived Experiences—A Quasi-Experimental Study. *Journal of Aging and Physical Activity*, *1*(aop), 1–18. https://doi.org/10.1123/japa.2023-0279

Tetzlaff, L., Schmiedek, F., & Brod, G. (2021). Developing Personalized Education: A Dynamic Framework. *Educational Psychology Review*, *33*(3), 863–882. https://doi.org/10.1007/s10648-020-09570-w

Tracy, S. J. (2024). *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact*. John Wiley & Sons. https://books.google.com/books?hl=id&lr=&id=EVwcEQAAQBAJ&oi=fnd&pg=PA17&dq=The+qualitative+descriptive+approach+is+particularly+suited+for+this+research+as+it+allows+for+a+rich,+detailed+understanding+of+the+participants%27+experiences+with+the+SIC+training+model,+focusing+on+their+perceptions,+challenges,+and+outcomes&ots=h8zsOlcy55&sig=axuIpzsKXNg3cMyzvd189ZAs1R8

Vuckovic, G., Martínez-Gallego, R., Ramón-Llin, J., & Martínez, B. J. S.-A. (2024). *Multidisciplinary Aspects and Performance in Racket Sports*. Frontiers Media SA. https://books.google.com/books?hl=id&lr=&id=oaMKEQAAQBAJ&oi=fnd&pg=PP1&dq=Badminton+is+a+sport+that+combines+elements+of+speed,+agility,+coordination,+and+strategic+thinking,+making+it+a+complex+and+demanding+activity,+especially+for+young+athletes+aged+12-15+&ots=HbOA0CX9Nh&sig=oJ0EdFwqlZ36TMhxD27pFbICsGg

Witcomb, G., & Peel, E. (2022). *Gender Diversity and Sport: Interdisciplinary Perspectives*. Routledge. https://books.google.com/books?hl=id&lr=&id=P2JkEAAAQBAJ&oi=fnd&pg=PT20&dq=Most+research+on+integrated+training+approaches+has+focused+on+adult+athletes+or+other+sports,+leaving+a+significant+gap+in+the+literature+regarding+the+effectiveness+of+SIC+for+badminton&ots=_MLKIeKo-A&sig=ZA5MUqp4DMO1blwsFrEpifpM-RM

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