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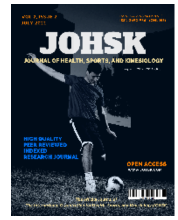

The Effects of App-Based Feedback on Students' Sport Knowledge in Sport Education Badminton Season

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Introduction

Sport education is a curriculum model that helps students to be a competent, literate, and enthusiastic sportsperson (Siedentop et al., 2020). The effectiveness of the model on badminton skill development has been demonstrated by previous literature (Hastie et al., 2011). Along with the skill development, cognitive outcomes (e.g., sport-specific knowledge) are considered to be important parts of one's performance in sports. Cognition of 'how to play' in a sport is associated with improved performances (Thomas & Thomas, 1994). Therefore, teaching sport knowledge is important to enhance the effectiveness of practice and gameplay.

Thomas and Thomas (1994) described the three concepts of sport knowledge in performance: (a) declarative (factual information, such as rules), (b) procedural (techniques and tactics), and (c) strategic knowledge (knowing how to learn). Given that the nature of sport knowledge has great potential to be developed for all levels of players (Dexter, 1999), it is important to dive into diverse ways to boost students' cognitive learning while playing sports in physical education.

Using advanced video technology, such as motion analysis mobile applications (Apps) with a feature of live capture for instant feedback, may enhance cognitive learning outcomes in physical education. Video technology has grown rapidly to support learning in physical education over the past decades (Palao et al., 2015; Rikli & Smith, 1980; van Wieringen et al., 1989). However, little is known about the effectiveness of a motion analysis App on students' sport knowledge enhancement in sport education. Therefore, the App-based feedback was examined to identify its effectiveness on students' sport knowledge enhancement during sport education badminton season.

Methods

8th grade students from two physical education classes participated in the 20-lesson badminton sport education season (Cohort A; *N*=20, Cohort B; *N*=16). An alternative control treatment group design (Borg, 1984) was applied to provide all participants with the benefit from the intervention. In Cohort A, only the teacher used the App named '*Hudl Technique*' to teach and provide feedback; whereas the students used the App during the 20-minute team practice in Cohort B. The teacher in Cohort A and the students in Cohort B were asked to create video clips to provide individual and visual feedback by using features of slow-motion, rewind, drawing tools, and voice recording through the motion analysis App.

Badminton knowledge tests were administered at the pre (Lesson 1) and post (Lesson 20). The knowledge test had 30 items selected from the badminton test battery (12 items for rules and scoring, 13 for technique, and 5 for strategy) (McGee & Farrow, 1987). The number of items correctly answered by each student was recorded and analyzed.

Descriptive and Two-way repeated measures analysis of variance (ANOVA) were used for data analysis. Each area of test score for the knowledge test at pre- and post-test was computed and analyzed by the total score percentage, ranging from 0 to 100, to better understand the effects of App-based visual feedback on the specific learning domain of knowledge in badminton. In addition, overall knowledge score was calculated by adding all three areas, ranging from 0 to 30. A critical incident (CI) instrument by Flanagan (1954) was also used to examine the effects of App-based visual feedback. The CI sheets were completed by each student at lessons 8, 11, 14, and 17, reflecting on their experiences and perceptions on the App. Constant comparative analysis was used to incorporate the frequency of the data categories with students' comments (Goetz & LeCompte, 1984). The CI data trustworthiness were validated by triangulation by researchers of the study.

Results

A total of 490 videos were created throughout the season (293 videos in Cohort A and 197 videos in Cohort B). Compared to the pre-test (M=9.92, SD=3.53), students' overall post knowledge test scores (M=15.03, SD=4.72) significantly increased by the use of motion analysis App [$F(1,34) = 57.253$, $p < .001$]. Specifically, there were also statistically significant increases in percentages of correct answers for all three knowledge categories (See Figure 1). No statistically significant differences were found in both pre and posttest scores between the two classes. 178 CI sheets were completed by both classes and 93 performance-related comments by the constant comparative analysis were categorized as: (a) reflecting myself/team (n=30), (b) correcting motion skills (n=14), (c) developing tactics (n=21), and (d) getting better and overall improvement (n=28) (See Table 1).

Table 1. Frequency of Students' Comment in Critical Incidents

	Lesson									
	Lesson 8		Lesson 11		Lesson 14		Lesson 17		Total	
Cohort	A	B	A	B	A	B	A	B	**A**	**B**
Themes	Frequency									
Reflecting myself/team	7	3	5	4	2	2	5	2	***19***	***11***
Correcting motion skills	5	2	0	1	1	0	2	3	***8***	***6***
Developing Tactics	0	0	4	2	2	5	4	4	***10***	***11***
Getting better & Overall improvement	3	6	2	3	3	2	3	6	***11***	***17***
Total	15	11	11	10	8	19	14	15	***48***	***45***

Discussion

This study investigated the effects of App-based feedback on middle school students' badminton knowledge in the sport education season. The main features of the sport education model such as longer season, team affiliations, and formal competitions created the active environment to implement the motion analysis App. Supported by Thomas and Thomas (1994), the knowledge test was divided into three categories to determine the changes in each category. For the 'Rules' category, 33 students were able to answer the questions of basic rules (e.g., point system or basic terminology) in the post-test, showing overall dramatic changes throughout the season. Figure 1 shows the noticeable increases in percentages of test scores in 'Rules' and 'Strategies', compared to 'Techniques'. Even though there were statistically significant differences in scores of the 'Techniques' category ($p < .05$), the scores have shown relatively few changes in both cohorts. However, based on the CI comments, it was understood that students' actual basic skills would have improved by watching and fixing their motions. However, the low percentage of knowledge improvement in technique was due primarily to the insufficient skill-related lessons for skill practices. It should be noticed that the improvement of knowledge in technique requires repetition that develops intuitive understanding of the movements and more efficient performance.

The results showed significant improvement in student cognitive domains at pre and post-test. However, due to the nature of the class that was the introductory level and no prior experiences, the percentages of correct answers in test scores showed relatively low. However, as shown in Figure 1, it is important to note that the use of the App had positive impacts on the students' post-test scores in the 'Strategies' category. Students' CI comments supported this positive effect on the students' improvement in tactical movements. In Figure 1, the students had little knowledge of strategies before the intervention but showed great enhancement in the post-test. This finding indicates that video technology using motion analysis App has the potential to enhance students' tactical movements and strategies. As suggested by Dexter (1999), further research will be warranted to identify the relationships between students' sport knowledge and their skill development and game performance.

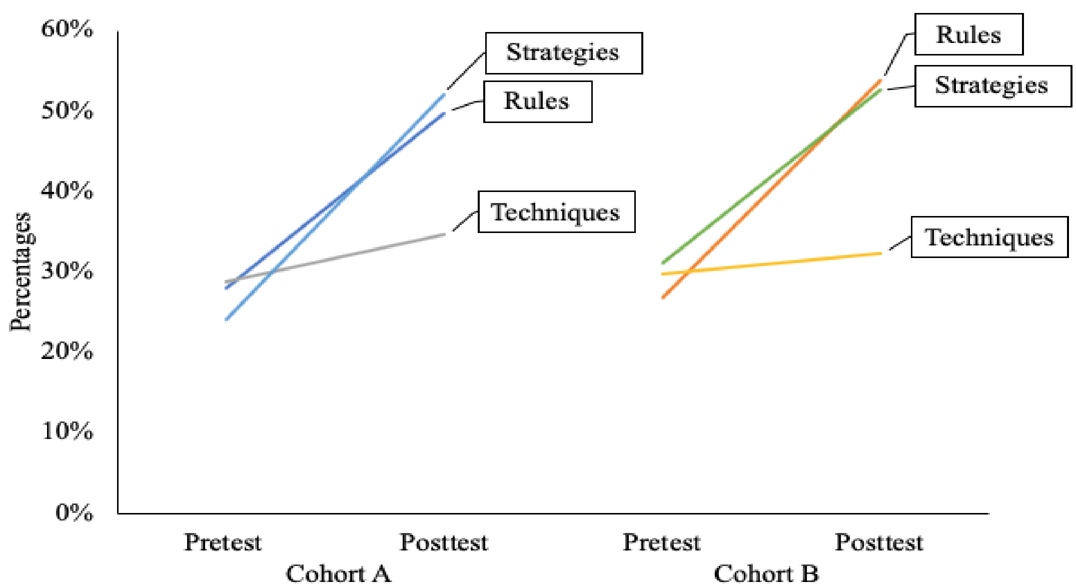

Figure 1. Badminton Knowledge Test Results in Cohort A and B

Conclusion

The study showed the improvement in student learning outcomes measured by the cognitive tests on rules, techniques, and strategies of badminton in sport education classes. The use of motion analysis App in sport education and the App-based feedback were positively associated with students' badminton-specific knowledge, supporting the national physical education standards.

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