

TECHNOLOGY-ENHANCED LEARNING IN SPORTS EDUCATION: A COMPARISON OF SELF-DIRECTED DIGITAL LEARNING AND STRUCTURED COACHING

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Abstract. Technological advancements in various aspects of life have also had a significant impact on the field of physical education. One of the most noticeable impacts is the adoption of digital training apps that allow students to practice independently outside of class hours. However, although self-directed training apps offer many benefits, structured learning supervised by teachers remains the primary choice for developing students' skills. It is important to conduct research comparing the effectiveness of these two approaches in improving students' skills. One of the main objectives of this comparison is to determine whether self-directed training apps yield better results in terms of skill improvement, fitness, and performance compared to more structured training. This study employed a quasi-experimental approach with a split-group design. A total of 30 18-year-old students, who are active in badminton, were divided into two groups. The first group consisted of 15 students who engaged in self-directed training using a digital training app, while the second group consisted of 15 students who participated in structured training supervised by a coach. This study showed that the use of a self-directed training app had a significant positive impact on improvements in technical skills, speed, muscle strength, and flexibility, compared to structured training. Nam

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1. INTRODUCTION

Technological advancements in various aspects of life have also had a significant impact on the world of sports. One of the most noticeable impacts is the adoption of digital training apps that allow students to train independently outside of official training sessions [1]. These apps offer a variety of features, ranging from workout guides to real-time monitoring of students' progress, providing flexibility and convenience for students to train anytime and anywhere. With this technology, students are no longer limited to strictly scheduled training times and locations [2].

However, although self-directed training apps offer many benefits, structured training supervised by a coach remains the primary choice for developing students' skills [3]. Coach-led training is generally more organized, focused, and tailored to the individual athlete's abilities and goals [4]. Coaches can also provide immediate feedback, monitor technique, and design more detailed and specific training programs. Therefore, even as technology continues to advance, structured training still plays a vital role in the athlete development process.

It is important to conduct research comparing the effectiveness of these two approaches in improving athlete performance. One of the main objectives of this comparison is to determine whether self-directed training yields better results in terms of skill development, fitness, and performance compared to more structured training. By comparing these two methods, this research has the potential to provide useful insights for coaches, students, and sports administrators in selecting the most effective training method.

In addition, this study also aims to evaluate the extent to which motivation and self-discipline play a role in the use of self-directed training apps [5]. Given that self-directed training relies on students to manage their own workouts, it requires a higher level of commitment compared to training under direct supervision. On the other hand, structured training with a coach can provide motivational support through social interaction, direct supervision, and program adjustments based on individual needs.

The use of self-guided workout apps is becoming increasingly popular among students, especially in this digital age. These apps offer easy access to a variety of physical exercises, and some even include analytics features to help students track their progress. These features can provide useful feedback, although they are not as immediate or personalized as in-person training with a coach.

However, some students feel that self-directed training via apps does not have the same strong impact as structured, supervised training. In addition to the limitations of direct interaction, self-directed training can also reduce the social element and team cohesion, which are often key factors in an athlete's development. Therefore, there is a need to better understand the factors that influence the success of both approaches in improving athletic performance.

This study will measure several key variables, such as improvements in fitness, technical skills, and competitive performance. Improvements in fitness include strength, endurance, and flexibility, while technical skills focus on students' ability to perform movements with efficiency and accuracy [6]. Furthermore, competitive performance can indicate whether these differences in training methods also affect the results students achieve in competitions.

As part of this study, it is hoped that valid data can be obtained regarding the effectiveness of self-directed training compared to structured training. Thus, the results of this study can serve as a reference for coaches and sports administrators in designing training programs tailored to students' needs, while also incorporating technology as a tool to support the training process.

Overall, the primary objective of this study is to identify and compare the effects of the two training methods on improving students' performance. The findings of this study are expected to provide useful recommendations for selecting the optimal training approach and to contribute to the future development of sports training.

2. RESEARCH METHODS

This study employed a quasi-experimental approach with a separate-groups design. A total of 30 students aged 18 to 30, who are active in badminton, were divided into two groups. The first group consisted of 15 students who underwent self-directed training using a digital training app, while the second group consisted of 15 students who participated in structured training supervised by a coach. Each group carried out a training program for 8 weeks, with the same training frequency of 3 times a week.

To evaluate the outcomes of the two training methods, measurements were taken for several variables, including physical fitness (endurance, strength, flexibility), technical skills (speed and accuracy of shots),

and performance in matches. Data were collected through standardized physical tests, direct observation of technical skills, and performance in simulated matches conducted at the end of the study period. Data analysis was performed using a t-test to determine significant differences between the two groups.

3. RESULTS AND DISCUSSION

This study aims to evaluate the differences between the use of self-directed training apps and structured training in improving students' skills, fitness, and performance. After conducting pretests and posttests on two training groups, the data obtained showed significant variations in several variables, though not all yielded the same results. Some variables, such as technical skills and speed, showed significant improvements in the group using the self-directed training app, while endurance showed no significant difference. The analysis was conducted using a paired-sample t-test to evaluate the differences between the pretest and posttest scores for each variable.

Technical skills showed encouraging results, with a significant difference between pretest and posttest scores. This indicates that students who trained using the self-directed training app experienced greater improvement in technical skills compared to those who trained in a structured manner. This may be due to the nature of self-directed training, which allows students to focus more on their technique outside of regular training sessions. Statistical tests on this group showed a p-value less than 0.05, confirming that this difference is highly significant.

Speed also showed a significant increase in the group using the self-guided training app. Although structured training provides a solid foundation, students who train with the app tend to be better able to adapt to higher training intensities. This increase in speed may be due to the app's ability to allow students to tailor their training sessions to their specific needs. Statistical test results showed a p-value of less than 0.05, indicating a significant difference in speed between the pretest and posttest.

However, endurance showed different results. Although there was a slight improvement in both groups, the results of the paired t-test indicated that there was no significant difference between the pretest and posttest for endurance. A p-value of 0.72 indicates that the training conducted—whether using a self-directed app or structured training—was not effective enough in improving the students' endurance in a short period of time. This suggests that other factors, such as training duration and intensity, may play a greater role in improving endurance.

Muscle strength also showed significant results in the group using the self-guided workout app. This improvement may be due to the variety of workout programs offered by the app, which allows students to specifically target various muscle groups. Students who train with the app have more freedom to choose programs that better suit their needs, whereas structured training may be more limited in terms of exercise variety. Statistical tests on strength showed a p-value of less than 0.05, indicating a significant difference between the pretest and posttest.

Flexibility also improved in the group that trained using the app, with statistical test results showing a significant difference between the pretest and posttest. The self-guided training app allowed students to engage in more structured and personalized stretching sessions. Although structured training also includes flexibility elements, the ability to tailor exercises to individual needs provided an advantage to the self-guided app group. These results suggest that the app can play a role in improving students' flexibility more effectively.

Nevertheless, the results of using the self-directed training app indicate that there are some challenges regarding self-discipline and commitment, particularly among students who have little experience using technology for training. This may pose a challenge to the widespread adoption of the app among beginner students. However, for experienced students, the app makes it easier to track their training progress in a clearer and more structured way.

In addition, these findings suggest that structured training offers advantages in terms of direct motivation from a coach and more personalized guidance. Coach-led training sessions ensure that each athlete receives individual attention, which can positively impact their training outcomes. While apps offer flexibility, a structured approach can provide more immediate feedback, which can boost students' motivation and performance.

On the other hand, these two methods yield varying results depending on each athlete's training goals. Structured training may be more effective for developing basic technical skills, while self-directed training is better at providing variety and flexibility in training. Therefore, the results of this study indicate that both methods have their own strengths and weaknesses, and combining the two may provide optimal benefits.

Variable	Independent Applications Group (Pretest)	Independent Applications Group (Posttest)	Structured Training Group (Pretest)	Structured Training Group (Posttest)	P-Value
Technical Skills	65.4 ± 4.3	78.3 ± 3.1	63.2 ± 5.1	68.7 ± 4.9	0.002
Speed	12.4 ± 0.9	10.5 ± 0.8	12.3 ± 1.2	11.2 ± 1.1	0.004
Durability	30.1 ± 4.5	33.2 ± 4.2	30.3 ± 4.6	32.0 ± 4.3	0.72
Muscle Strength	45.2 ± 3.7	52.1 ± 4.0	44.9 ± 3.8	48.5 ± 3.9	0.01
Flexibility	19.5 ± 1.4	22.1 ± 1.2	18.9 ± 1.3	20.3 ± 1.1	0.03

This study shows that the use of self-directed training apps leads to significant improvements in students' technical skills and speed compared to structured training. This suggests that self-directed training apps can provide a more flexible experience and more opportunities to train at a higher intensity. Students who use apps tend to have greater control over the timing and type of exercises they perform. Additionally, the ability to track their training progress independently motivates them to continue improving [7].

In terms of technical skills, the significant improvement observed in the self-directed app group may be attributed to the apps' ability to provide exercises tailored to students' needs and abilities. The apps offer a variety of exercises that allow students to focus more deeply on specific techniques. This is not always possible in structured training, which typically focuses more on group exercises with limited supervision. This improvement in skills aligns with research showing that technology enabling more personalized and adaptive training can enhance athlete performance [8].

Speed also showed a significant increase in the self-directed app group. The main advantage of training using an app is the ability for students to train more frequently in shorter but more intense sessions. Structured training is sometimes limited by strict training schedules and time constraints for students. In previous studies, the use of apps has also been shown to accelerate improvements in students' speed, as workouts can be tailored to individual needs and progress [9].

However, regarding endurance, the results of this study showed no significant difference between the pretest and posttest scores in either group. This may be due to the limited time available for the study, as improvements in endurance typically require longer and more regular training. A study by [10] showed that endurance training requires a longer duration and stricter training discipline, so the results of this study are consistent with their findings.

Nevertheless, the significant increase in muscle strength observed in the app-based group indicates that the types of exercises provided by the app are quite effective in building strength. The app offers a variety of programs focused on strength training, allowing students to train different muscle groups more intensively. This is consistent with other studies showing that technology can be used to design more specific and structured workouts for strength development.

The improvement in flexibility among the group using the standalone app also indicates that this type of exercise is quite effective in increasing students' range of motion. The app provides clearer and more specific instructions on how to perform stretches, which helps students improve their flexibility. Better flexibility is crucial in many sports, particularly in reducing injuries and improving overall performance. Previous research has also emphasized the importance of flexibility in improving athletic performance, and apps can be an effective tool for achieving this.

However, although self-guided training apps offer many advantages, there are still challenges in their implementation, particularly among students who lack experience with technology. Some students may find it difficult to follow instructions or adapt to the app, which can reduce the effectiveness of their training. This is not an issue in structured training, where coaches can provide direct instruction and help students tailor their workouts to their specific needs.

On the other hand, structured training offers the advantage of direct guidance and closer supervision. Coaches can provide immediate feedback, correct technique, and ensure that exercises are performed correctly. This can boost students' motivation and performance, as they feel more supported throughout their

training journey. A study also found that more intensive coaching supervision can improve training outcomes, particularly in sports that require technical skills.

It is also important to note that combining structured training with the use of self-guided training apps can yield optimal benefits. Students who train using both methods can take advantage of the flexibility and variety offered by the apps, while also receiving direct supervision and guidance from a coach. Study findings indicate that a combined approach can produce better results than relying on just one training method.

In addition, although app-based training offers freedom and flexibility, closer supervision may still be necessary in some contexts. Beginner students or those who are just starting to train may not be able to maximize the benefits of the app without more intensive supervision. This highlights the importance of tailoring training methods to an athlete's level of experience in order to achieve optimal results.

When compared to previous studies, the results of this study share some similarities and differences. The study also showed that self-directed training apps have a significant impact on students' performance, particularly in terms of speed and strength. However, the study also noted that endurance did not show a significant improvement, similar to the results of this study. This reinforces the finding that self-directed training apps may be more effective for certain aspects of training but cannot always replace traditional training when it comes to endurance.

Other research findings indicate that structured training still plays an important role in improving students' basic techniques and motivation. These findings are consistent with the results of this study, which show that structured training is more effective in improving students' basic techniques and technical skills, but does not yield significant results in terms of endurance or flexibility. Thus, this study reinforces the argument that the two training methods have different strengths and weaknesses, and that they can complement each other.

4. CONCLUSIONS

The findings of this study indicate that the use of self-directed training apps has a significant positive impact on improving students' technical skills, speed, muscle strength, and flexibility, compared to structured training. However, structured training remains more effective in providing direct guidance and correcting basic techniques, which may be more difficult to achieve using only an app. Although apps offer students greater flexibility and control, structured training is still necessary to ensure comprehensive training quality. Overall, a combination of both training methods can yield more optimal results, depending on the athlete's specific goals and level of experience.

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