Beden Eğitimi ve Spor Araştırmaları Dergisi
Eylül 2022, 14(2) 87-101

BESAD JPESS

Journal of Physical Education and Sports Studies
September 2022, 14(2) 87-101

Evaluating the Content Knowledge in Badminton of Preservice Physical Education Teachers: A Case Study

Beden Eğitimi Öğretmen Adaylarının Badminton Alan Bilgisinin Değerlendirilmesi: Bir Durum Çalışması

Won Seok Chey[a], Phillip Ward[a], Emi Tsuda[b], Kyuil Cho[b], Obidiah Atkinson[a] & Daekyun Oh[c]

[a]The Ohio State University, Department of Human Sciences
[b]West Virginia University, School of Sport Sciences
[c]St. Bonaventure University, School of Education

Makale Geçmişi
Geliş : 26 Haziran 2022
Kabul : 27 Eylül 2022
Çevrimiçi : 30 Eylül 2022
DOI: 10.55929/besad.1133035

Makale Türü
Araştırma Makalesi

Öz: Bu çalışmanın amacı, beden eğitimi öğretmen yetiştirme programında öğretilen bir badminton dersinin etkililiğinin incelenmesidir. Alan bilgisi; genel alan bilgisi (GAB) ve özelleşmiş alan bilgisi (ÖAB) olarak iki kategoriye ayrılmıştır. Ward (2009) GAB'ini bir görev ya da aktiviteyi sergilemek için gerekli bilgi olarak, ÖAB'ni ise bir görev ya da aktiviteyi öğretmek için gerekli bilgi olarak tanımlamaktadır. Önceki çalışmalar, öğretmen adaylarının düşük alan bilgisine sahip olduğunu göstermektedir. Bu çalışmada iki araştırma sorusu incelenmiştir: (a) (a) Sekiz öğretmen adayının GAB, performans (GAB-P), ÖAB öğretim tasarımı geliştirme ve ÖAB öğrenci hatası analiz ön test skorları nedir? ve (b) Badminton dersinden sonra; GAB, performans (GAB-P), ÖAB öğretim tasarımı geliştirme ve ÖAB öğrenci hatası analiz ön test – son test skorlarındaki değişim nedir? Katılımcılar, 2-4 sınıflarda öğrenim gören sekiz öğretmen adayıdır. Katılımcıların tümü GAB, performans (GAB-P), ÖAB öğretim tasarımı geliştirme ve ÖAB öğrenci hatası analiz değişkenlerinde ön test – son test olarak değerlendirilmişlerdir. Veriler, dört değişkende oluşan farkları gösterebilmek için betimsel olarak sunulmuştur. Bulgular, öğretmen adaylarının dört değişkende düşük skorlara sahip olduğunu göstermektedir. Bununla birlikte, dersin tamamlanmasının ardından, ÖAB öğretim tasarımı geliştirme dışındaki tüm değişkenlerde son test skorlarında gelişim saptanmıştır. Bulgularımız beden eğitimi öğretmen yetiştirme programında alan bilgisi eğitiminin önemini vurgulamaktadır. Beden eğitimi öğretmen yetiştirme programlarındaki uygulamaları zenginleştirilmek ve kanıta dayalı uygulamaların etkililiğini test etmek için daha fazla çalışma ile güçlü bir alan yazın oluşturulmasına ihtiyaç vardır.

Anahtar Kelimeler: *Öğretmen yetiştirme, genel alan bilgisi, özelleşmiş alan bilgisi, öğretim tasarımı geliştirme*

Article History
Received : June 26, 2022
Accepted : September 26, 2022
Online : September 30, 2022
DOI: 10.55929/besad.1133035

Article Type
Research Article

Abstract: The purpose of this study was to examine the effectiveness of teaching a badminton content class in physical education teacher education (PETE). Content knowledge is divided into two large categories: common content knowledge (CCK), and specialized content knowledge (SCK). Ward (2009) defined CCK as the knowledge necessary to perform physical activity or a task, and SCK as the knowledge necessary to teach the physical activity or a task. Previous research has demonstrated low levels of preservice teachers' (PSTs') content knowledge. In this study we examined two research questions: (a) What are the pre-test scores of eight male PSTs for CCK, performance (CCK-P), SCK task progression knowledge, and SCK error analysis in badminton? and (b) What are the changes in pre-post scores for CCK, CCK-P, SCK task progression knowledge, and SCK error analysis after a badminton content class? Participants were eight male PSTs ranging from sophomore to senior year. All were assessed using pre-and-post tests of badminton CCK, CCK-P, instructional tasks, and error analysis. Data were reported descriptively to determine the difference between pre and post scores on the four variables. The results indicated that PSTs had low pretest scores on all four variables However, post-test scores following the completion of the badminton content class demonstrated improvement on all variables except for task progression. Our results highlight the importance of content knowledge training in PETE) programs. There is a critical need for additional research to ensure the effectiveness of evidence-based practice and build a body of literature that can enhance our practice in PETE.

Keywords: *Teacher education, common content knowledge, specialized content knowledge, content development*

Contact: Won Seok Chey
The Ohio State University, Department of Human Sciences, PAES Building, 305 Annie & John Glenn Avenue, Columbus, OH 43210-1221
chey.1@osu.edu

INTRODUCTION

Teachers cannot teach and help students learn if they do not have knowledge about what is being taught (Ball, 1991). Yet, despite the obviousness of this statement, there has been a longstanding criticism in physical education that teachers do not know their content well enough to teach effectively (Hoffman, 1987; Kim et al., 2015; Siedentop, 2002; Tsuda et al., 2019; Vickers, 1987; Ward, Ayvazo, Dervent, Iserbyt & Kim, 2020). For example, Siedentop (2002, p. 369) noted:

> We have arrived at a point in our history where we can now prepare teachers who are pedagogically more skillful than ever, but who, in many cases, are so unprepared in the content area that they would be described as "ignorant" if the content area were purely a cognitive knowledge field.

Siedentop relied on anecdotal observations of physical education teacher education (PETE) programs and teachers. Two decades later, his statement remains relevant. For example, several studies have shown that preservice teachers (PSTs) and physical education teachers do not know their health-related fitness knowledge. Miller and Housner (1998) used a 40-item knowledge test to assess 23 physical education teachers and 54 PSTs. They reported mean scores at or below 66%. Castelli and Williams (2007) investigated 73 middle school physical education teachers and reported a mean score of 63.9% in health-related fitness knowledge (i.e., CCK of health-related fitness knowledge). More worrying, 62% of the teachers failed to meet the criterion expected of the ninth-grade students they were teaching. Furthermore, Santiago et al. (2012) used their 40-item health-related fitness knowledge test to assess 89 PSTs and 61 physical education teachers and reported mean scores of 54.8% and 57.5%.

More recently, Santiago and Morrow (2021) asked 621 PSTs across 68 PETE programs located in different regions in the United States (U.S.) to complete a 40-item multiple-choice test on health-related fitness knowledge prior to student teaching. The mean percentage of correct answers on the test was 61.3%.

In terms of movement contents besides health and fitness, Dervent et al. (2020) collected CCK, and SCK data from 1514 PETE students from 16 universities in Türkiye and found that the mean percentage scores of the PETE students in CCK were below 60% (soccer: 51.85%, gymnastics: 49.91%). Also, the SCK index scores of the PETE students were below 3.0 (soccer: 0.23, gymnastics: 0.20) which is the benchmark for the SCK score that differentiates the appropriate level of SCK (Ward et al., 2017). In addition, Ward, He, et al. (2018) conducted a national analysis

in China and reported that even the in-service teachers who had experience in teaching soccer and specialized in soccer were below 3.0 (2.19) in the SCK scores.

Collectively, these data highlight a great concern for the preparation of PSTs. If we judge these results using the common letter grade system used in most U.S. universities, the scores are close to a failing grade (e.g., Kalamazoo College, 2022). This is surprising since PSTs are required to complete several classes based on health-related fitness knowledge in the U.S. (Fisher, 2013; Williams et al., 2016). These results signify a systemic issue. Findings are consistent regardless of geographical location, and instrumentation of data collection, which raises a couple of questions. How effective are physical education teacher education (PETE) programs in teaching content knowledge? Also, how is student learning in schools affected when physical education teachers do not know the content they are teaching?

In the past decade, there have been conceptual and operational advances in understanding the content knowledge that teachers need to know in general education (e.g., Ball et al., 2008) and the physical education field (Tsuda et al 2019; Ward, 2009). These advances have helped define the concept of content knowledge and how to operationalize it in teaching and teacher education. In physical education, Ward (2009) further classified CCK into four sub-domains. The four CCK sub-domain are knowledge of rules, etiquette and safety, techniques, and tactics. Using badminton to illustrate, rules include understanding how points are scored, where to stand when serving, and not carrying a shuttlecock on the racquet. Safety CCK would include not stepping onto a court when others are playing, keeping the racquet grip dry, and securing the net correctly. The second CCK sub-domain is technique. Examples of CCK techniques in badminton include knowing how to hold the racquet, how to perform the underhand and overhead clears, and how to execute the service. The third and final CCK sub-domain is tactics. In the sport of badminton, an example of a common tactic is to make the opponent move around the playing area by using different shots and hitting open spaces. CCK is an essential knowledge base to define the range of the desired performance (Ward, Ayvazo, Dervent, Iserbyt, Kim, & Li, 2020). Biscan and Hoffman (1976) claimed that proficiency in observation skills could be determined by the teacher's ability to formulate and portray a live image of the proper criterion responses and compare the image during the observation. This argument emphasizes the knowledge base of what should be the standard for each skill and movement during the observation. Thus, teachers must know the essential features of the skill and movement.

The second content knowledge domain, specialized content knowledge (SCK) refers to three elements of content needed for teaching. This includes representing content, progressing content, and error analysis. Representing content commonly focuses on demonstrations by the teacher, students, or using video and pictures. For example, the teacher provides verbal instructions to students, "the underhand clear is an effective shot to drive the opponent into the back court" or "start by using the forehand grip." Task progression is the progression of student learning using sequenced and incremental instructional tasks. For example, if the initial task was to hit a forehand/backhand underhand clear straight to the backcourt marked by an endzone, task two could be a forehand/backhand underhand clear to targets (e.g., hula hoops) in the corners of the court. Error analysis is the ability to identify errors in the performance with how to correct the errors. For the underhand clear, common errors may include tossing the shuttle rather than dropping it, not watching the shuttle, or contacting the shuttlecock too far forward of the body or above the waist. SCK is a crucial knowledge base because it is the knowledge base that a teacher draws on to select the instructional tasks and determine how they will represent/present content to students to move their performance forward or correct performance using feedback.

A recent study by Tsuda et al. (2019) reported that pretest scores of CCK were at or below 50% for tennis, badminton, volleyball, and 70% for basketball. Tsuda et al. (2019) reported that the knowledge of instructional task progressions was low to zero for volleyball and basketball, and only slightly higher for volleyball and tennis. The authors did report significant gains in PSTs' CCK and task progressions when it was explicitly taught in a required content class compared to classes that solely focused on CCK. Similarly, Ward, Tsuda, et al. (2018) found low scores for SCK at the pretest on the same four sports but also reported improvement in SCK scores among the PSTs in the PETE program that focused on learning to teach. PSTs in Ward, Tsuda, et al.'s (2018) study were explicitly taught SCK as compared to the basic instruction classes which focused only on performance (CCK-P). Tsuda et al. (2019) also measured the CCK-P of PSTs in badminton, basketball, and tennis and reported improvement in pre to posttests scores from 46-69%, 72-86%, and 65-79% respectively when explicitly taught to perform in a major's class.

The pretest scores of CCK and performance are direct indicators in identifying where the PSTs and K-12 physical educators' knowledge bases are at the time of testing. The data demonstrate that CCK was quite low for PSTs (Tsuda et al., 2019). However, the pretest performance of PSTs in Tsuda et al.'s (2019) study was in-line with expectations considering most PETE programs around the U.S. teach content units of approximately seven to ten days (Ward, 2011). This pretest score

may also reflect the effectiveness of the teachers and coaches that PSTs have had. In terms of SCK, the pretest scores should not be worrying. The SCK hypothesis is derived from the work of Ball et al. (2008) and Ward (2009), who both argued that SCK represents knowledge that is typically not acquired by performing an activity. They describe SCK as a special kind of knowledge needed only by those who provide instruction (e.g., teachers and coaches). However, both Ward, Tsuda, et al. (2018) and Tsuda et al. (2019) used basic instruction classes as comparison groups, and in these groups, the students did not improve their SCK while the PETE majors did show improvement.

Given that previous studies by Ward, Tsuda, et al. (2018) and Tsuda et al. (2019) provided evidence that PSTs enter PETE programs with limited CCK, a poor understanding of task progression (i.e., SCK), and moderate levels of CCK-P, our research first sought to replicate this work and extend it by adding error analysis as a second SCK measure which was not previously assessed in studies to provide a more comprehensive examination of SCK. As in the previous studies (Ward, Tsuda, et al., 2018; Tsuda et al. 2019), we report on the effects of a PETE content class that focused on teaching CCK, task progressions and error analysis, and CCK-P to gain a better understanding of how to conduct PETE content classes to improve these outcomes. As such this study should be considered a case study. In addition, we focused on a badminton unit that was being taught in our curriculum, which we had access to in our program. With these objectives in mind, we address the following research questions: (a) What are the pre-test scores of PSTs for common content knowledge (CCK), performance (CCK-P), task progression knowledge, and error analysis in badminton? and (b) What are the changes in pre-post scores for CCK, CCK-P, task progression knowledge, and error analysis after a badminton content class?

METHOD

Participants

The study was approved by the institutional review board of the first author's university and informed consent was obtained from all participants. The study was conducted at a university in a large midwestern city in the U.S. Our analyses are based on a group enrolled in a PETE badminton class. All eight students who were enrolled in a PETE badminton content class agreed to participate in the study. The PSTs were eight males, in the second year of the PETE program, and ranged from sophomores to seniors. In addition, only two out of eight PSTs had badminton experience throughout their K-12 education, and no PSTs took university badminton classes. All eight PSTs

had no experience in teaching or coaching badminton. The instructor of this course was a male with 19 years of experience in playing badminton and 11 years of experience in teaching badminton in K-12 and higher education settings, and he was considered a very competent instructor from our periodic observations of his teaching over the past two years. The instructor was familiar because of his engagement in other studies of the concepts of CCK, CCK-P, and SCK.

Settings

The setting for this study took was a required content course in the university's PETE curriculum. The purpose of the course was to teach the knowledge that is required to teach racquet sports in the K-12 setting. The badminton unit was part of a three-credit class where tennis was taught for the first half of the semester and badminton in the second half. We report only for data from badminton. Each content area was seven weeks in duration. The class met twice a week for a total duration of 80 minutes per session (i.e., 2 hours and 40 minutes per week) for a total of 18 hours and 40 minutes. In the first week (two sessions), the instructor provided lecture-based sessions, and the rest of the class sessions were gym-based.

The Content of Badminton Content Class

During classroom-based sessions, the PSTs discussed the instructional task sequences that could be taught in middle school. The instructor explained the concept of the content map by providing the example of a badminton content map that is illustrated in Ward & Lehwald's (2018) textbook. Then, PSTs were asked to reproduce the content maps for their peer teaching tasks.

The instructor did focus on explaining all the CCK in the lecture. Instead, PSTs had a weekly online content quiz on CCK and a weekly in-class quiz about the basic critical elements of specific badminton skills, as well as a comprehensive final exam on PST's CCK. None of these data were reported in this study.

In the gymnasium sessions, the instructor demonstrated the instructional tasks and sequences to the PSTs. Then, the PSTs taught the instructional task sequences to each other in peer (1:6) learning groups. The goal of the peer teaching was to introduce the task sequence clearly and correctly (i.e., representing the task and task selection). In addition, PSTs were asked to identify each individual's errors in their peers' performance and to correct them based on the correct critical elements before progressing to the next task.

The PSTs in their teacher role received feedback from the instructor regarding their teaching performance of the instructional tasks. Typically, no more than 3 PST were peer teaching at once. The content information and resources about badminton were drawn from *Effective Physical Education Content and Instruction* (Ward & Lehwald, 2018) and *Badminton: Steps to Success* (Grice, 2007).

Measurements and Instruments

Four instruments were used to assess the badminton content knowledge in this study, namely a written test to determine CCK, a CCK-P test, content maps to determine SCK task progression, and video observation to determine error analysis. The content of all assessments was biased toward secondary school physical education since badminton is often a unit taught in secondary school.

Common Content Knowledge Written Test

Since there were no validated CCK tests of badminton for PSTs, therefore, the researchers in this study developed a 34-item open-ended CCK badminton test. The test questions were derived from *Badminton Steps to Success* (Grice, 2007) and evaluated for content validity by badminton experts. Content experts were selected based on their ability to teach badminton instructions reasonably well and who were recommended by their colleagues.

Once experts developed the questions, face validity was established by two graduate students not connected to the study but knowledgeable of our intent, taking the test and editing areas that required clarification to ensure the understandability of the test. To confirm the validity of the assessment relative to class content, we asked the instructor of the PETE majors if the content of the questions would be covered in class, and the instructor confirmed this alignment between instruction and the test. The final CCK badminton test contained 12 items on rules, safety, and etiquette, 10 items on techniques, and 12 items on tactics. Participants were given 30 minutes to complete the test using paper and a pencil. There were three true or false questions and 31 open-ended answers were compared to a rubric created from descriptions found in Grice (2007). In scoring the test, the coders biased their interpretation of the written response toward a correct answer, rather than against it. The total raw score for this assessment was 34. Participants took the test using paper and pencil at the start and end of the badminton period.

Common Content Knowledge-Performance (Skill Performance Test)

To assess CCK-P, the three badminton techniques that were assessed included ready position, forehand long-serve, and high-clear. The PSTs were evaluated individually, live, during the class. Each assessment was conducted discretely but within the context of a rally. All assessment criteria were selected from Grice (2007) for validity. The first technique was assessed by observing PSTs' ready position. The assessment criteria for the ready position were (a) feet apart and staggered, (b) knees bent and leaning forward, and (c) racket around the head. Each criterium was coded as 1 point when demonstrated by PSTs whereas 0 was coded if not shown. Participants had a total of three trials in the skill practice context, thus the maximum score the participant could achieve was 9 points. The second technique assessed was the forehand long-serve. The assessment criteria for the forehand long-serve were (a) start to swing from behind, (b) trunk rotation, (c) follow through with the racket above the nose, and (d) should be sent to where the receiver is standing. Again, trials and scoring were the same as in the previous assessment, where PSTs could receive a maximum score of 12 points. The last technique was high-clear. To achieve this task, a researcher threw a shuttle cock over the net to PSTs. Then, PSTs were asked to strike back to the other side of the court using the high clear. The assessment criteria for the high-clear were (a) shoulder perpendicular to the net, (b) elbow high and whip down on the follow through, (c) follow-through down towards hip, and (d) hit straight (not cross court). The number of trials and scoring followed the assessment protocols of previous techniques, so PSTs could receive a maximum score of 12 points. The possible maximum score for CCK-P was 33 points. Participants were assessed at the start and end of the badminton content class.

SCK Task Progressions (Content Map Test)

To assess SCK task progressions, content maps were used. Content maps have been previously validated and identify the skills and tactics that should be taught in a lesson or instructional unit specific to a certain grade level (Ward et al., 2017). PSTs were asked to complete a content map suitable for teaching badminton in a middle school for 10-days. An example of a content map can be viewed at https://youtu.be/v3t8hIAOFzA.

We used six task categories modified from Rink's (1979) original four categories to analyze the depth of content development presented in the content maps: informing, extending, refining, applying tasks, an extension of applying tasks, refining during applying tasks, and assessing tasks in non-game settings (Ward et al., 2017). Task progression in badminton was calculated using a formula that placed the sum of all task categories except informing as a numerator with informing

tasks as a denominator (Ward et al., 2017). This formula assumes that an informing task is an initial task in the task sequence against which all other tasks can be compared. This formula creates an SCK index score representing how many tasks are developed beyond the informing task. An index score of 3.0 indicates an essential depth of content development (Hastie, 2021; Ward, Tsuda, et al., 2018). Content maps were assessed before and after the badminton content class.

SCK Error Analysis (Video Skill Analysis Test)

PSTs watched four video clips with specific examples of errors in two technical (underhand clear with three principal errors obvious and overhead clear with three principal errors) and two tactical aspects of beginner badminton play (i.e., moving to receive the shuttlecock with two principal errors and returning to the center of the court during a rally with one principal error). Our protocol said that if participants identified additional errors that were legitimate these were counted in the determination of their score. However, it happened only once. The performers in the video clips were researchers, and the researchers selected the errors because they were the most common errors that K-12 students make when performing badminton lessons based on the textbook by Ward and Lehwald (2018) for validity. PSTs were assessed individually, and each video was watched three times at the regular viewing speed. Participants then were asked to state the errors within each skill. Their verbal answers were compared to a list of major errors compiled by the instructor in the class and one other expert. There were at least two primary errors for each skill. Though if the participant identified a legitimate error, however minor, it was accepted. The presence or absence of errors was recorded in the spreadsheet and a percentage reflecting the identified errors compared to the total errors was created. The total number of identifiable errors was nine. Participants were assessed at the beginning of the badminton unit and the end of the badminton unit.

Research Design and Analysis

A pre-post-test non-control group design was used because we were specifically interested in the changes that occurred in the course relative to its instructional design. Because of the small sample size, the results of the four measures were analyzed descriptively and are reported as means and standard deviations. Reliability was conducted on 100% of three of the four measures (CCK, CCK-P, and SCK task progression) using interobserver agreement (IOA). To calculate the IOA percentage, the number of agreements was divided by the total number of events and then converted to a percentage. The IOA was CCK 97.8% (range 96% - 99.5%), CCK-P 97.5% (range 89%-97%), and task progression 98% (range, 98% - 98%).

RESULTS

Table 1 indicates the results of CCK (the mean score in percentage), CCK-P (the mean score in percentage), SCK-task progression (the mean index score), and SCK-error analysis (the mean of identified errors). The pretest CCK scores had a mean of 44% (SD = 3.3), and the posttest scores had a mean of 62% (SD = 5.8). The mean pretest CCK-P score was 48% (SD = 8.73), and the posttest score was 86% (SD = 4.5). The pretest SCK task progression scores had a mean of 1.53 (SD = 1.32), and the posttest scores had a mean of 1.43 (SD = 1). Finally, in the SCK error analysis, among the intentionally made errors in the videos, participants identified 1.3 (SD = 0.7) errors and in the posttest 5.4 (SD = 1.69) errors on the pretest.

Table 1. Mean Scores for CCK, CCK-P, and SCK Task Content Map and Error Analysis Assessments

Variable	CCK		CCK-P		SCK Task Progression		SCK Error Analysis	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Mean	44%	62%	48%	86%	1.53	1.43	1.3	5.4
Standard Deviation	3.3	5.8	8.73	4.5	1.32	1	0.7	1.69

Note. SCK task progression scores are reported as index scores, and SCK error analysis scores are reported as numbers.

In addition, Table 2 provides information on the individual improvements. Seven out of eight PSTs improved on CCK after taking a badminton content class. Furthermore, all PSTs improved on SCK error analysis and CCK-P scores after the badminton content class. However, four out of eight PSTs improved their SCK content map score.

Table 2. Individual Scores for CCK, CCK-P, and SCK Task Content Map and Error Analysis Assessments

Variable	CCK		CCK-P		SCK Task Progression		SCK Error Analysis	
ID	Pre (%)	Post (%)	Pre (%)	Post (%)	Pre	Post	Pre	Post
1	38	50	18	55	0.43	1.2	1	5
2	41	74	12	37	4	1.1	2	4
3	47	71	21	64	1	0.3	1	7
4	38	59	18	55	1.25	2.6	2	6
5	53	82	18	55	3	2.7	1	6
6	38	35	12	37	0	0	2	4
7	62	79	24	73	1.33	2.2	1	8
8	32	47	9	28	1.25	1.3	0	3

Note. SCK task progression scores are reported as index scores, and SCK error analysis scores are reported as numbers.

DISCUSSION

Amid increasing calls for teacher education to demonstrate effectiveness using evidence-based practices that prepare PSTs for the tasks of teaching, there is a widespread understanding of the need to evaluate both PSTs and teacher education programs (Darling-Hammond & Oakes, 2019). Our findings align with the longstanding calls for PETE programs to demonstrate that PSTs know the content that they are to teach to students in public schools (Hoffman, 1987; Kim et al., 2015; Siedentop, 2002; Tsuda et al., 2019; Vickers, 1987; Ward, Ayvazo, Dervent, Iserbyt & Kim, 2020). To better assess PETE programs, we must create and design (a) reliable and valid instruments to measure what is being taught, (b) pre-post measures to determine change, and (c) standards to judge effectiveness. Therefore, we frame our discussion around these three principles.

Our results show that the PSTs started with a low level of badminton CCK and improved on average by 18.5 percentage points. However, if we were to assign a letter grade to this score that is commonly used in universities, PSTs would be at or near a failing grade. With the entry scores as low as they were, this teacher education program should review its curriculum to see how to better improve PSTs' knowledge. This score is surprisingly similar to scores we reported in our literature review for both the CCK of health-related fitness and sports, which suggests this PETE program might not be alone in producing this outcome. What is being asked of PSTs was not that they should have advanced knowledge of badminton, but that they should know the techniques and tactics for teaching beginning badminton to K-12 students along with the rules, safety, and etiquette of the game. In our view, a score of 60% is not a good outcome. If this were math or a medical class, we would not want teachers only knowing 60% of the math they were to teach or for the medical student knowing only 60% of the medical procedure they were to use. The questions that arise from these results are: What is a good outcome? and How do we achieve it? We think that a score of 85% on the knowledge that a teacher is to teach their students is the minimum that we should be accepting. Our recommendations for achieving it are straightforward, cost-effective, and time efficient. We believe PSTs should learn the CCK of a content area and then be tested on it online repeatedly across the duration of the course using reliable and valid tests of CCK (e.g., Tsuda et al., 2021).

Regarding CCK-P, the instructor in this class moved students from a mean of 48% to 86%. This represents a strong improvement, and it meets the 85% criterion. Important to know is that less than 50% of the 1.5 credits were devoted to performance. Being able to perform the content is

important for PSTs because they are often required to demonstrate the content to their students. An important factor here was the competence of the instructor who was an accomplished physical education teacher who knew badminton. Our position is clear, if PSTs are to learn the content, they must be taught by competent instructors who are not only good performers and knowledgeable in the content, but instructors who have the knowledge of instructional tasks, task representation, and analyzing students' errors and how to fix it.

The SCK content map scores indicated low scores in task progression knowledge. In fact, these scores were lower in the posttest than in the pretest. In examining the content of the course, this area received the least amount of attention from the instructor. To improve task progressions, previous research has demonstrated that using content maps can be an effective method (e.g., Tsuda et al., 2019; Ward, Tsuda, et al., 2018). Thus, we argue that more time should be spent on teaching task progressions using the six categories and creating content maps across the duration of the course. In addition, increasing the portion of classroom-based lectures is recommended to make sure that the theory is aligned with the practice. In fact, we would be willing to accept that time be taken from performing with a potential lower performance score in favor of a higher content map index score. This was the recommendation for the next time this course is to be taught. Also, the results of low SCK task progression highlighted the importance of preparing teacher educators to teach SCK.

Few studies that have examined SCK error analysis. The improvement the instructor achieved in our view was substantive and meaningful relative to the time spent on it and relative to the entry and final CCK scores that PST achieved. We believe that there is a relationship, though it has not been empirically demonstrated, between CCK and error analysis. If teachers do not know what they are looking for (i.e., CCK) how do they see and detect correct or incorrect performance? This is an area in need of more research.

There are at least three primary limitations to this investigation. First, our sample size is small. It was a function of the number of students enrolled in the class. Among the ways to address this limitation in future studies is to perhaps combine multiple years of students or combine students from multiple universities. In both cases, there would have to control over the internal validity of the study by ensuring the same class content and instruction. Second, we did not use a control group in this study. Our interest was only in the improvement of the participants. However, a comparison or a control group, in future studies would also demonstrate the importance of content

classes in the PETE curriculum in terms of teaching content knowledge. Third, reliability for the error analysis was not conducted because of a personnel shortage of individuals with expertise. The interobserver agreement for the error analysis in the future would strengthen the internal validity of the research.

CONCLUSIONS

There are clear and demonstrable links between teachers' CCK and SCK, and their ability to affect student learning in physical education (Kim et al., 2018). In the content knowledge domain, as in all domains, PETE programs must assess the effects of their curriculum, and if the effects are not strong enough, modify their coursework with the goal of improvement. Our programs in PETE must be more evidence-based in terms of judging the effects of what we do. This study provides one example of how to achieve these objectives, and we call for more studies that focus on teacher education to build a body of literature that can inform our practice.

ORCID

Won Seok Chey https://orcid.org/0000-0003-3437-5276
Phillip Ward https://orcid.org/0000-0002-7447-3594
Emi Tsuda https://orcid.org/0000-0002-2488-9313
Kyuil Cho https://orcid.org/0000-0003-4885-4470
Obidiah Atkinson https://orcid.org/0000-0003-1923-8476
Daekyun Oh https://orcid.org/0000-0002-1128-5692

REFERENCE

Ball, D. L. (1991). Research on teaching mathematics: Making subject matter part of the equation. In J. Brophy (Ed.), *Advances in research on teaching: Teachers' subject matter knowledge and classroom instruction* (pp. 1–48). JAI Press.

Ball, D.L., Thames, M.H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*(5), 389–407. https://doi.org/10.1177/0022487108324554

Biscan, D. V., & Hoffman, S. J. (1976). Movement analysis as a generic ability of physical education teachers and students. *Research Quarterly. American Alliance for Health, Physical Education and Recreation, 47*(2), 161-163. https://doi.org/10.1080/10671315.1976.10615356

Castelli, D., & Williams, L. (2007). Health-related fitness and physical education teachers' content knowledge. *Journal of Teaching in Physical Education, 26*(1), 3–19. https://doi.org/10.1123/jtpe.26.1.3

Darling-Hammond, L., & Oakes, J. (2019). *Preparing teachers for deeper learning.* Harvard Education Press.

Dervent, F., Devrilmez, E., Ince, M. L., & Ward, P. (2020). A national analysis of the content knowledge of Turkish physical education teacher education students. *Physical Education and Sport Pedagogy*, *25*(6), 613-628. https://doi.org/10.1080/17408989.2020.1779682

Fisher, M. (2013). Current practices in the delivery of undergraduate exercise physiology content. *The Physical Educator, 70(1),* 32–51.

Grice, T. (2007). *Badminton: Steps to Success* (2nd ed.). Human Kinetics.

Hastie, P. (2021). A primer on content knowledge in physical education research. *Journal of Teaching in Physical Education, 41*(1), 165-170. https://doi.org/10.1123/jtpe.2020-0221

Hoffman, S. (1987). Dreaming the impossible dream: The decline and fall of physical education. In J. D. Massengale (Ed.), *Trends toward the future in physical education* (pp. 121–135). Human Kinetics.

Kalamazoo College. (2022, May 19). *Grading practices.* https://www.kzoo.edu/catalog/policies/academic-policies/grading-practices/.

Kim, I., Lee, Y. S. Ward, P., & Li, W. (2015). A critical examination of content knowledge courses in physical education teacher education programs. *Journal of Teaching in Physical Education. 34(1),* 59-75. https://doi.org/10.1123/jtpe.2013-0166

Kim, I., Ward, P., Sinelnikov, O., Ko, B., Iserbyt, P., Li, W., & Curtner-Smith, M. (2018). The influence of content knowledge on pedagogical content knowledge: An evidence-based practice for physical education. *Journal of Teaching in Physical Education,* 37(2), 133-143. https://doi.org/10.1123/jtpe.2017-0168

Miller, M.G., & Housner, L. (1998). A survey of health-related physical fitness knowledge among preservice and inservice physical educators. Physical Educator, 55(4), 176-186.

Rink, J. (1979). Development of a system for the observation of content development in physical education. Unpublished doctoral dissertation. The Ohio State University, Columbus.

Santiago, J. A., & Morrow, J. R. (2021). A study of preservice physical education teachers' content knowledge of health-related fitness. *Journal of Teaching in Physical Education,* 40(1), 118-125. https://doi.org/10.1123/jtpe.2019-0138

Santiago, J. A., Disch, J. G., & Morales, J. (2012). Elementary physical education teachers' content knowledge of physical activity and health-related fitness. *The Physical Educator, 69*(4), 395–412.

Siedentop, D. (2002). Content knowledge for physical education. *Journal of Teaching in Physical Education, 21*(4), 368-77.

Tsuda, E., Ward, P. & He, Y. (2021). Test questions for preservice teachers and students in physical education content. Biblio Publishing.

Tsuda, E., Ward, P., Li, Y., Higginson, K., Cho, K., He, Y., & Su, J. (2019). Content knowledge acquisition in physical education: Evidence from knowing and performing by majors and nonmajors. *Journal of Teaching in Physical Education,* 38(3), 221–232.

https://doi.org/10.1123/jtpe.2018-0037

Vickers, J. N. (1987). The role of subject matter in the preparation of teachers in physical education. *Quest, 39*(2), 179–184. https://doi.org/10.1080/00336297.1987.10483870.

Ward, P. (2009). Content matters: Knowledge that alters teaching. In L. Housner, M. Metzler, P. Schempp, & T. Templin (Eds.), *Historic traditions and future directions of research on teaching and teacher education in physical education* (pp. 345–356). Fitness Information Technology.

Ward, P. (2011). The future direction of physical education teacher education: It's all in the details. *Japanese Journal of Sport Education Studies, 30*(2), 63-72. https://doi.org/10.7219/jjses.30.2_63

Ward, P., & Lehwald, H. (2018). *Effective physical education content and instruction.* Human Kinetics.

Ward, P., Ayvazo, S., Dervent, F., Iserbyt, P., & Kim, I. (2020). Instructional progression and the role of working models in physical education, *Quest, 72(4),* 410-429. https://doi.org/10.1080/00336297.2020.1766521

Ward, P., Ayvazo, S., Dervent, F., Iserbyt, P., Kim, I., & Li, W. (2020). Skill analysis for teachers: Considerations for physical education teacher education. *Journal of Physical Education, Recreation & Dance, 92*(2), 15-21. https://doi.org/10.1080/07303084.2020.1853635

Ward, P., Dervent, F., Lee, Y-S, Ko, B., Kim, I. & Tao, W. (2017). Using content maps to measure content development in physical education: Validation and application. *Journal of Teaching in Physical Education,* 36(1), 20-31. https://doi.org/10.1123/jtpe.2016-0059

Ward, P., He, Y., Wang, X., & Li, W. (2018). Chinese secondary physical education teachers' depth of specialized content knowledge in soccer. *Journal of Teaching in Physical Education, 37*(1), 101-112. https://doi.org/10.1123/jtpe.2017-0092

Ward, P., Tsuda, E., Dervent, F., & Devrilmez, E. (2018). Differences in the content knowledge of those taught to teach and those taught to play. *Journal of Teaching in Physical Education,* 37(1), 59-68. https://doi.org/10.1123/jtpe.2016-0196

Williams, S.E., Greene, L., Satinsky, S., & Neuberger, J. (2016). Content analysis of conceptually based physical education in southeastern United States universities and colleges. *The Physical Educator,* 73(4), 671–688. https://doi.org/10. 18666/TPE-2016-V73-I4-6554