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Instructional Variables and Student Knowledge and Conceptions of Fitness

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Chapter 4: Instructional Variables and Student Knowledge and Conceptions of Fitness

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Although there is a growing awareness regarding the benefits of regular physical activity, it is estimated that more than 60% of American adults are not regularly active and 25% of the adult population is completely sedentary (United States Department of Health and Human Services [USDHHS], 1996). Based on recent reports (Kann et al., 2000; USDHHS, 1996), it appears that this trend of inactivity may begin in adolescence. Nearly half of U.S. adolescents aged 12–21 years are not physically active on a regular basis and approximately 14% report no recent physical activity. In addition, daily enrollment in physical education has dropped from 42% to 29% among high school students from 1991 to 1999, with only 56% of students enrolled in a physical education class (Kann et al., 2000).

Research supports the notion that increased knowledge of health-related fitness concepts such as fitness assessment, goal setting, and application of the FITT (frequency, intensity, time, and type) principles will result in increased activity (Dale & Corbin, 2000; Dale, Corbin, & Cuddihy, 1998; Pearman et al., 1997). For this reason, many physical education programs are placing more emphasis on health-related fitness in an attempt to teach students how to be physically active for a lifetime (Dale & Corbin, 2000; Pate et al., 1995). Publications such as *Moving Into the Future: National Standards for Physical Education* (National Association for Sport and Physical Education [NASPE], 1995) identify various fitness concepts such as fitness assessment, goal setting, and the application of the FITT principles as concepts students should be taught in physical education programs.

The physical education curriculum in the state of South Carolina is representative of a trend towards increasing instruction in health-related fitness concepts. In 1994 the South Carolina state legislature mandated that the required physical education course in high school include one semester of lifetime fitness and one semester of personal fitness. In response to this mandate, four performance indicators were developed, based on the National Standards for Physical Education (NASPE, 1995), that describe what students should be able to do after a one-year high school required physical education course (see Appendix A). The South Carolina Physical Education Assessment Program (SCPEAP), initiated in January 2000, was formed to provide professional development to ensure programs were consistent with the standards and to provide the State Department of Education a valid and reliable assessment of physical education programs in South Carolina. The second of four performance indicators specifically targets health-related fitness concepts by requiring that students design and develop an appropriate physical fitness program to achieve a desired level of personal fitness.

In spite of the support for teaching health related fitness concepts, we know little about student learning or effective teaching processes in this area. There is an absence of published studies that identify variables related to the effective instruction of health-related fitness, as well as a lack of research documenting what students know and do not know about fitness concepts. Reasons for this are varied and include a lack of emphasis on cognitive learning objectives in physical education, the ongoing struggle for time and support in high school physical education, and assessment issues related to measuring these variables. Due to the recent emphasis on health-related fitness in physical education and findings indicating that increased knowledge of fitness concepts may result in increased activity, it is important to know what conceptions adolescents have in the fitness area and how best to provide effective instruction. As we identify the appropriate content to be taught and how best to teach it, we should be better able to provide programs that will contribute to the goal of helping students acquire the skills, knowledge, and desire to maintain an active lifestyle into adulthood.

In spite of factors limiting investigations, several authors have begun a line of research attempting to understand students' current knowledge and understanding of fitness concepts (Desmond, Price, Lock, Smith, & Stewart, 1990; Merkle & Treagust, 1993; Placek et al., 2001). Desmond and colleagues used a 70-item questionnaire to explore fitness conceptions of 257 urban high school students. They reported that a large percentage of students held misconceptions about fitness. For example, many either incorrectly believed or were uncertain if wearing extra layers of clothing while exercising would help the body rid itself of body fat and many believed or were uncertain whether or not the statement "no pain, no gain" was true. Another common belief reported was that, when exercising, how fast you run is important—not how far you run.

Merkle and Treagust (1993) conducted 22 interviews and collected 109 paper and pencil test responses from high school students. While students scored relatively well on the test items (true and false format), explanations of their responses frequently indicated faulty reasoning. Misconceptions noted in this study included the belief that being fit meant not being overweight and related fitness to big muscles and running without breathlessness. The authors concluded that students often leave school without a clear understanding of many health concepts.

Placek and her colleagues (2001) interviewed 39 middle school students to understand their conceptions of fitness. Specifically, they asked if students thought it was important to exercise, if they could identify and define components of fitness, and if they could describe activities that improve these components. Several alternative student conceptions were identified, including the notion that fitness means looking good, that jogging improves strength, and that a specific exercise can lead to fat loss in a particular area. In addition, students demonstrated a lack of specific knowledge about fitness components, activities that improve fitness, and FITT principles. The Placek et al. (2001) study broke new ground in identifying students' alternative conceptions and domain-specific knowledge in physical education and provided insights into important, necessary analyses for this study and others in this field of inquiry.

In the context of statewide reform and assessment of physical education, the purpose of this study was to identify instructional variables that may impact student knowledge and conceptions of health-related fitness. It was also the purpose of this study to examine high school students' knowledge and conceptions of health-related fitness.

Methods

The methods used to study both the instructional variables relative to effective instruction in health related fitness and student knowledge and conceptions are described first in terms of the instruments and then in terms of the process involved.

Instruments

There were two instruments used for data collection in this study. First, an Instructional Impact Survey was administered to teachers. The second instrument used for data collection was a written test administered to students to assess knowledge of health related fitness.

Instructional impact survey. This survey was developed to define and measure selected variables relating to the instruction of personal fitness. The self-administered questionnaire contains 20-items in a mixed format that includes yes and no, checklists, rating scales, and open-ended questions. Content validity was established by a group of university professors with expertise in physical education pedagogy, measurement, and survey design. Section one addresses characteristics of the personal fitness unit (time spent) taught by the teacher, characteristics of the facility used for personal fitness instruction (resources), and instructional aids and strategies a teacher used in personal fitness instruction. Section two addresses teacher experience, attitude, and perceptions related to personal fitness instruction. In section three, assessment of the personal fitness unit and administration of the written test are addressed.

The survey was piloted with four former South Carolina high school physical educators who were familiar with the assessment program and had been teaching personal fitness for several years. Upon completion of the survey, respondents were interviewed regarding their understanding of the items, their ability to answer the questions, whether the ranking of items was difficult to understand, how they felt about having to make forced-choice answers, and whether any language or question was offensive. Modifications were made to this instrument based on results of the pilot test.

Written test. The written test used in this study was developed for the purpose of statewide program assessment in South Carolina. The test was developed by members of a research task force organized to develop assessment materials for all four performance indicators. Input for the written test in particular involved specialists in test construction and response analysis, reading level experts, physical education pedagogy specialists with specific content knowledge, and high school teachers and administrators to provide insights into test administration issues. An initial pilot test was conducted with 24 high school students and adjustments were made to the instrument. The modified version of the test was then piloted in 11 high schools across South Carolina. Final modifications to the written test were made prior to administration for this study.

The written test used for this study was accepted by the State Department of Education and SCPEAP as the official measure of PI-2 (cognitive fitness). The test begins with a brief case study and describes the results of six tests on the Fitnessgram. Students are asked to identify what health related fitness component each test item represents and to determine whether the reported scores are below, within, or above the healthy fitness zone for the subject. Next, students are asked to identify reasonable 9-week goals for each of the health related fitness components identified as below the healthy fitness zone. Last, students are required to design a 9-week personal fitness program to improve one deficient component. An open-ended format requires students to identify a fitness component and prescribe a type of activity, frequency, intensity, and time for weeks one, three, and six of a program. Based on pilot testing, students were given 40 minutes to complete the test—to allow students to finish the exam in either of the class lengths (e.g., 55 minutes and 90 minutes) popular in the state. Three versions of this test (Forms A, B and C) with minor variations (changes in case study components out of the health fitness zone and name and gender of the study subject) were distributed to schools being assessed.

The written test was scored at four levels, as a 0, 1, 2, or 3. Level 0 represents student performance below 15 out of 30 possible points; Level 1 represents a student score of 15 to 20 points; Level 2 represents a student score of 21 to 26 points; and, Level 3 represents a student score of 27 to 30 points.

Participants

One hundred and fifty teachers in cycle one (one-third of the state high schools) of the South Carolina Physical Education Assessment Program (SCPEAP) who submitted written tests, and their students were identified for participation in this study. The participants for this study were the students who took the written test on fitness and the teachers who taught the fitness content during the 2000–2001 school year. The total database consisted of 270 classes from 62 high schools.

A stratified random sample of 180 tests was examined. The sample was stratified by test form (Forms A, B and C), and by level of teacher effectiveness (Levels 1, 2 and 3). Each level of teacher effectiveness was represented by two classes from each of the three test forms, for a total of 18 classes. Ten written tests were randomly selected from each class to form the test sample. A random number table was used in selecting all classes and tests for the sample. Written test sample demographics are described in Table 4.

Procedures

Teachers at each individual school handled the administration of the written test for assessment of PI-2 (cognitive fitness). Teachers were asked to make arrangements to have the written test administered by someone other than the instructor of the class, but teachers were responsible for grading their own students' written tests, following an official scoring rubric. Scoring rubrics for each test form were developed by the same researchers who developed the written test, and provided references and page numbers which identified the location of each concept in two major fitness texts used in South Carolina high schools, *Personal Fitness: Looking Good, Feeling Good, Teachers Ed.* (Williams, Harageones, Johnson, & Smith, 1995) and *Personal Fitness and You* (Stokes, Moore, & Schultz, 1996).

Teachers submitted their scores and the original student tests to SCPEAP with data on other performance indicators. The monitoring committee checked the accuracy of the teacher's scoring. A single observer randomly sampled 25% of tests from each class and scored the sample following the official rubric. When agreement with the monitoring committee fell below 80%, an additional 25% sample was scored. If 80% agreement was still not obtained, a second observer began the process. If the second observer did not reach 80% agreement or if classes had major protocol violations, they were given a score of zero. Examples of protocol violations include students appearing on the official roster without any data or a form to document why the data should be missing, not following the official scoring rubric for grading, and/or submitting tests that had not been graded.

Each teacher who submitted data for assessment was mailed a survey including an informed consent letter. Since most schools were in their last few weeks of school at the time of the initial mailing, a low number of surveys were returned. Therefore, a reminder postcard was mailed at the beginning of the following semester to all teachers who had not responded. One month later, faxes were sent to the remaining non-respondents. Ultimately, sixty-one completed surveys were returned, resulting in a 41% response rate. Of those respondents, the average individual teacher score for PI-2 was 72.7%, with scores ranging from 0 to 100. The state average score for PI-2 (cognitive fitness) was 57% (see chapter 2), which means that the teachers in the sample returning surveys were more effective at teaching PI-2.

Data Analysis

Teacher survey. Teacher survey data were analyzed by the same researchers involved in analyses of the written tests using descriptive statistics such as frequencies, means and standard deviations. Indexes were created by categorizing several survey questions into measures of time, resources, and teacher attitude. Correlations were conducted to determine the relationship between time (e.g., time spent teaching fitness), resources (e.g., classroom availability, books), and teacher attitudes and teacher means (percent of students scoring 21 or better out of 30 on the written test for all classes submitted).

Teacher grading. A content analysis of teacher grading errors was conducted on the sample of written tests used to examine student knowledge and conceptions. Categories were identified and coded based on items scored by teachers that were deemed incorrect by the researchers as well as the monitoring committee observer.

Student knowledge. The total database (n = 270 classes) was analyzed by averaging class means for all teachers and classes to create a school score. The total score represented the percentage of students competent (scoring a level 2 or better) in PI-2 (cognitive fitness) for that school. The sample database (180 tests) was examined by five researchers using descriptive statistics for each section of the written test and content analyses using a form of constant comparison (Glaser & Strauss, 1967) to examine open-ended questions. Categories were identified and described for incorrect responses. Correct responses were also analyzed and described qualitatively. All results were further analyzed for relationships and themes to provide focus and meaning to the analysis.

Results

There were two main purposes to this study. First, relationships among instructional variables and student knowledge were sought. Second, student knowledge and conceptions of fitness were examined. Results are divided into two sections. In the first section instructional variables and their relationship to student performance on the test are described. The second section includes results related to student knowledge and conceptions about health-related fitness.

Instructional Variables

Five instructional variables were targeted for analysis in this study. Variables included: time allocations, resources, instructional strategies, teacher attitudes, and assessment strategies.

Time allocations. Teachers reported a wide range of time spent in personal fitness instruction (40 minutes to 4860 minutes per semester). Mean minutes spent in personal fitness instruction were 1312.4 (SD = 949.8) per semester with a median of 1170 minutes. The mean translated to 82 minutes per week or approximately 22 hours per semester. Less than half of the respondents (43%) indicated that personal fitness was taught as a separate unit. A Pearson product-moment correlational analysis performed on the time spent teaching fitness (minutes per semester) and teacher effectiveness (class means) found no statistically significant relationship.

Resources. Many teachers reported working with limited resources to support personal fitness instruction. Seventy-seven percent of the teachers taught fitness concepts in a gym rather than a classroom. Although 67% of the teachers indicated that they did have access to a classroom at least some of the time, many were teaching in areas such as weight rooms, fitness labs, locker rooms, cafeterias, hallways, entryways and libraries. In addition, 27% of the teachers indicated that they did not have enough space or the space used was not isolated from other activities (23%), and they did not have enough textbooks to assign to each student for the semester (69%) (meaning students could not take the textbook home). The only textbook identified by participants was *Personal Fitness: Looking Good, Feeling Good* (Williams et al., 1995).

A resource index was developed to contrast resources available with student performance. Scoring for this index consisted of assigning one point for each of the responses indicating the availability of desirable instructional spaces (e.g., a classroom, private space, permanent space, etc.), and other aids (e.g., textbooks, handouts, computers, etc.). Analysis of this index representing resources available to teach fitness yielded scores ranging from 1 to 6, with a mean of 4.4 (SD = 1.2). Pearson product-moment correlations performed on the resource index score and teacher class means revealed no statistically significant relationship.

Instructional strategies. Illustrated in Table 1 are frequencies for instructional aids used by teachers. Frequencies of instructional strategies used in teaching personal fitness are shown in Table 2. Traditional teaching methods such as lecture (83%) and textbooks (93%) were most frequently used. Several non-traditional methods such as workout logs, partner work, self-evaluations and demonstrations were also identified. In addition to aids and strategies provided, participants also listed "digiwalkers," "other resources," "case studies," "note taking," and "combination of strategies" as additional strategies they used in their teaching.

The majority of teachers indicated that they covered major fitness concepts such as HRF components (100%), FITT principles (98%), and program design (92%). Eighty-seven percent reported specificity of training as a topic covered and only half of respondents addressed cross-training in their personal fitness unit.

Table 1 Instructional Aids Used in Teaching Personal Fitness

Instructional aid	*N* (*n* = 61)	Percent
Textbooks	52	93%
Handouts	45	74%
Fitness equipment	38	62%
Blackboards	31	51%
Video/TV/film	31	51%
Charts	18	30%
Overheads	17	28%
Workbooks	13	21%
Lab equipment	12	20%
Tape recorders	9	15%
Fitness software	9	15%
Bulletin boards	7	11%
Magazines	6	10%
Computers	5	8%
Activity monitors	4	7%
Heart rate monitors	3	5%
Newspapers	3	5%

Note. Items were identified as the top five most frequently used instructional strategies.

Table 2 Instructional Strategies Used in Teaching Personal Fitness

Instructional aid	*N* (*n* = 61)	Percent
Textbooks	52	93%
Lecture	49	83%
Tests	33	56%
Group discussion	31	53%
Workout logs	30	51%
Partner work	29	49%
Self-evaluations	27	46%
Demonstrations	27	46%
Question/answer	26	44%
Lab experiences	16	27%
Quizzes	16	27%
Cooperative work	15	25%
Journals	8	14%
Homework	7	12%
Projects	6	10%
Simulations	6	10%
Questionnaires	4	7%
Incentives	3	5%
Guest speakers	3	5%

Note. Items were identified as the top five most frequently used instructional strategies.

No statistical analyses were performed on these strategies. These data are provided to describe the nature of instruction in cognitive fitness information provided by teachers in this study.

Teacher attitudes. The majority of teachers indicated they wanted to teach personal fitness and enjoyed teaching this content (both 92%). When asked what would help improve fitness instruction, most participants indicated various physical resources as opposed to curricular changes. Examples included having more space (73%), access to a classroom (67%), and equipment and materials (66%).

A teacher attitude index was developed by assigning one point for each of the following responses: yes for question 12 (want to teach), yes for question 13 (enjoy teaching), and actual number (1-5) of the Likert scale circled for questions 15 (how important) and 16 (how confident). Points for responses to each of these questions were totaled and resulted in scores ranging from 6 to 12, with a mean score of 11.1 (SD = 1.2). A Pearson product-moment correlation between scores on the teacher attitude scale and student performance means for the teacher revealed no statistically significant relationship.

Assessment strategies. Physical education teachers in this study assessed students by placing most of the semester grade emphasis on "participation," with three respondents indicating student participation represented 81-100% of the semester grade for personal fitness and 67% of respondents giving participation 20% or more of the student's grade. Described in Table 3 are details of the percentages representing students' semester grade and frequency of use for each assessment tool. Seventy-six percent of teachers who integrated personal fitness into an activity (did not teach personal fitness as a separate unit) considered it worth at least 25% of the student's semester grade.

Student Knowledge and Conceptions of Health Related Fitness

Class means for all teachers in a school were averaged, resulting in a school score, which represented the percentage of students competent in PI-2 (cognitive fitness) for that school. The mean score for all schools for students reaching competence on the PI-2 written test in South Carolina for assessment year 2000/2001 was reported as 57% (SD = 31, median = 68%). The mean included scores of zero given for teachers who did not turn in data, as well as scores of zero received for unacceptable data due to protocol violations or inaccurate teacher scoring.

Identifying health-related fitness components. Students were asked to identify health-related fitness components that corresponded to a sample of test results (e.g., given a pacer score, what health-related fitness component is being measured?). Fifty-seven percent of the 180 tests analyzed contained errors in identifying the correct health-related fitness component. The most common error (29%) involved identifying a recognizable health related fitness component, but not the component that matched the Fitnessgram test item. In this category of errors, the most common error (52%) was for the trunk lift test item. Most students gave muscular strength or endurance as the component—rather than flexibility. Categories of student errors in identifying health-related fitness components on the written test were developed and are described in Table 5.

Twenty-six percent of the errors on the question requiring students to match the health-related fitness component with the Fitnessgram test item were "no

Table 3 Assessment Tools and Percentage of Students' Semester Grade

Assessment tool	Percentage of semester grade	Frequency
Tests (*n* = 60)	0%	10
	1–19%	10
	20–40%	36
	41–60%	1
	61–80%	3
Projects (*n* = 20)	0%	1
	1–19%	10
	20–40%	9
Quizzes (*n* = 39)	0%	10
	1–19%	15
	20–40%	12
	41–60%	2
Participation (*n* = 54)	0%	10
	1–19%	3
	20–40%	26
	41–60%	11
	61–80%	1
Papers (*n* = 12)	0%	4
	1–19%	4
	20–40%	4
Design a Personal (*n* = 47)	0%	10
Fitness Program	1–19%	16
	20–40%	18
	41–60%	3
Homework (*n* = 28)	0%	5
	1–19%	12
	20–40%	10
	41–60%	1

Note. *n* = number of teachers who used this assessment tool.

response." Students who provided a fitness concept instead of a health-related fitness component (14%) often gave the body part or muscle group the test would target, such as "upper body" for push-ups, "abs" for curl-ups, and "legs" for pacer or mile run. Other fitness concepts given for health-related fitness components included "body mass, body fat, or % body fat" instead of body composition, and "intensity, time, or power" for push-ups and pacer. Fourteen percent of students did not word a component correctly (i.e., they used "endurance" for cardiovascular or muscular endurance or "strength" for muscular strength) and 12% of students didn't follow directions, either providing the case subject's fitness scores or repeating the test name.

Table 4 Written Test Sample Demographics

School	School enrollment	School % free lunch	% Competent* (Level 2) PI-2
Level 1 (15–20 out of 30 points), Form A			
Class 1	908	45.1	9
Class 2	362	72.4	42
Level 1 (15–20 out of 30 points), Form B			
Class 3	1647	45.1	32
Class 4	951	44.0	22
Level 1 (15–20 out of 30 points), Form C			
Class 5	547	42.9	44
Class 6	1525	28.3	14
Level 2 (21–26 out of 30 points), Form A			
Class 7	418	43.9	83
Class 8	309	40.1	76
Level 2 (21–26 out of 30 points), Form B			
Class 9	874	72.3	74
Class 10	773	66.0	71
Level 2 (21–26 out of 30 points), Form C			
Class 11	354	42.9	68
Class 12	1231	21.4	68
Level 3 (27–30 points), Form A			
Class 13	786	17.8	97
Class 14	710	23.0	94
Level 3 (27–30 points), Form B			
Class 15	342	60.3	100
Class 16	508	62.6	100
Level 3 (27–30 points), Form C			
Class 17	1301	12.7	84
Class 18	507	37.9	100

*Percent competent (level 2 or better) reported by class sampled, not by school.

Table 5 Incorrect Responses for Health-Related Fitness (HRF) Components

Response category	Frequency	Percent of total errors*
Wrong component for test item	83	29%
No response	77	26%
Didn't follow directions	36	12%
Not a HRF component but a fitness concept	41	14%
HRF component not worded correctly	41	14%
Unrecognizable	11	4%
No relationship to fitness	2	1%

*291 errors out of 1080 responses.

Interpreting results. Most students did well when asked to determine whether Fitnessgram scores provided were below, within, or above the healthy fitness zone for the subject's age and gender. For this question, students had to correctly read a table describing fitness scores. Over half (56%) of the students answered all six items correctly (m = 5.2; SD = 1.13).

Setting a fitness goal. Students were required to create 9-week goals for the case study subject to improve each of the health-related fitness components identified as below the healthy fitness zone. In each form of the test, at least 2 components were below the healthy fitness zone. These components differed by test form. When cardiovascular fitness was an option—as it was on test forms B and C—71% of the students chose this health related fitness component. A content analysis of incorrect responses to this question revealed six distinct categories, which are described in Table 6.

Of the 180 tests analyzed, 62% contained errors. The most common error (39%) in goal setting was providing an exercise prescription, not a specific number. For example, students would describe what the case study subject should do to improve their score such as "run three times a week for 20 minutes" instead of giving an appropriate time for the one-mile run that would be within the healthy fitness zone.

The second most common error was "no response." Sixteen percent provided a number that was below the correct healthy fitness zone, and 12% responded with a number too high (unrealistic) for nine weeks. Not only was the number too high, it was often an extreme and unattainable number (i.e., 80 push-ups when the upper end of the healthy fitness zone was 20), or 80 laps on the pacer (should be no more than 60), and 15 inches on the sit and reach (should be no more than 12).

Designing a fitness program. Students were next directed to choose one of the health related fitness components for which they had just set a 9-week goal, and design a program to reach that goal. Based on a content analysis, categories were identified to describe incorrect responses for frequency, intensity, time and type of activity. Correct responses were analyzed to reveal patterns of cognition relating to FITT principles. Each variable (frequency, intensity, time, and type of

Table 6 Incorrect Responses for Fitness Goals

Response category	Frequency	Percent of total errors*
Exercise prescription (no specific number)	102	39%
No response	74	29%
Number below correct healthy fitness zone	41	16%
Number too high (unrealistic) for nine weeks	30	12%
Number corresponded with a test not below healthy fitness zone	9	4%

*256 errors out of 720 responses

Table 7 Incorrect responses for FITT Principles

Response category	Frequency	Percent of total errors*
Frequency (*n* = 68)		
Not appropriate (too much or not enough)	50	74%
Confused time and frequency	10	15%
Not specific enough (vague)	4	6%
No response	4	6%
Intensity (*n* = 128)		
Not specific enough (vague)	95	74%
Not appropriate (too much or not enough)	18	14%
No response	9	7%
Confused intensity and time	6	5%
Time (*n* = 83)		
Not appropriate (too much or not enough)	68	82%
Confused time and frequency	9	11%
No response	3	4%
Not specific enough (vague)	2	3%
Confused intensity and time	1	1%
Activity (*n* = 87)		
Gave test name or activity, not a HRF concept	25	29%
HRF component and type of activity do not match	19	22%
(specificity)HRF component not one that needs improvement)	15	17%
No response	14	16%
Not specific enough (vague)	14	16%

*Percent of total errors by category out of 180 responses.

activity) is described separately for both incorrect and correct responses. Frequencies of incorrect responses by category and variable are described in Table 7.

Frequency. This variable was measured by asking students to identify "how often" the case study subject should participate in the activity(ies) identified for weeks one, three, and six. Of the 38% of tests that contained errors relating to frequency, the most common was "not appropriate" (too much or not enough) (74%). These errors were divided between being "too much" or "not enough" (50% each). Those classified as "not enough" responded with 2 times or less per week and those classified as "too much" responded with everyday or more if referring to high-intensity activity. Fifteen percent of students confused time and frequency, meaning they provided a response such as "20 minutes" for frequency and "3 times a week" for time. Responses that were not specific enough or vague (6%) included "very often," "a lot," and "as much as he can."

Correct answers to the frequency variable ranged from two to six days per week or "every other day." Thirty-six students provided a range of days per week and 36 students showed evidence of progression (increasing frequency) for each of the three weeks (one, three and six). The single most common response (not a range) was three times per week (29).

Intensity. This variable was evaluated by asking students to identify "how hard" the case study subject needed to work at the activity(ies) identified for weeks one, three, and six. Of all health-related fitness variables examined, intensity appeared to be the most problematic. Of the 180 tests sampled, 71% contained intensity errors. Seventy-four percent of student errors made on intensity items were categorized as "not specific enough (vague)." Common responses in this category included "hard, not too hard, harder," "slow, medium, moderate, fast," and "low or high resistance."

Fourteen percent of students provided a level of intensity that was not appropriate for the activity or fitness level of the case study subject. Examples included those that described a measure of intensity that did not match the given activity (i.e., a target heart rate range was given with weight training) and intensity levels over 90% of maximum heart rate. Several students confused intensity and time, for example, describing intensity as "run for 20 minutes."

Correct responses to intensity were provided for only two health-related fitness components, muscular strength and cardiovascular endurance. No correct responses were given for muscular endurance or flexibility (body composition was not an option for this question). Measures of intensity for muscular strength included "a weight that allows her to do 10 repetitions for week one, then add 5 pounds in weeks three and six (weight lifting)," "50–75% of one-rep max (bench, incline)," "until he can't do anymore (push-ups)," and "body weight (push-ups)." Several students gave actual weights for a particular exercise (i.e., 85 lbs for bench press). Measures of intensity for cardiovascular fitness included "60–85% maximum heart rate (walk, jog, run)," "55%, 60%, 65% (pacer)," "50–85% maximum heart rate (jog, walk, aerobics, soccer, biking, swimming)," "within target heart rate (jogging)," "60–75% maximum heart rate (run, walk)," and "lower, middle, and upper target heart rate range (walk, jog, run)." Several students provided specific beats per minute (25–35 bpm).

Time. Students were asked to explain "how long/how many" of the activity(ies) the case study subject should participate in or complete. Of the 46% of tests containing errors, 82% were related to the appropriateness of the time given to the activity and fitness level of the case study subject. The majority (81%) of these errors were "too much" time. Most of these responses prescribed more than 1 hour per session. Eleven percent of students confused time and frequency, meaning they provided a response such as "3 times a week" for time and "20 minutes" for frequency. Several responses were considered vague, such as "a lot" (push-ups) or "not too much" (weight-training) and a few students did not provide a response for time in one or all weeks (one, three, and six).

Correct responses for time were identified for all four fitness component options (cardiovascular, muscular strength, muscular endurance, and flexibility). Time in relation to muscular strength/endurance was either in the form of sets and/or repetitions (the most common being 3 sets of 12 repetitions) or a specific number of repetitions for a given exercise, such as push-ups or curl-ups. Recommended time for flexibility ranged from 10–30 minutes. Time spent engaged in cardiovascular exercise was either in the form of actual time, which ranged from 30 minutes to one hour, or distance, given in laps or miles. The most common amount of time was 20–30 minutes, with 82% of correct responses for cardiovascular exercise within this range.

Type of activity. Students were asked to identify appropriate activities for weeks one, three, and six that would contribute to improving the health related fitness component they had identified. To receive credit, the student must have identified a correct health-related fitness component and appropriate activities for each week. Almost half (48%) of tests examined contained incorrect responses, with the most common error being "gave test name or activity, not a fitness component" (29%).

The second most common error was "health-related fitness component and type of activity do not match (specificity)" (22%). Students often gave activities that would not improve the HRF component they chose. For example, many students listed running/jogging/walking as activities for muscular strength, muscular endurance, or flexibility. Nearly half of the students (47%) identified only one activity for all three weeks—potentially a correct response. Sixteen percent of the students provided an answer that was not specific enough or was too vague for the health related fitness component. In other words, the student did not word the component correctly (i.e., wrote "endurance" instead of cardiovascular or muscular endurance).

Student responses (correct and incorrect) for type of activity were varied and defined as 1) health-related fitness activities (self-paced or structured activities which directly impact one or more health-related fitness components), 2) health-related fitness exercises or calisthenics (a specific exercise to improve a health-related fitness component, usually focusing on one muscle group), 3) performance-related activities (sport activities that may or may not impact a health-related fitness component), and 4) Fitnessgram test as activity (named the actual test as the activity to improve a health-related fitness component). The majority of responses were health-related fitness activities (233) (i.e., walking, jogging, swimming), followed by fitness test as the activity (147) (i.e., push-ups, sit and reach, pacer), health-related fitness exercises (128) (i.e., jumping jacks, curl-ups, pull-ups), and performance-related activities (12) (i.e., soccer, volleyball, basketball). The five most common activities identified included push-ups (68), running (57), walking and jogging (each 44), curl-ups (40), and swimming (27). All activities (correct and incorrect) identified in response to this question appear in Table 8.

Table 8 Activities Identified for Improving a HRF Component

HRF Component	Activity	Frequency	Activity	Frequency
Cardiovascular fitness	Walking	40	Running	41
	Jogging	38	Swimming	21
	Bicycling	12	Mile run	9
	Jump rope	7	Soccer	5
	Pacer	5	Aerobics	3
	Rollerblading	3	Jumping jacks	1
	Push-ups*	1		
Flexibility	Stretching	9	Sit and reach	9
	Trunk lift	8	Curl-ups*	6
	Push-ups*	3	Running*	3
	Weight training*	1	Toe touches	1
Muscular Endurance	Push-ups	9	Curl-ups	6
	Swimming	5	Volleyball*	2
	Aerobics	1	Baseball*	1
	Sit and reach*	1		
Muscular Strength	Push-ups	39	Weight training	18
	Curl-ups	21	Bench	5
	Crunches	4	Pull-ups	3
	Ab Roller	3	Incline	2
	Running*	2	Trunk lift*	2
	Bicycling*	1	Jumping jacks*	1
	Mile run*	1	Sit and reach*	1
	Swimming*	1		
No HRF Component	Push-ups	16	Running	11
	Curl-ups	7	Jogging	6
	Weight training	5	Walking	4
	Sit and reach	3	Basketball	2
	Crunches	1	Football	1
	Jumping jacks	1	Leg press	1
	Pull-ups	1	Stretching	1
	Tennis	1	Toe touches	1
	Trunk lifts	1		

*Incorrect activity for health-related fitness component.

Fifty-eight percent of the correct responses for activity provided more than one activity across the 9-week program; however, in many cases the frequency, intensity, and time were not specific or accurate for each activity provided. In other words, if a student gave swimming, biking, and walking as activities across the nine weeks, they would only provide one prescription for frequency, intensity, and time for all three activities. These prescriptions may or may not have been appropriate for all activities provided. Fifty-seven percent of correct responses for activity provided a test item (i.e., pacer, push-ups, sit and reach) as the activity.

Discussion

The dual purposes of this study were first, to identify instructional variables that may impact student knowledge and conceptions of health-related fitness, and second, to examine high school students' knowledge and conceptions of health-related fitness. The potential value of these purposes rests with the insight available for professionals seeking understanding of how to best influence student learning in a significant area of the physical education curriculum.

The generalizability of findings from this study related to instructional variables is impaired by a low response rate (41%) biasing the sample toward more effective teachers, and concerns with the fact that these are self-report data (teacher survey). Nonetheless, several interesting findings emerged from the teacher survey. On the other hand, the extensive database of student responses provided a rich source for analysis of student knowledge. Findings regarding instructional strategies will be discussed first, followed by student knowledge.

Instructional Variables

Results were reported on five instructional variables. These variables included time allocations for instruction, resources available to and used by teachers, teacher attitudes toward teaching health related fitness, and assessment strategies. The lack of a statistically significant relationship between time spent in personal fitness instruction and student performance seems counter-intuitive and contrary to some of the early work on student engaged time (cf. Rosenshine, 1979). The absent relationship is consistent with claims made by other researchers that observed time-on-task, and teacher reports of instructional time, are less significant than student thought processes (cf. Brophy & Evertson, 1976; Peterson & Swing, 1982; Peterson, Swing, Braverman, & Buss, 1982; Wittrock, 1986). Understanding why some students out-perform their peers may require more sophisticated study of what sense students make of the instruction they receive.

There is another factor that may have influenced the relationship between student achievement and instructional time, beyond student engagement. Teachers may have had difficulty accurately measuring time spent in personal fitness instruction. Since 55% of teachers reported they did not teach personal fitness as a separate unit, they may not have known how much time was actually devoted to personal fitness and, therefore, simply provided an estimate. Some teachers may also have included time working on being fit (movement activity) in their estimates of fitness instructional time (i.e., not limited to cognitive instruction alone).

No statistically significant relationship was identified between teacher resources and student achievement, or between instructional strategies and student performance on the written test. It is possible that neither of these instructional variables is related to student performance. More probably, the critical information was not gathered in this particular study—the process of how resources and strategies are actually used with students.

Most teachers reported a positive attitude toward teaching health related fitness concepts, in spite of the fact that many lacked an appropriate setting, did not have enough textbooks to allow students to do reading or assignments as homework, and did not have (or did not allocate) enough time to teaching personal fitness.

What remains unclear is why teachers report positive attitudes with these negative conditions and seemingly inconsistent behaviors. This discontinuity may simply be what Argyris and Schon (1974) have identified in the behaviors of many professionals. They note a common inconsistency between espoused theories (what professionals say they believe) and theories-in-use (what professionals actually do). These inconsistencies may be an artifact of false posturing where professionals describe what they believe others want to hear (sometimes described as an effort to be politically correct). Other possibilities are that these professionals may not be aware of, or are working toward resolving, inconsistencies between expressed attitudes and behaviors. For those interested in effecting change in teacher performance, understanding the reasons for these apparent inconsistencies is important.

The majority of teachers (54 of the 61 teachers surveyed) placed a great deal of grading emphasis on participation. From 20 to 40% of a student's grade could be earned by participation for 26 of the 54 teachers using participation to calculate student grades. As reported in Table 3, this means that participation was at least as important as student performance on tests for many teachers, and even more important than test performance for a few teachers. Put differently, simply showing up for class and appearing to try is nearly sufficient to pass the class for many teachers. The apparent paradox of these findings is that while teachers espouse the value of teaching health related fitness, they are not holding students accountable for demonstrating mastery of the content. Future research should consider the relationship between grading practices and student achievement in physical education.

The extent to which teachers are aware of the inconsistency between their content values and grading emphasis is an area worthy of further study. The literature on occupational and organizational socialization (cf. Lawson, 1988) may be a helpful place to begin a search for answers regarding these issues.

Student Knowledge

Students in South Carolina high schools sampled in the first cycle of statewide assessment scored higher on PI-2 (cognitive fitness) than they scored on the other three indicators. Fifty-seven percent were considered competent in their ability to design a personal fitness program on the basis of the test administered. While these scores are not particularly high, they do reflect a consistency with teacher espoused values of teaching health related fitness.

Analyses of this sample of high school students' knowledge and conceptions of health-related fitness supported existing research characterizing student knowledge regarding fitness. Problem areas consistent with recent literature (Placek et al., 2001) include a lack of foundational knowledge, misconceptions, and incorrect generalizations about fitness. Many examples of problems relating to foundational knowledge about fitness were identified. Over half of the students had trouble identifying health related fitness components and the majority of students had problems applying basic principles, such as FITT, to improve a health related fitness component in the case study.

Woolever and Scott (1988) described knowledge as a pyramid, with facts forming the base, then a layer of concepts that can be described as ideas developed from facts, with the top of the pyramid being a layer of generalizations. Generalizations are developed when concepts are brought together in a defining statement. To use this illustration in describing students' knowledge of fitness, the factual layer was often missing. For example, not knowing the health related fitness components was a poor foundation upon which to build concepts or ideas. Inaccurate facts, such as matching activities or fitness tests with the wrong health related fitness components ultimately led to generalizations that were inaccurate.

These errors need to be viewed in the context of a program evaluation effort rather than as individual student grades. Teachers have an obligation to assess individual students in the context of all sorts of extenuating circumstances. Accommodations can be made for individuals when determining how much any specific assignment contributes to a final course grade. Program evaluation involves less flexibility in interpreting results.

An explicit performance indicator for high school physical education programs in South Carolina involves the ability to design fitness programs. The only way to improve programs is to very clearly understand where students make errors and then to find ways to remediate. Once errors have been identified, the next challenge in the remediation process is understanding why errors were made.

Conclusions

This study was designed to examine instructional variables related to personal fitness instruction and to describe high school students' knowledge and conceptions of health related fitness concepts. Several conclusions appear warranted based on this study.

First, no statistically significant relationships were identified for any of the instructional variables studied. Time allocations, teacher resources, and teacher attitudes, as measured, showed no statistically significant relationship to student achievement. Time and resources varied substantively across teachers. The lack of a statistical relationship suggests that it is not how much time teachers spend or what resources they have so much as it is how they use what they have and what sense students make of the instruction. Clearly, more refined methods will be required to focus in on how teachers use the time and resources at their disposal.

Second, the instructional variables of instructional strategies and assessment strategies reflect variety across teachers and a continued emphasis on student effort over content mastery. These variables were studied to create baseline data rather than for statistical purposes, and will provide some structure for how others may wish to pursue more intensive study of how teachers use their time and make demands on students.

Third, student knowledge and conceptions of fitness concepts were found to be narrow, vague, and often incorrect. Most students (56%) could read charts to determine which scores are below, within, or above an appropriate health related fitness zone. In designing a program, frequency was correctly described by 62% of the sample and time was correctly described by 42% of the sample. Problem areas included the concept of specificity (selecting an appropriate activity to improve a fitness component), goal setting (a specific, realistic goal to improve a fitness component within a given time period), and the application of FITT principles (understanding relationships and interactions among principles), particularly the concept of intensity. The majority of students had problems applying basic principles to a case study (designing a personal fitness program to improve a health related fitness component). In spite of these problems, all students included in this database passed their physical education courses. None of these shortcomings in fitness knowledge was sufficient to warrant failure in the program.

The implicit message that trying hard is as important as (and sometimes more important than) content mastery is troubling. Is the content not worthy of holding students accountable for mastery? Are students incapable of learning this content? Are teachers unable to teach, or is there another defensible reason for not holding students accountable for learning in physical education?

In the final analysis, what matters in our field is what we are willing to hold our students and ourselves accountable for achieving. The data in this study suggest that we are willing to settle for less. In light of these findings, is it reasonable to expect more respect for physical education from anyone else?