

EXERCISE SCIENCE**Current Practices in the
Delivery of Undergraduate
Exercise Physiology Content**

Michele M. Fisher

Abstract

The purpose of this study was to identify current practices for the delivery of exercise physiology content at the undergraduate level. An anonymous 22-item survey was sent to instructors of exercise physiology to collect information concerning the structure of course offerings and instructional practices. One hundred ten instructors responded to the survey for a return rate of 34%. Most programs offer exercise physiology as a general section (90.0%) with a mixture of majors (athletic training, exercise science, physical education) in the same course. Content covered in the lecture portion of the course was more focused on applications relative to adult fitness and athletic performance rather than youth fitness. The majority of respondents felt that the needs of each student group were met at least fairly well, although somewhat higher percentages were noted for exercise science (90.3%) than for athletic training (83.7%) or physical education (80.0%). The most common strategies reported for addressing major-specific needs included development of assignments differentiated to each student group and use of multiple examples from the various disciplines during lecture. Attention to major-specific applications within the course and throughout the curriculum may help students make stronger connections between fitness theory and daily practice in their respective professions.

Michele M. Fisher is an associate professor, Department of Exercise Science and Physical Education, Montclair State University. Please send author correspondence to fisherm@mail.montclair.edu

An introductory course in exercise physiology is a fundamental component of undergraduate programs that prepares students for careers in physical education, exercise science, and athletic training. Exercise physiology may be defined as the study of how the body's structures and functions are changed as a result of acute and chronic bouts of exercise (Wilmore, Costill, & Kenney, 2008). In a review of the historical role of exercise physiology in kinesiology programs, Ivy (2007) categorized applications of exercise physiology content related to human performance, fitness, development/aging, and prevention/rehabilitation from disease. Students in physical education would likely benefit from a focus on development and fitness, but those in exercise science would be more concerned about human performance and fitness. An emphasis on fitness and disease-related concepts would be best suited for students in the rehabilitation sciences (Ivy, 2007). Although fitness is a common key application for each of these majors, the remaining applications have varying degrees of relevance depending on the area of study. Many institutions offer introductory exercise physiology as a general course with multiple majors in the same class (Van Donselaar & Leslie, 1990). This creates a significant challenge for the instructor in developing course materials that will meet the needs of each student group (National Association for Sport and Physical Education [NASPE], 2006).

Some have called into question the applicability of traditional exercise physiology for the preparation of students in physical education. Karper (1997) raises concerns over the practice of teaching a standard exercise physiology course based on an adult model to students who will ultimately be working with children and adolescents in a physical education setting. Citing developmental-based differences in metabolism, exercise programming, cardiorespiratory dynamics, thermoregulation, fitness assessment, and body composition, Karper argues for a greater emphasis on pediatric exercise physiology for prospective physical educators. The lack of attention to developmental aspects of exercise physiology is one area of concern in enabling students to bridge the gap between fitness theory and exercise programming in a physical education setting. Instructional issues concerning class composition (meeting the needs of multiple majors in the same class) and instructor characteristics (subdisciplinary specialists with little background in the pedagogical aspects of teaching physical education) may also

contribute to student difficulty in translating theoretical concepts to daily practice (Bulger, Mohr, Carson, Robert, & Wiegand, 2000).

In fact, both preservice and in-service physical educators exhibit relatively low levels of health-related physical fitness knowledge, one of the primary applications of exercise physiology. Barnett and Merriman (1994) reported an average score of 80% on a 27-item multiple-choice fitness test for preservice physical education seniors, yet questioned the extent students knew how to apply such knowledge in a practical setting. Miller and Housner (1998) extended this line of work to include preservice physical education majors and in-service physical education teachers. Both groups scored below 70% on a 40-item test, raising questions over the initial mastery and retention of fitness knowledge. It was recommended that exercise physiology courses for physical education majors be reevaluated for content validity and pedagogical relevance. In an intervention study, Bulger, Mohr, and Wiegand (2007) observed higher scores in health-related fitness knowledge in physical education students completing an alternative exercise physiology course applying theory to teaching situations compared to students completing a traditional exercise physiology course. Thus, greater attention to teaching applications may enable students in physical education to better bridge the gap between theory and practice.

Concerns over the transfer of exercise physiology theory to professional practice prompted Van Donselaar and Leslie (1990) to query exercise physiology specialists and teacher education specialists at 61 higher education institutions regarding their perceptions on the status of preparing physical education teachers in exercise physiology. Less than half of the faculty (in both groups) reported that teaching applications were covered in exercise physiology, although the majority of faculty (more so in teacher education) felt that inclusion of teaching applications would be beneficial. Additionally, faculty from both groups had concerns over the adequacy of student preparation to teach fitness. It was suggested that greater attention to teaching fitness applications could be integrated into existing exercise physiology courses and labs and/or additional fitness methods courses.

Numerous resources are available that provide recommendations for exercise physiology-related competencies for undergraduate students in physical education (Bulger & Housner, 2007; NASPE,

2006), exercise science (American College of Sports Medicine [ACSM], 2010), and athletic training (National Athletic Trainers' Association [NATA], 2011). Common topics of recommended proficiency for all three areas of study are (a) benefits of physical activity, (b) components of health-related physical fitness including assessment and exercise programming, (c) adaptations to chronic aerobic and resistance exercise, (d) consequences of obesity and strategies for weight management, and (e) role of nutrients on metabolism. Professional guidelines in all three areas of study call for students to understand the relationship between growth/development and exercise; however, the need to apply exercise science concepts to a pediatric population is much more pervasive in the competencies geared toward teacher education (NASPE, 2006). Additional topics such as training to maximize performance or recover from injury, exercise prescription for adults, thermoregulation, and ergogenic aids are of greater priority for students in exercise science and/or athletic training (ACSM, 2010; NATA, 2011). The vast scope of material in the exercise science discipline combined with diverse needs of different student groups presents a substantial challenge to instructors assigned to teach a general section of exercise physiology.

A survey on the status of exercise physiology instruction has not been conducted in the last 20 years. Furthermore, the majority of literature regarding exercise physiology content knowledge is geared toward the preparation of physical education majors. A more comprehensive examination of instructional practices in a general section of exercise physiology offered to multiple student groups is needed. Therefore, the purpose of the present study was to identify current practices for the delivery of exercise physiology content at the undergraduate level, with a focus on a setting in which a general section is offered to multiple majors. More specifically the objectives of the survey were to (a) identify common structures of course offerings, (b) examine content addressed in the lecture and lab portions of the course, (c) explore relationships between course content and faculty perception of student preparation, (d) evaluate instructor perceptions of the pros and cons of teaching a general section of exercise physiology to multiple majors, and (e) summarize strategies utilized to meet the needs of multiple major groups in a general section of exercise physiology.

Method

Participants

A search of college websites throughout the United States was conducted to construct a list of institutions that offer undergraduate majors in at least two of the following areas: athletic training, exercise science, and physical education. The goal was to identify institutions that have multiple majors who would take a course in exercise physiology. Three hundred thirty-seven institutions were included on the list. For each of the institutions, the faculty member assigned to teach the initial undergraduate course in exercise physiology was identified via an examination of the online schedule of course offerings. Email addresses of the respective faculty members were obtained from the institution website, although 13 of the addresses were ultimately returned as undeliverable. Of the 324 emails successfully transmitted, 110 participants responded to the survey for a return rate of 34%.

Instrument

The 22-item survey was created by the author specifically for this study to collect information on program demographics; structure of course offerings; course content; and, when applicable, experiences with teaching a general section of exercise physiology to multiple majors. Content validity of the instrument was established by initial review and feedback concerning question appropriateness and clarity from a panel of four expert faculty members, two in exercise science and two in teacher education. The format of items varied, with the majority of questions employing either a multiple-choice or a 4-point Likert scale response option. Also, a few open-ended questions asked participants to identify positive and negative aspects of teaching a general section of exercise physiology, as well as strategies used to meet the needs of students from multiple majors. For the most part, questions were constructed as distinct items for the simple reporting of instructional-related practices. No attempt was made to tie a series of items to any particular construct. Once finalized, the survey was entered into Survey Monkey, a website for administering electronic questionnaires.

Procedures and Analyses

The survey was administered electronically. An initial email with consent information and a link to the survey was sent to the list of faculty teaching exercise physiology. Assurances of confidentiality (names of participants and institutions were not collected) and the voluntary nature of the study were stated in the initial email. Consent to participate in the study was implied through the act of submitting the survey as approved by the University Institutional Review Board. Participants were encouraged to submit the survey within 10 days of receiving the initial email. A month later a follow-up email was sent to the entire list of faculty to provide another window for them to respond to the survey if they had not already done so. Analysis of data was performed descriptively through computation of means and standard deviations for selected demographic questions and a tally of frequencies and percentages on multiple-choice and scaled questions via the SPSS 17.0. A Pearson chi-square (4 x 4 contingency table) was computed to determine if faculty perceptions of student preparedness were dependent on the content covered relative to major-specific applications. The criterion for achieving statistical significance was set at $p < 0.05$. Responses to the three open-ended questions were examined qualitatively by grouping answers into categories based on common themes.

Results

Data for each item on the survey are presented in tabular form (Tables 1–3) as the potential number of responses (n), the number of affirmative responses (count), and percentage of affirmative responses based on complete data (valid %). The potential number of responses varied depending on whether the item addressed an overall concern in the teaching of exercise physiology ($n = 110$) or a subgroup (i.e., certain questions pertained only to institutions offering a general section of exercise physiology, $n = 99$). Valid percentage took into account missing responses. Thus the percentage was based on the number of affirmative responses compared to the number of faculty who answered the question rather than the potential number of responders. Out of the 2,090 potential responses (number of close-ended questions 19 x 110 participants), 37 were left unanswered (1.8%).

Institution Characteristics

One hundred ten faculty members (institutions) responded to the survey, representing 289 programs in athletic training, exercise science, and/or physical education. Seventy-four percent of the institutions had a program in athletic training, 96.4% a program in exercise science, and 91.8% a program in physical education. Sixty-four percent offered all three majors. The majority of programs (70.1%) were relatively small with less than 101 students in the major. An introductory level course in exercise physiology was required by all of the institutions with programs in athletic training or exercise science, but only by 91.7% with programs in physical education. On average, institutions offered 2.6 ± 2.2 sections of exercise physiology over the course of a year with a typical enrollment of 34.8 ± 17.6 students per section. The number of full-time faculty regularly assigned to teach exercise physiology was 1.4 ± 0.7 , most of whom had a graduate degree in exercise physiology. A more detailed depiction of institution characteristics is provided in Table 1.

Table 1

Descriptive Data for Characteristics of Participating Institutions

Characteristic	<i>n</i>	Count	Valid %
Majors offered (110 institutions represented)			
Athletic training	110	82	74.5
Exercise science	110	106	96.4
Physical education	110	101	91.8
Size of major (289 programs represented)			
Less than 101 students	289	202	70.1
101–250 students	289	62	21.5
251–400 students	289	18	6.3
More than 400 students	289	6	2.1

Table 1 (cont.)

Characteristic	<i>n</i>	Count	Valid %
Require a course in exercise physiology			
Athletic training programs	82	76	100.0
Exercise science programs	106	101	100.0
Physical education programs	101	88	91.7
Academic degrees of exercise physiology faculty (could check more than one if multiple faculty)			
Specialization in exercise physiology	110	99	90.8
Specialization in teacher education	110	7	6.4
Specialization in sports medicine	110	16	14.7

Structure of Course Offerings

Most institutions offered exercise physiology as a general section (90.0%) with a mixture of majors in the same course. The remaining institutions offered variations of major-specific sections: completely different sections (8.2%) or a common lecture with a lab-specific section (1.8%). Irrespective of whether the class was offered as a general or a major-specific section, a laboratory component was typically present (88.2%), either incorporated into a lecture-based course or offered for separate credit. The amount of input from other faculty groups (i.e., teacher education, athletic training) regarding the delivery of exercise physiology content in a general section varied widely with the majority of responses indicating either *some involvement* (42.9%) or *substantial involvement* (31.6%) from non-exercise physiology specialists. A summary of data for course structure is provided in Table 2.

Content of Course

Information concerning course content was collected using a 4-point Likert scale as displayed in Table 3. To simplify presentation of data, findings are discussed as percentages of *quite a bit* and *extensively* combined. Items regarding content covered in the lecture portion of the course were geared toward specific needs of different major groups. Topics related to exercise programming for

Table 2*Descriptive Data for Structure of Course Offerings*

Item	<i>n</i>	Count	Valid %
General vs. major-specific section			
Separate section for each major	110	11	10.0
General section with a blend of majors	110	99	90.0
Inclusion of a laboratory component			
No	110	13	11.8
Yes, incorporated into lecture-based course	110	56	50.9
Yes, for separate credit in addition to lecture	110	41	37.3
Degree of communication among faculty			
Little to no input from other faculty groups	99	14	14.3
Some input from other faculty groups	99	42	42.9
Substantial input from other faculty groups	99	31	31.6
Extensive input from other faculty groups	99	11	11.2

adults (80.9%) and athletes (83.3%) are addressed to a greater extent than for children (29.3%) and individuals recovering from an injury (42.6%). Questions concerning the laboratory component of exercise physiology were more general in nature. Laboratory activities were focused on assessment of resting parameters such as heart rate and blood pressure (86.6%), measurement of responses to acute exercise (93.9%), assessment of health-related fitness (82.3%), and, to a lesser extent, sport performance (62.5%). Instructors were also queried about their perceptions of how well a general section of exercise physiology meets the needs of various major groups. In this case, only respondents with a general course and program in the targeted area were included in the analysis. For example, the potential number of responses for meeting the needs of athletic training students was 75, as seven of the 82 athletic training programs offer a major-specific course. When the *fairly well* and *very well* responses were combined together, results showed a greater percentage of faculty believe that the needs of exercise students are met (90.3%) compared to those of athletic training (83.7%) and physical education (80.0%). These differences are more pronounced when looking at the column for

Table 3*Descriptive Data for Course Content*

Variable	<i>n</i>	Not at all C (V%)	Somewhat C (V%)	Quite a bit C (V%)	Extensively C (V%)
Content in lecture	110				
Applications for youth fitness		11 (10.1%)	66 (60.6%)	30 (27.5%)	2 (1.8%)
Applications for adult fitness		1 (0.9%)	20 (18.2%)	68 (61.8%)	21 (19.1%)
Applications for athletes		0 (0.0%)	18 (16.7%)	67 (62.0%)	23 (21.3%)
Clinical applications		10 (9.3%)	52 (48.1%)	37 (34.3%)	9 (8.3%)
Content in lab	97				
Resting measures of HR, BP		3 (3.1%)	10 (10.3%)	42 (43.3%)	42 (43.3%)
Measures during exercise		0 (0.0%)	6 (6.2%)	34 (35.1%)	57 (58.8%)
Assessment of fitness		1 (1.0%)	16 (16.7%)	52 (54.2%)	27 (28.1%)
Assessment of performance		3 (3.1%)	33 (34.4%)	43 (44.8%)	17 (17.7%)
Exercise program design		18 (18.8%)	41 (42.7%)	28 (29.2%)	9 (9.4%)
General section meets the needs					
Athletic training	75	0 (0.0%)	12 (16.2%)	32 (43.2%)	30 (40.5%)
Exercise science	95	0 (0.0%)	9 (9.7%)	17 (18.3%)	67 (72.0%)
Physical education	90	1 (1.2%)	16 (18.8%)	37 (43.5%)	31 (36.5%)

Note. C = count; V% = valid percentage.

very well (72.0% for exercise science vs. 40.5 % for athletic training and 36.5% for physical education).

A 4 x 4 chi square analysis was performed to examine the relationship between content covered in the lecture and perception of faculty relative to meeting student needs. In physical education programs a significant chi square, $\chi^2(9) = 20.78$, $p < 0.05$, was observed; institutions with no coverage of youth applications were more likely to have faculty who felt that needs of physical education students were not met. However, in this analysis 68% of cells had an expected frequency of less than 5, heightening the risk of a type I error. Collapsing the analysis to a 2 x 2 table with the Yates' correction for continuity solved the problem with no cells with an expected frequency less than 5, but changed the result to a nonsignificant score, $\chi^2(1) = 2.21$, $p = 0.137$. No significant relationships were detected for exercise science or athletic training programs between content covered and student needs.

Perceptions Regarding General Section

The final part of the survey addressed perceptions concerning the positive and negative aspects of teaching a general section of exercise physiology to multiple majors. Seventy participants out of 99 who teach a general section responded to these open-ended questions. Answers were analyzed qualitatively and grouped into categories as summarized in Table 4. In some cases, a single answer fell into more than one category and therefore was counted in each area. On the positive side, a general section promotes exposure to applications outside of a student's given major and enhances student interaction and discussions. A few specific responses related to this theme included "allows majors to appreciate unique contributions of each major to the larger study," "allows students to learn from each other...discussions are richer with a broader student base," and "shows connection between professions." Additionally, several instructors commented that a general course was economical and appropriate for presenting a common fundamental core of exercise physiology principles that is relevant to all majors. On the negative side, many of the participants acknowledged the difficulty in adequately addressing the major-specific areas. One respondent noted, "It is difficult to be all things to all people...physical education students have less appreciation of the clinical applications and exercise science students have less appreciation of the

Table 4*Summary of Comments From Open-Ended Items Concerning a General Section of Exercise Physiology*

Aspect	Category of response
Positive aspects of teaching a general section	<ul style="list-style-type: none">• Wide range of topic exposure / students see how exercise physiology applies to other areas ($n = 25$).• Everyone should learn the basics of exercise physiology ($n = 16$).• Leads to richer discussions of content ($n = 12$).• Enhances student interaction among majors ($n = 10$).
Negative aspects of teaching a general section	<ul style="list-style-type: none">• It is difficult to address major-specific issues in depth ($n = 24$).• Students have different levels of prerequisite knowledge ($n = 19$).• Some majors require more depth than others ($n = 12$).• Many students feel that exercise physiology is not relevant to their major ($n = 11$).• There are no negative aspects ($n = 8$).
Strategies employed to meet the needs of multiple majors	<ul style="list-style-type: none">• Incorporate a variety of activities/case studies/labs/assignments tailored to different majors ($n = 20$).• Teach the basics and provide examples to each area ($n = 18$).• Strategies are not necessary—basics are appropriate for all ($n = 13$).• Strike a happy medium for all groups ($n = 6$).• Use a variety of pedagogy and assessment styles ($n = 5$).

pedagogical applications,” and another instructor felt the externally driven competencies in athletic training and physical education made it difficult to provide sufficient rigor for students in exercise science. Time constraints were frequently mentioned as a factor limiting depth of specialization. Also the varying level of student prerequisite knowledge presents a challenge in devising common course materials, with several respondents alluding to inadequate background in the sciences among physical education students. Faculty members who teach a general section of exercise physiology were also asked to provide examples of strategies that they employ

to meet the needs of multiple major groups in their classroom. The top strategies involved assigning major-specific activities and assignments, as well as giving examples of the application of basic concepts in each area. Major-specific assignments included case studies, research papers, outside readings, discussion board questions, and lab exercises in which students are required to apply content to their area of interest. Additionally, one instructor explained that students were paired up with other students from their major every 2 weeks to discuss how information can be used in their chosen career path. Several respondents made a point of using a variety of examples from different disciplines when presenting exercise physiology content, with one stating, “Showing application is the highest form of learning and extremely important.” However, a number of instructors did not feel that special strategies were needed when teaching a general section.

Discussion

Concerns over the efficacy of a traditional course in exercise physiology in the preparation of prospective physical educators have been raised in the literature (Bulger, Mohr, Carson, Robert, & Wiegand, 2000; Bulger et al., 2007; Karper, 1997; Van Donselaar & Leslie, 1990). A general format offering, in which multiple majors share the same class, may add to the difficulty students exhibit in translating fitness theory to daily practice in the respective professions (i.e., exercise programming for athletes, adults, students K–12). The purpose of the present study was to document and examine actual practices in the instruction of exercise physiology relative to course structure, content, and strategies to meet student needs. It was confirmed that the general format is the predominant structure for offering exercise physiology in institutions with multiple majors. Course content was geared more to applications in adult fitness and athletic performance than to youth fitness or rehabilitation from injury. Despite the apparent disparity in time spent on major-specific issues, the majority of respondents ($\geq 80\%$) felt the needs of each student group were met at least *fairly well*.

Given the scope of the exercise physiology discipline and diverse needs of multiple majors, designing course experiences for a general section of exercise physiology is a daunting task. Van Donselaar and Leslie (1990) question whether the distinct needs of teacher education majors are adequately addressed in such an environment. In a survey of exercise physiology faculty and

teacher education faculty, 94% (groups combined) reported that exercise science and physical education students were currently required to take the same course, yet only 63% recommended this practice (Van Donselaar & Leslie, 1990). Twenty years later, the primary format for introductory courses in exercise physiology continues to be a general section with multiple majors. Although separate major-specific sections would allow for greater attention to respective applications, feasibly most institutions cannot do this. Seventy-one percent of the respondents from the current study indicated they did not have sufficient numbers of students and/or faculty to offer major-specific sections of exercise physiology. Of the 11 institutions offering major-specific sections, eight had larger programs with enrollments greater than 100 students in at least one major. On the other hand, 45.9% of instructors in the present study felt there was no need to offer major-specific sections, stating that both formats are equally effective in addressing student needs. There are positive aspects to having multiple majors in the same section. Many participants commented on the benefit of students seeing how exercise physiology applies to related disciplines, as well as enriched class discussions from diverse perspectives. Conversely, several respondents noted challenges in covering major-specific applications in depth, accommodating varying levels of prerequisite knowledge, and motivating students who may feel that exercise physiology is not relevant to their discipline.

Calls for a greater emphasis on developmental physiology for prospective physical educators are prevalent in the teacher education literature (Bulger et al., 2000; Karper, 1997; Miller & Housner, 1998). Furthermore, guidelines for undergraduate exercise physiology in physical education teacher education programs (NASPE, 2006) and a Delphi investigation of recommended exercise science competencies for physical education majors (Bulger & Housner, 2007) included the following topics related to pediatric exercise physiology: (a) benefits of physical activity for children and adolescents, (b) developmental changes in physiological function, (c) protocols for testing health-related components of fitness in youth, (d) guidelines for exercise programming in children and adolescents, (e) role of weight-bearing activity on optimization of bone density in youth, and (f) unique adaptations to various forms of chronic exercise in children and adolescents. In the current study, 29.3% of respondents indicated teacher education applications were covered either *quite a bit* or *extensively* and 10.1% did not address this area. When

institutions were eliminated that did not have a physical education program, these numbers improved only slightly (31% for *quite a bit* and *extensively* combined, 9% for *not at all*). These findings support concerns over inadequate attention to developmental physiology for physical education students. More than 20 years ago, Van Donselaar and Leslie (1990) reported that 21% of exercise physiology faculty members and 40% of teacher education faculty members indicated that teacher education applications were currently incorporated into exercise physiology at their institution, and a higher percentage of faculty in both groups (53% of exercise physiologists, 78% of teacher education specialists) recommended increased attention to teaching applications in exercise physiology. Significant progress has been made over the last two decades with 89.9% of instructors in the present study stating that applications to physical education were covered *somewhat*. To some extent, this may be attributed to the expansion of knowledge in the area of pediatric exercise physiology (Malina, Bouchard, & Bar-Or, 2004; Rowland, 2005) and to published position statements concerning exercise programming in youth (Faigenbaum et al., 2009; NASPE, 2004).

Little has been written concerning the efficacy of introductory courses in exercise physiology for the preparation of students in athletic training or exercise science, although a set of desired competencies has been established by respective organizations related to accreditation (ACSM, 2010; NATA, 2011). In the present study, a high percentage of respondents gave substantial coverage (*quite a bit* and *extensively* combined) to applications related to exercise programming for health fitness in adults (80.9%) and exercise training in athletes (83.3%), both of which are prominent in standards for exercise science (ACSM, 2010) and athletic training (NATA, 2011). However, clinical applications related to rehabilitation are not covered as much with a response rate of 42.6% (*quite a bit* and *extensively* combined) in the overall sample and 43.8% for institutions with an athletic training education program. However, clinical applications are likely addressed at other points in the athletic training education curriculum.

Most instructors in the current study felt that a general section of exercise physiology meets the needs of all student groups at least *fairly well*, although somewhat higher percentages were noted for students in exercise science compared to those in athletic training or physical education. The disparity in time spent on applications from the respective fields may contribute to this phenomenon.

For example, it was expected that the relatively little time spent on teaching applications might influence how faculty rate student preparedness in physical education. However, the evidence for such a relationship was inconclusive. One factor may be that an overwhelming majority of respondents were trained in exercise science and may not have been fully aware of physical education-related competencies. An assessment of student performance on major-specific competencies related to exercise physiology would likely be a better measure of the extent to which a general course in exercise physiology meets student needs.

A number of strategies have been proposed to help students bridge the gap between theory and practice in physical education including (a) emphasis on developmental physiology (Karper, 1997), (b) separate or team-taught labs (Dodds, 1987, as cited in Van Donselaar & Leslie, 1990), (c) addition of a capstone course to provide students the opportunity to integrate concepts from subdisciplinary courses (Robertson & Heyden, 1985), and (d) integration of fitness concepts as a thread throughout the curriculum (Bulger et al., 2001). Strategies concerning content directed to the unique needs of physical education majors (i.e., emphasis on developmental physiology) are appropriate for major-specific sections and labs of exercise physiology, but may be unrealistic for a general section with other majors. Although inclusion of developmental physiology and teaching applications is possible in a general section, time constraints limit the extent to which these concepts can be fully incorporated without sacrificing needs of other student groups. A large number of respondents ($n = 20$) in the current study wrote that they use a variety of activities/assignments tailored to different majors. Thus, students may be asked to apply exercise physiology concepts to their discipline in assignments, projects, case studies, and entries on a discussion board. An example of an assignment differentiated to student group is depicted in Table 5. Another strategy employed by instructors ($n = 18$) in the present study was to teach the basic concept and provide examples of application for the respective areas in the lecture. Although time consuming, this strategy might help students to better recognize how the material relates to their discipline. Instructors can use these examples within a course to translate theory into practice.

A more comprehensive approach to curricular planning is likely needed to enable students to fully integrate and apply subdisciplinary knowledge to their profession. In teacher education, Bain and

Table 5

Sample Assignment Differentiated According to Student Group

Students design a resistance exercise program for one of the following scenarios:

Athletic training:	Develop a preventative program to correct an imbalanced Quadriceps to hamstring ratio in an athlete.
Exercise science:	Develop a program to promote general muscular fitness for a sedentary middle-aged adult.
Physical education:	Develop a lesson plan for teaching a session on resistance training to an eighth grade class.

Poindexter (1981) suggested that pedagogical concepts be infused into subdisciplinary courses just as subdisciplinary knowledge is incorporated into pedagogical courses, accompanied by additional coursework to further integrate the two areas. Van Donselaar and Leslie (1990) proposed the addition of a “fitness methods” course beyond the traditional theory-based course in exercise physiology, and Bulger et al. (2001) made a case for fitness concepts to be infused systematically as a thread throughout the curriculum. This type of curricular work requires substantial communication and cooperation among faculty representing each student group. In the survey administered by Van Donselaar and Leslie (1990), only 38% of exercise physiology faculty and 26% of teacher education faculty acknowledged there was periodic communication between the two groups; however, approximately 95% in both groups recommended such interaction. In the current study, faculty indicated higher levels of communication with 85.7% saying other faculty groups provided input relative to the instruction of exercise physiology. However, whether the interaction among faculty groups goes beyond the course of exercise physiology to curricular planning is unknown.

The primary limitation of the current study was that the scope of the survey was restricted to practices in instruction for a single introductory course in exercise physiology. A few respondents ($n = 6$) noted that specific applications of exercise physiology were addressed in advanced courses, even though they were not asked this directly. Future research might examine how institutions infuse applications of exercise physiology content knowledge throughout the curriculum for each major group. Also, the response rate of 34%, combined with the relatively small size of programs represented,

may limit the extent to which findings of the present study can be generalized to larger programs. Finally, the perceptions of how well a general format meets the needs of different majors were based strictly on the impressions of course instructors. Opinions from the students themselves, as well as measures of student performance on major-specific competencies, would certainly complement this information and provide a more comprehensive understanding of the issue.

In conclusion, the majority of institutions with multiple majors in the health–fitness field offer exercise physiology as a general section. Although limitations exist relative to covering major-specific applications, the general format is likely to continue to be the dominant course structure for small- to medium-sized programs. Raising awareness of major-specific needs among exercise physiology instructors and providing students opportunities to apply general concepts to their respective profession within the class should enhance the efficacy of this course in preparing students to use exercise physiology content knowledge in practice. However, a general section of exercise physiology is likely not sufficient to fully enable students to apply fitness principles in their respective area. Faculty from all areas must communicate and work together to ensure that principles in exercise physiology are reinforced throughout the curriculum with multiple opportunities for students to integrate such information into their practice.

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