

SPORT EDUCATION

Effects of Weight Training Sport Education Model on Fitness Levels and Knowledge in University Physical Activity Courses

Tony Pritchard, Andrew Hansen, and Christine Johnson

Abstract

The purpose of this study was to investigate the impact of the Sport Education Model (SEM) and the Direct Instruction Model (DIM) on fitness levels, content knowledge, and enjoyment of weight training among university students. A 15-week weight training course was completed by 157 students enrolled in one of three SEM courses or three DIM courses. Students met twice a week for 50 minutes each day. Pre- and post-tests consisted of the bench press strength to mass ratio, FITNESSGRAM components, percent body fat, push-ups, and curl-ups to determine a fitness level score. Fitness knowledge was measured with a 50-question content knowledge test. Participants completed an online survey at the end of the semester. Results indicated a significant time effect for the strength-to-mass ratio, fitness levels, and the content knowledge test. There was a group-by-time effect for the push-ups and curl-ups, with the SEM outperforming the DIM. Survey results revealed that both groups enjoyed certain aspects of the weight training courses.

Tony Pritchard, Professor, Waters College of Health Professions, Georgia Southern University; Andrew Hansen, Professor, Jiann-Ping Hsu College of Public Health, Georgia Southern University; and Christine Johnson, graduate of the Department of Kinesiology and Health, University of Kentucky. Johnson passed away and we gratefully acknowledge their contributions..Please send author correspondence to tpritchard@georgiasouthern.edu

The SEM group had a positive experience due to the components of the SEM that included team affiliation and a team points contest. The results suggest that the SEM is an effective instructional model for promoting fitness levels, content knowledge, and enjoyment in university weight training physical activity courses.

Introduction

The American College Health Association (ACHA, 2024) found that 43.3% of university students were overweight or obese in the spring of 2024, based on Body Mass Index calculations. University students reported 42.7% met the guidelines for an active adult in the same fall semester (ACHA, 2024). The US Department of Health and Human Services (USDHHS, 2018) defines an active adult as one meeting the recommendations for aerobic activity and strength training. Aerobic activity includes 150 minutes or more of moderate-intensity physical activity per week, or 75 minutes of vigorous-intensity physical activity, or an equivalent combination (USDHHS, 2018). Strength training involves two or more days a week of moderate to high-intensity activities that target all major muscle groups (USDHHS, 2018). The ACHA (2024) reported that 33.8% of university students met the guidelines for highly active adults. Highly active adults are defined as those who meet the recommendations for strength training and twice the recommendations for aerobic activity (USDHHS, 2018). These numbers demonstrate that university students need opportunities to increase their physical activity levels to promote lifelong health. Effective higher education physical activity (PA) instructional programs can provide the opportunity that university students need to improve their overall health. Society of Health and Physical Educators (SHAPE) America (2021) states a major outcome of PA programs in higher education is "... to build upon this foundation and educate students to continue the journey to enhance well-being, and live healthy, physically active lives" (p. 5).

Teaching effectiveness is crucial in implementing a quality PA program. To be an effective instructor, it is essential to choose an appropriate instructional model. Metzler and Colquitt (2021) describe eight instructional models a teacher can utilize in physical education, including PA university programs. Of these eight models, the Sport Education Model (SEM) and Direct Instruction Model (DIM)

are two of the more popular models. The SEM encourages students to become competent, literate, and enthusiastic in the activity being taught by using the six characteristics, including: 1) season, 2) affiliation, 3) record keeping, 4) formal competition, 5) culminating event, and 6) festivity (Siedentop et al., 2019). The DIM is a teacher-led model in that the teacher has total control of the learning environment (Metzler & Colquitt, 2021).

SEM research has predominantly focused on sports (e.g., basketball, volleyball, badminton), with very little research dealing with how the model affects the content of fitness. Hastie, Buchanan, Wadsworth, and Sluder (2009) were among the first to demonstrate a positive effect on aerobic fitness utilizing the SEM in fitness when investigating fifth graders following an obstacle course fitness season. Pritchard et al. (2015) researched the SEM in a fitness season for high school students. Results were promising with participants averaging 60.47% moderate to vigorous physical activity (MVPA) while increasing fitness levels and fitness knowledge. Other researchers investigated the impact the SEM had during a fitness season for fifth graders (Ward et al., 2017). Participants significantly increased fitness levels and fitness knowledge while averaging 54.5% MVPA during the fitness season (Ward et al., 2017). The research thus far has been promising, but little research has measured the impact of the SEM at the university level.

The research on the SEM at university PA programs revealed that university students perceived they learned more in the SEM class than in any other physical activity class, and 90% of those students reported they would take another course taught using the SEM (Bennett & Hastie, 1997). Students' ratings of progress of selected learning objectives were high, and ratings of teaching effectiveness were high in university PA courses that utilized the SEM (Mohr et al., 2012). Little research has been conducted to determine the effects of the SEM on weight training, including at college/university levels. The purpose of this study was to investigate the impact of the Sport Education Model (SEM) and the Direct Instruction Model (DIM) on fitness levels, content knowledge, and enjoyment of weight training among university students.

Methods

Design

This study involved a two (group) x two (time) design. All variables were measured in all weight training classes during pre-testing at the beginning of the semester and post-testing at the end of the semester.

Participants and Setting

The study was administered in six university PA weight training courses at a public university located in the southeastern United States. The weight training courses met during the university spring session for fifty minutes, two days a week, for a total of 29 lessons. On the first day of class, instructors reviewed the course syllabus and the purposes of the current study with students. Participants included 157 university students (115 males and 42 females) with an age range of 18 to 39 ($M = 20.08$, $SD = 3.09$). University students signed up for one of the six weight training courses, and each course was randomly assigned to the SEM group or the DIM group. The SEM and DIM groups comprised 77 and 80 participants, respectively. Participation was voluntary, and no extra credit was provided. The Institutional Review Board for the Protection of Human Subjects approved the investigation prior to data collection.

Instrumentation

Bench Press Strength to Mass Ratio

The bench press strength to mass ratio (SMR) (Harman, 2008) was determined by measuring a participant's one-repetition maximum lift (1RM) on the bench press in pounds and dividing the 1RM by the participant's body weight in pounds. The SMR provides a more accurate measurement of muscular strength compared to the 1RM test alone. The research team and teachers followed the 1RM testing protocol described by Earle (2006), then calculated participants' SMR.

Fitness Levels

Fitness levels were assessed using percent body fat, curl-ups, and push-ups. Percent body fat was measured using handheld bio-

electric impedance analyzers. The curl-ups and push-ups were measured using the FITNESSGRAM protocol (Meredith & Welk, 2010). Components were administered by the research team and teachers who had prior experience executing the FITNESSGRAM components through undergraduate physical education method courses. Comprehensive training entailed multiple administrations of the FITNESSGRAM to their peers, meeting 98.7% inter-observer agreement with the instructor.

Knowledge Test

A 50-question multiple-choice test was used to measure weight training knowledge, with questions chosen from the test bank by McGee and Farrow (1987). The knowledge test had no data quality coefficients, but other researchers have effectively used the test bank (French et al., 1996a; French et al., 1996b; Pritchard et al., 2008). Safrit and Wood (1995) considered the test bank, “the best source of test items for sport” (p. 421). Each participant's score reflected the total number of correct responses, with a maximum possible score of 50. The test was administered to Physical Education Teacher Education (PETE) majors the semester before data collection for the current study. It was evaluated by a Certified Strength and Conditioning Specialist from the National Strength and Conditioning Association to further establish content validity.

Teachers and Intervention Verification

The two teachers were graduate students who were trained using the SEM and DIM during undergraduate and graduate programs located at the university. The teachers had experience implementing both models at the secondary and university levels before beginning the current study. To ensure the SEM and DIM were appropriately implemented, researchers followed the teacher and student benchmarks of the SEM and DIM described by Metzler and Colquitt (2021). Both models met all teacher and student benchmarks of the SEM and DIM during the study.

Procedures for Data Collection

Participants were provided with a study description on the first day of the weight training course. The knowledge test, bench press, SMR, and fitness levels (i.e., percent body fat, curl-ups, and push-

ups) were tested on lessons two to four. After pre-testing was completed, the teachers taught the weight training courses using SEM or DIM, depending on which class was randomly assigned to each. At the end of the semester, post-testing occurred following the same procedures as the pre-testing.

Weight Training Season/Unit

Sport Education Model Season

The SEM weight training season was divided into three phases: the pre-season, mid-season, and post-season. During the pre-season, participants were assigned to teams by the teachers based on their fitness levels. Participants conducted daily roles (i.e., coach, fitness trainer, equipment manager, statistician, substitute, and reporter) for each phase of the season. In the pre-season lessons, the teachers taught the techniques and content necessary to initiate a weight training program effectively. At the beginning of the lesson, the assigned fitness trainers warmed up the teams while the team coaches met with the teacher to review the coaching plan. The coaching plan included content that students would need to know for the lesson, such as what exercises would be utilized, the muscles activated for the exercises, and any other content knowledge the teachers were teaching for the lesson. Coaches then peer-taught the information from the coaching plan to their teams, after which the teachers taught the weightlifting exercises that the teams would execute during the lesson. Participants practiced the exercises, then performed the lesson's daily workout plan. A lesson closure was provided at the end of the lesson to review the weight training exercises learned, along with cues and muscles activated in the pre-season lesson.

During the mid-season and post-season, teams competed against one another to earn points and become team champions. Points were awarded throughout the season by wearing team colors, performing the team cheer, and performing daily roles. Periodically during the mid-season and post-season, teams competed against each other with team contests such as a push-up contest, a lifting form contest, and a 5RM contest. The team with the most points at the end of the season was the champion of the weight training season. The SEM champions received certificate awards at the end of the weight train-

ing season, along with individual awards (e.g., Most Improved, Team Before Self).

Direct Instruction Model Unit

The DIM weight training unit enabled participants to learn correct weight training techniques and identify the muscles activated during exercises. At the beginning of each lesson, the teachers led all participants in a warm-up routine. After the warm-up routine, teachers taught the weight training exercises, including the technique and muscles activated. Unlike the SEM, participants were not put on teams, nor did they have daily roles. They were put in two groups where one group performed upper-body exercises, and the second group performed lower-body exercises. During the next lesson, the groups would switch exercises. The DIM participants did not compete against one another like the SEM participants. This format was followed for the entire weight training course. No awards were given to the DIM participants.

Survey

Upon completion of the post-testing of the 1RM bench press, fitness levels, and knowledge test, participants were sent a link to an online survey to gather data on their perceptions of the SEM and DIM weight training courses. Surveys comprised the following six questions: 1) What did you like most about this weight training course? 2) What did you like least about this weight training course? 3) How did you like being on a team during the weight training course? Please state why or why not. 4) Did you think being on a team helped you be motivated in the weight training course? Why or why not? 5) Did the point contest motivate you to be a part of the team and improve in the weight training course? Why or why not? 6) Is there anything you would like changed in the weight training course? If yes, please provide any suggestions. The answers to the questions were analyzed to identify emerging themes from the participants.

Data Analysis

IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA) was used to perform two (time) \times two (group) repeated measure Analysis of Variances (ANOVAs) with a priori al-

pha set at .01 due to a Bonferroni Adjustment. The repeated measure ANOVAs were evaluated on the following dependent variables: 1) bench press strength to mass ratio; 2) percent body fat; 3) curl-ups; 4) push-ups; 5) knowledge test.

Results

Descriptive statistics were generated on the dependent variables, including 1) bench press strength to mass ratio; 2) percent body fat; 3) curl-ups; 4) push-ups; and 5) knowledge test, and are provided for SEM and DIM in Table 1.

Table 1

Descriptive Statistics for Strength to Mass Ratio, Fitness Scores, and Knowledge Test

Sport Education Model (<i>n</i> = 77)	Pretest	Posttest
Bench Press Strength to mass ratio	0.93 (0.04)	1.04 (0.04)
Percent body fat	18.75 (0.95)	18.04 (0.89)
Curl-up test	33.05 (2.27)	48.69 (2.55)
Push-up test	18.62 (1.28)	24.43 (1.23)
Knowledge test	26.87 (0.66)	38.01 (0.63)
Direct Instruction Model (<i>n</i> = 80)		
Bench Press Strength to mass ratio	0.99 (0.04)	1.10 (0.04)
Percent body fat	18.65 (0.93)	17.34 (0.87)
Curl up test	39.05 (2.21)	45.19 (2.49)
Push up test	20.84 (1.25)	23.22 (1.20)
Knowledge test	27.19 (0.64)	36.81 (0.62)

Note: Descriptive scores expressed as means with standard error.

Bench Press Strength to Mass Ratio

A two (time) × two (group) repeated measure ANOVA revealed a significant time main effect [$F(1, 155) = 159.68, p < .01, \eta^2 = .51$] for the bench press strength-to-mass ratio. There was no significant

group effect [$F(1, 155) = 1.53, p > .01$] or a time by group interaction [$F(1, 155) = 0.34, p > .01$].

Percent Body Fat

A two (time) \times two (group) repeated measure ANOVA revealed a significant time main effect [$F(1, 155) = 10.4, p < .01, \eta^2 = .06$] for percent body fat. There was no significant group effect [$F(1, 155) = 0.10, p > .01$] or a time by group interaction [$F(1, 155) = 0.92, p > .01$].

Curl-ups

A two (time) \times two (group) repeated measure ANOVA revealed a significant time main effect [$F(1, 155) = 62.13, p < .01, \eta^2 = .29$] and a significant time by group interaction [$F(1, 155) = 13.18, p < .01, \eta^2 = .08$] for curl-ups. There was no significant group effect [$F(1, 155) = 0.21, p > .01$].

Push-ups

A two (time) \times two (group) repeated measure ANOVA revealed a significant time main effect [$F(1, 155) = 64.67, p < .01, \eta^2 = .29$] and a significant time by group interaction [$F(1, 155) = 11.14, p < .01, \eta^2 = .07$] for push-ups. There was no significant group effect [$F(1, 155) = 0.14, p > .01$].

Knowledge Test

A two (time) \times two (group) repeated measure ANOVA revealed a significant time main effect [$F(1, 155) = 387.29, p < .01, \eta^2 = .71$] for the knowledge test. There was no significant group effect [$F(1, 155) = 0.16, p > .01$] or a time by group interaction [$F(1, 155) = 1.82, p > .01$].

Survey Data

Participants completed an online survey to elicit their perspective on the qualities of the weight training course. The specific quotes shown here were used to convey the meaning of both positive and negative feelings. To distinguish participant quotes, each quote is followed by the identification number of the participant's answer to the question (e.g., ID P4).

Figure 1
Curl-up Test Interaction

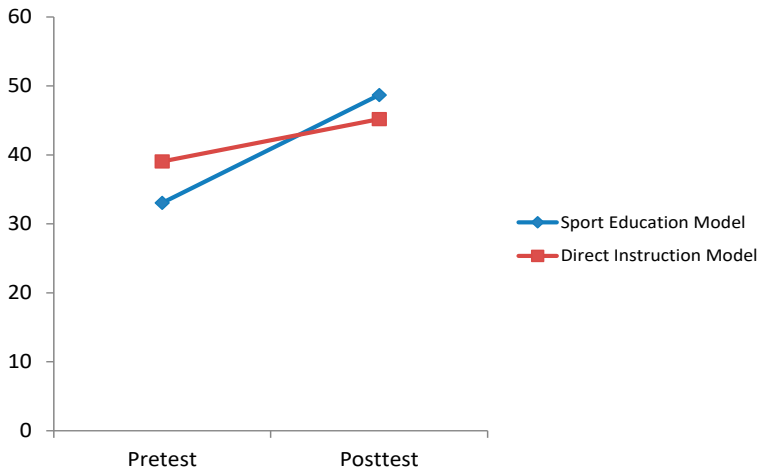
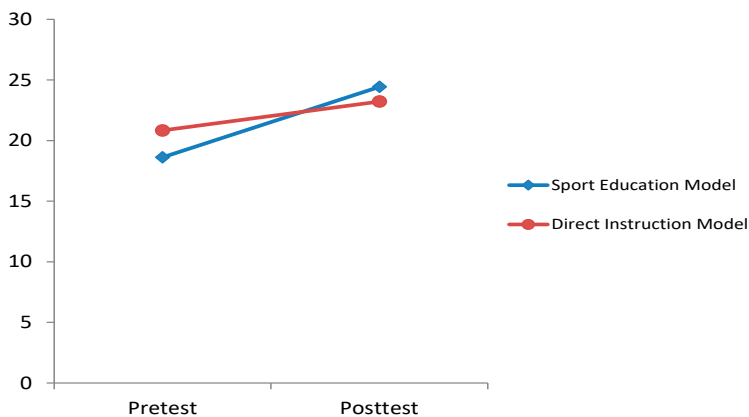


Figure 2
Push-ups Test Interaction



What Did You Like Most About This Weight Training Course?

Participants in both the SEM and DIM weight training courses appreciated learning how to perform weight training exercises properly and discovering new exercises. Both groups also enjoyed working out to improve their strength while earning course credit and having a routine to follow, which was provided by the teachers. The SEM participants liked being part of a team using team notebooks,

and the independent teams worked out with their teammates. “The independence we had during class, where we mostly just worked as a team instead of tedious things the instructor told us to do” (ID P73). The DIM participants were divided into two groups, with one group performing upper-body exercises and the other group performing lower-body exercises during a lesson. They then switched exercises in the next lesson, but no affiliation was established for the DIM participants. The DIM participants liked how the lessons were structured and learning new techniques in weightlifting taught by the teachers, “My teacher for challenging us and the workout guides for upper and lower body” (ID P105).

What Did You Like Least About This Weight Training Course?

One theme emerged in the survey data, with both groups stating that the time of the course was too short, or only met twice a week. Some of the SEM participants did not like having to wear team colors for class. These participants were unhappy if a team member did not wear team colors; then the team only earned a certain number of points for that lesson. Additionally, some participants wanted to work out on their own with little structure, “that we were the research group and had to work out at his pace and not our own” (ID P12). A few participants in both the SEM and DIM groups wanted to exercise using their own workout routine. The weight training course is designed to educate all participants on proper weight training exercises and workout routines, which are based on periodization. If teachers allowed participants to work out on their own, the workout routines may not be developmentally appropriate, so routines were designed to enhance student learning in both groups.

How Did You Like Being on a Team During Weight Training Class?

This question was asked to the SEM participants because the DIM participants were not placed on teams. Most of the SEM participants liked and enjoyed being on a team. “I liked it a lot, it gave you friends to workout with to help you and push you to become better” (ID P42). Participants stated that being on a team had a motivation factor to exercise harder, plus they did not want to let their teammates down. One participant wrote, “I liked it because it gave a sense of tenacity, and you didn’t want to let your teammates down”

(ID P6). Participants liked being on a team because they got to meet their classmates. “I actually really liked it because it made me work harder. I also met new people in my class, and it was fun working with them and getting to know them better!” (ID P15). Although most participants thought the teams were positive, as mentioned in the previous question, some participants did not appreciate being on a team because they had to wear the same-colored shirt or had to work out with their team instead of working out on their own.

Did You Think Being on a Team Helped You Be Motivated in the Weight Training Class?

This question was asked of the SEM participants because the DIM participants were not placed on teams. Thirty-four participants responded with a yes to this question. These participants believed the team was a motivating factor. The team concept encouraged participants to work out harder and push themselves to get stronger because they did not want to let their teammates down. “Yes, because you did not want to let your teammates down” (ID P15). Eleven participants responded to this question with a no, with some of the participants responding that they are self-motivated, or they preferred to work out alone. The remaining 33 participants stated that it somewhat motivated them or did not respond to the question.

Did the Point Contest Motivate You to be Part of the Team and Improve in the Course?

This question was asked of the SEM participants because that group was earning points for their team, while the DIM participants were not on teams. Of the responses, 28 SEM participants stated that yes, the point contest was a motivating factor. “Yes, because I didn’t want to let my team down and a contest helps you to push harder... because I like to win” (ID P31). Ten SEM participants stated that the contest somewhat motivated them because they wanted to help the team. Some team members did not care about the contest. This lack of enthusiasm by some team members was discouraging for those who answered somewhat. Of the 10 participants who stated “no” to the point contest being motivating, they felt the contest was childish, they wanted to work out on their own, or they also had unenthusiastic team members. Twenty-seven SEM participants did not answer this question.

Is There Anything You Would Like Changed in the Weight Training Course? If Yes, Please Provide Any Suggestions

Participants in both the SEM and DIM weight training courses were asked this question. Most participants stated that they had no response or no intention of changing anything in the weight training courses. Of those participants who stated “yes,” most responses were to have more time, such as having class three times a week, more class time than the fifty minutes assigned for each lesson, or allowing participants to exercise on their own. A minority of the SEM participants did not like wearing team colors for each lesson or participating in team cheers.

Discussion

The findings of the current study demonstrate that both SEM and DIM participants made significant gains in strength-to-mass ratio and content knowledge. These findings were expected because both groups were taught how to effectively participate in weight training. Both groups were provided with exercise workouts to improve upper-body strength, thereby enhancing their one-repetition maximum lift (1RM) in the bench press. By increasing the 1RM, the strength-to-mass ratio increased. What differed between the groups in the current study was how the exercise workouts were provided and how the participants executed them. The SEM group provided exercise workouts to their teams. Each team would have a different exercise workout to improve overall strength using periodization and the equipment available in the weight training facility. Participants exercised with their team, and then, periodically, a team contest was held for teams to compete for team points. For the DIM group, participants were placed in mini-groups and then provided with different exercise workouts to improve overall strength using periodization and the equipment available in the weight-training facility. One of the mini-groups would execute upper-body exercises in one lesson, while a different group would execute lower-body exercises. They would switch in the next lesson. The teachers used this strategy due to the availability of equipment. All DIM mini-groups could not start on the same exercise workout, as participation time would have been limited due to the large number of participants waiting. The teachers were effective in teaching the proper techniques in the exer-

cises performed in class and provided appropriate exercise workout plans for both the SEM and DIM groups.

The teachers were also effective in teaching weight training content knowledge to both groups. These findings are supported by other SEM research, which has measured an increase in content knowledge for various types of activities (Pritchard et al., 2008; Pritchard et al., 2015; Pritchard et al., 2019). The difference in teaching was based on the instructional model utilized in the weight training courses. The SEM group was provided with course materials that included coaching plans, which the coaches used to review previously taught content from the teachers. When teachers of the SEM group taught new material, such as new exercises, they used a direct instruction teaching style, complete with a demonstration of the new exercises, teaching cues, and an explanation of the muscles activated, along with checks for understanding. In the next lesson, that content was provided as a review in the coaching plans. Research demonstrates that when students engage in peer teaching, they experience consistent benefits to their learning and retention (Duncan, 2005; Mazur, 1997). Unfortunately, post-testing was not done beyond the end of the course. For the DIM group, teachers would review the previous lesson materials using a direct instruction teaching style, then teach new exercises utilizing the same approach, complete with a demonstration of the latest exercises, teaching cues, muscles activated, and checks for understanding. The same content knowledge was provided to both groups using different teaching methods (i.e., peer teaching for SEM and direct instruction for DIM). The instructional model implemented did not determine the effectiveness of the content knowledge if the teachers were effective in teaching the same content to both groups.

The SEM in weight training outperformed the DIM in curl-ups and push-ups. Both groups were provided with exercises to improve upper-body and abdominal strength throughout the weight training courses. For the SEM group, teams would compete in periodical team competitions, such as a curl-up contest and push-up contest, to earn team points for the overall championship. The DIM group did not have any type of competition during the semester. The SEM competitions were included to enhance the affiliation component of the instructional model. It is possible that this increase in opportu-

nities to perform curl-ups prepared students to perform better on the post-test. Pritchard et al. (2015) found a significant increase in push-ups when investigating the SEM with body conditioning. The SEM high school participants showed significant improvement on the PACER test and push-up test, but did not exhibit a significant difference in curl-ups from the FITNESSGRAM (Meredith & Welk, 2010). The difference between the current study and Pritchard et al. (2015) is that the current study compared two instructional models. Pritchard et al. (2015) investigated the SEM body conditioning with no comparison to any instructional model. The current study did not utilize the PACER test because this activity consisted only of weight training.

The survey data provided insight into whether most of the SEM and DIM participants enjoyed the weight training courses. The SEM students appreciated being on a team to increase the affiliation aspect of the model. Similar results were reported by Wallhead et al. (2014), who observed that SEM students enjoyed the SEM more than those in the multi-activity model. Pritchard et al. (2015) reported that participants enjoyed the SEM in a high school fitness class. The high school participants enjoyed being on teams and competing against other teams (Pritchard et al., 2015). Mohr et al. (2012) reported that college-aged students were highly positive about aspects of the SEM when participating in physical activity courses. Student evaluations of the teaching approach were highly positive, and students rated their progress in acquiring skills highly (Mohr et al., 2012).

Earning points for the team was a driving factor for some SEM participants. These participants did not want to let their team down by not providing full effort in the weight training courses. Pritchard et al. (2015) found similar results with high school students when they participated in a body conditioning unit incorporating the SEM. The high school students reported that earning points for the team made them put forth more effort, especially on competition days.

A minority of SEM participants thought the point system was pointless and wanted to exercise on their own. An issue observed in teaching college-aged students in physical activity programs is the expectations college students have when participating in a physical activity course. Some students in this age group expect less instruc-

tion and desire greater autonomy. Some participants in this study expressed this view when responding to the survey. They were not expecting a structured class that required students to learn weight training techniques and course material.

Team awards and individual awards were given at the end of the semester. The SEM characteristics are unique and provide an overall learning experience unlike the DIM. The DIM was just as effective in improving skills such as strength, but there are no teams, team contests, or awards associated with this instructional model.

Conclusion

Both the SEM and DIM were effective in promoting student learning in weight training. The SEM participants enjoyed the aspects of the model, such as the affiliation, earning team points, and being motivated by their teammates. Most of the teachers in a PA program are graduate teaching assistants who have very little pedagogical knowledge, teaching content to university students. Choosing a structured instructional model, such as SEM, in PA courses can promote student learning, especially in weight training courses.

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