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FOURTH NORTH AMERICAN SURVEY OF UNDERGRADUATE BIOMECHANICS INSTRUCTION IN KINESIOLOGY/EXERCISE SCIENCE

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A web-based survey of introductory biomechanics instructors in Kinesiology/Exercise Science departments from North America was conducted to document current instructor and course characteristics. Responses from 165 faculty from the USA and Canada were compiled and compared to previous surveys. Survey respondents tended to have doctoral training in biomechanics and reported nominally larger percentages, relative to previous surveys, of courses entitled "biomechanics" and mechanical content. The respondents also reported greater diversity of course prerequisites, less emphasis on anatomy, and less familiarity with NASPE guidelines for the course than reported in previous surveys.

KEY WORDS: Curriculum, pedagogy, professor, standards, teaching.

INTRODUCTION: Kinesiology/Exercise Science (KES) students often have difficulty learning mechanical concepts in the introductory biomechanics course (Knudson, 2006). Since most students struggle in the introductory biomechanics course faculty have collaborated over the years to work to improve instruction through six major teaching conferences and the establishment of national guidelines and standards (Kinesiology Academy, 1980, 1992; NASPE, 2003). In addition, three North American surveys of biomechanics instruction in KES have been reported (Deutsch et al., 1978; Marett et al., 1984; Satern 1999).
It is unclear if the status of the introductory biomechanics course has changed given increased specialization and curricular changes in KES. KES has some of the fastest growing academic majors in the USA with a variety of career tracks from athletic training, fitness, physical education, pre-PT/medicine, to sport management. In biomechanics instruction, some scholars (Duncan and Lyons, 2008; Pandy et al., 2004; Roselli and Brophy, 2006; Washington et al., 1999) have reported adaptations of problem-based and active learning strategies that have been show to be more effective than traditional lecture in the physics education research literature (Hake, 1998; Henderson and Dancy, 2009; Redish and Steinberg 1999). The purpose of this study was to survey North American instructors of introductory biomechanics in KES to document current course characteristics and instructional techniques relative to previous surveys. This paper focuses only on the data related to instructor and course characteristics.

METHOD: A 60-question web based survey was developed by modifying selected questions from past surveys and developing new questions on instructional strategies and perceptions of the faculty. The survey was designed in accordance with the Declaration of Helsinki and approved the Marquette University Institutional Review Board for the protection of human subjects. Biomechanics instructors from KES departments were invited to participate through two emails to the NASPE Biomechanics Academy (n=279) and BIOMCH-L (n>6000) listservs. Survey data were collected and analyzed using Opinio software (ObjectPlanet, Inc., Oslo, Norway). Respondents who identified themselves as teaching in KES in North American were included in the study. Survey data were analyzed and descriptive data (percentages, mean ± SD) were calculated and qualitatively compared to previous survey results. A copy of the instrument can be obtained by an email inquiry (lukegarceau@gmail.com) to the author.

RESULTS AND DISCUSSION: Responses were received from 165 faculty from the United States (85%) and Canada (15%). The response rate was somewhere between 21 and 59%

given the population and the KES faculty reached by email is unknown. This response rate was consistent with previous surveys (25-37%) of biomechanics instructors. Instructors were 43 ± 10 years of age with 10.3 ± 9.5 years of teaching experience and 8.6 ± 8.6 years of experience teaching biomechanics. Eighty-seven percent had an earned doctorate, with the main areas of training as biomechanics (56%), KES (17%), and engineering (10%). The majority (82%) of the respondents were from public-supported universities. The names of the departments where these courses were offered were different (Physical Education 0%, HPER 12%, Kinesiology 36%, Exercise Science 17%, and Other 35%) than previous surveys (Physical Education 27-34%, HPER 23-26%, and Kinesiology 0-15%).

The introductory course is now primarily (83%) entitled in some form of "biomechanics," with only 7% of the courses still called "kinesiology." The course is a core requirement for 72% of all KES majors. These percentages were substantially different from the first survey where 79% of the courses were titled kinesiology and the course was a program requirement for 96% of all majors (Deutsch et al., 1978). Course characteristics that have remained fairly stable over the years were course credits (3 credits: 66% 4 credits 24%) and most (61%) courses having an associated laboratory experience. A laboratory is important because it is recommended by the NASPE guidelines (NASPE, 2003) and doubles student learning of biomechanical concepts (Knudson et al., 2009) compared to the traditional three credit lecture course.

The top course topics, prerequisites, and required textbooks for the current and most recent survey (Satern, 1999) are presented in Table 1. The data show a trend of increasing diversity of course prerequisites, but fairly consistent emphasis on mechanical concepts. There is also an apparent decrease in the emphasis on functional anatomy, both as a prerequisite and as important content in the course. It is unfortunate that the current study did not ask a question similar to a question new to the third national survey (Satern, 1999). Satern (1999) reported that 6% of respondents to her survey indicated that there were multiple versions of the introductory course at their university, 83% had two versions and 17% had three major-specific versions of introductory biomechanics. This could be an important issue to reexamine in future surveys.

One outcome of previous biomechanics teaching conferences was the development and revision of national guidelines and standards for the introductory course (Kinesiology Academy, 1980, 1992; NASPE, 2003). The second national survey (Marett et al., 1984) on instruction in biomechanics reported that 82% of the respondents were familiar with these standards, thought they were useful in supporting their programs, and developing similar standards for graduate education. Only 32% of the respondents to the current survey were familiar with the NASPE guidelines for undergraduate biomechanics instruction. It is unclear if there is a reduction in familiarity with the guidelines over time, or if the apparent change is an artifact of differences between the two surveys. It is possible that differences in doctoral training or the proportionally larger responses from Canadian faculty in the present study contributed to the lower familiarity with United State KES instructional guidelines in the current study.

The present study indicated that, for North American biomechanics faculty in KES inclined to respond to the survey, instruction in introductory biomechanics is characterized by: 1) a large majority of faculty with doctoral training, primarily in biomechanics, 2) decreased emphasis on anatomical concepts in favor of mechanical concepts compared to previous surveys, and 3) subtle shifts in prerequisites, course requirements, and content compared to previous surveys. Future research on introductory biomechanics instruction should directly assess different versions of the introductory biomechanics course, as well as the potential increasing diversity of prerequisites and instruction relative to different majors within KES.

The present study had differences from previous surveys and limitations that affect the interpretation of the data. There is potential bias from the electronic sampling procedure and faculty response to a rather long survey. Faculty with primarily research positions and without doctorates in biomechanics might be less inclined to respond to the survey. There were also some differences in how questions were worded between the current survey and previous surveys. Because the current survey was designed to respect respondent's rights to participate at the item level, there were variations in the numbers of responses to each

question. Taken together, these issues indicate that the results should not be generalized to all biomechanics courses in KES in North America. The current results represent a large subsample of instructors who likely value teaching, so there is a possibility that the differences noted between current results and previous surveys could also be due to sampling variation, so differences with previous surveys should be interpreted with caution.

Table 1
Major Topics and Prerequisites for Introductory Biomechanics Courses

Survey	1999*		Current	
Prerequisites				
	Anatomy	91%	Anatomy	79%
	Physiology	52%	Physiology	36%
	Mathematics	48%	Pre Calc	34%
	Physics	19%	Physics	32%
			Calculus	13%
Topics				
	Mechanics	44%	Kinematics	41%
	Anatomy	30%	Kinetics	28%
	Application	20%	Newton's Laws	22%
	Neuromuscular	8%	Movement Analysis	17%
			Tissue Mechanics	17%
			Muscle Mechanics	15%
			Application	13%
			Energy/Work/Power	12%
Textbooks				
	Hall	33%	McGinnis	28%
	Luttgens & Hamilton	17%	Hall	23%
	Kreigbaum & Bartels	17%	Hamill & Knutzen	18%
	Thompson	7%	Ozkaya et al.	4%
	Hamill & Knutzen	6%	Knudson	3%

*Data with permission from Satern (1999).

CONCLUSION: North American faculty in KES responding to the survey tended to have doctoral training in biomechanics and reported nominally larger percentages, relative to previous surveys, of courses entitled "biomechanics" and mechanical content. The respondents also reported greater diversity of course prerequisites, less emphasis on anatomy, and less familiarity with national guidelines for the course than reported in previous national surveys. These comparisons to previous surveys should be interpreted with caution given limitations from sampling, selective responses, and question wording differences between surveys.

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