

TEACHING SPORT BIOMECHANICS IN JAPAN

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Sport biomechanics programs conducted in the School of Health and Physical Education, University of Tsukuba, Japan are shown to share teaching experiences and discuss its outcomes, contents and managing of classes with our successful and failed examples. More importantly, we have to seek for effective ways to apply knowledge of sport biomechanics such as effective data feedback to teaching, coaching, training and rehabilitation, which would most attract students of physical education, health and sport sciences.

KEY WORDS: education, outcome, biomechanical principles, active learning

INTRODUCTION: In recent years, the number of colleges and departments relating to physical education, health and sport sciences has drastically increased in Japan. As a result, aims and curricula of education for the students have become more diversified. According to a survey on basic curricula for students majoring physical education, health and sport sciences (PEHSS) in Japan, which was conducted in 2011 by The Japan Alliance of Colleges/Departments of Physical Education, Health and Sport Sciences (JACPEHSS, 2011), sport biomechanics as a subject has been taught as one of major subjects for PEHSS students in all colleges and universities under the Alliance umbrella. There are two kinds of interpretations on this result; 1) sport biomechanics should be learned as one of their professional knowledge and 2) sport biomechanics must be assigned as a requirement because many of PEHSS students dislike the subject and tend to avoid taking the class if possible. Similar status can be seen in many colleges and universities in various countries.

Most of Japanese universities are quickly innovating the education programs and education systems to be more globalized and become more excellent in the world, and to be more professionalized and specialized to a certain area, depending on the policy of each university. The disposition, interests and motivation of PEHSS students have always been changing, as students in other disciplines. Under such a circumstance, there are many changes in curricula, programs, instruction methods in this two decades. In this session, describing sport biomechanics programs conducted in the School of Health and Physical Education, University of Tsukuba, Japan, in this two decades, I would like to share experiences and discuss what should be taught, how we should instruct diverse students and how we can attract talented students to sport biomechanics area.

OUTCOMES OF SPORT BIOMECHANICS PROGRAMS IN UNIVERSITY OF TSUKUBA, JAPAN: The Alliance established some reference standards and basic key words to be learned by PEHSS students. As listed in Table 1, undergraduate students who are not majoring sport biomechanics are required to understand basic concepts and knowledge of biomechanics for a qualitative analysis of human movement and sport techniques, while biomechanics majors learn and use some biomechanical research techniques for their bachelor thesis. For non-major graduate students of biomechanics learn advanced knowledge of sport biomechanics, biomechanical principles, knowledge for the evaluation and diagnosis of sport techniques while biomechanics majoring graduate students are required to learn these items and advanced research techniques, to present papers at conferences, and to publish their

research papers in case of PhD students.

Table 1: Outcomes of sport biomechanics programs at University of Tsukuba

	Introductory (non-major)	Advanced (major)
Undergraduate level	Basic knowledge of biomechanics for qualitative understanding and analysis of sport motions	Adding to the left, 1) Research methods: videography and force platform techniques 2) Bachelor thesis
Graduate level	1) Advanced knowledge of sport biomechanics: energetics, dynamics 2) Biomechanical principles of human movement 3) Evaluation and diagnosis ability of sport techniques 4) Biomechanical data feedback for practical use	Adding to the left. 1) Advanced research methods, 3D motion analysis, etc. 2) Computer programming 3) Presentation and publication 4) Theses for master degree and PhD degree

CONTENTS OF SPORT BIOMECHANICS IN UNIVERSITY OF TSUKUBA: As most of us feel and recognize, there are impediments to teach sport biomechanics for PEHSS students who have diversified interest, motivation, background and intention. According to the syllabus of introductory sport biomechanics for freshman students in 1996(Curriculum Committee,1996; Ae,1997), they learned biomechanical properties of human body, basic concepts of mechanics, and some biomechanical principles in order of basic to applied or practical contents. Although instructors spent more time with intention of familiarizing the students with mechanics and teaching from basic to applied contents. However, most of students would have felt serious difficulty in sport biomechanics which was revealed by the examination result that 25 % of registered students failed.

In retrospect, I and those who spent the student hood in the emerging period of biomechanics, ca. 1980 to 2000, may have learned practical aspects of biomechanics in PE and sport science with intention of improving performance and preventing injuries. We may have started with practical and clinical aspects rather than mechanics, computer programming and so on. Putting ourselves on student-centered position, we should change contents of introductory sport biomechanics for freshman and sophomore students to essentials of sport biomechanics from basic concepts of mechanics.

Due to the decrease in class hours for sport biomechanics in recent years, we have shifted contents for junior students from basic concepts to applied or practical biomechanics which included some key knowledge and biomechanical principles such as counter-movement, swing motion of body segments, control of radius of gyration, kinematic chain, transfer mechanical energy, efficiency of human movement and

biomechanics of various human movements (Curriculum Committee,2015).

It is expected that a future textbook of sport biomechanics be described in order of 1) biomechanical principles for optimization of human movements, prevention of sport injuries and teaching sport, 2) biomechanics of basic movements, and 3) biomechanical concepts and theories underlying human movements.

MANAGING SPORT BIOMECHANICS CLASSES: Although an active learning have been recommended as an effective approach in Japanese universities in this decade, many professors and instructors in universities are still seeking for better or best active learning techniques and ways, with MEXT of Japan setting a subsidy for good practices of active learning. There are several instruction and learning methods for sport biomechanics from a traditional lecture with materials, VTR and ppt slides to small group projects. We have conducted the following laboratory and project task (called "Ensyu" in Japanese) in the class of non-major students, ca.80 students.

Laboratory and project task with a short paper

- 1) Introductory brief lecture
- 2) Laboratory activity, i.e. videotaping of running, throwing and so on
- 3) Digitizing of video images in the Laboratory for Sport Biomechanics (Lasbim)
- 4) Computation of biomechanical data with Motion Analysis Programs programmed by Lasbim: smoothing, computation of velocity and joint angles
- 5) Manual plotting of data on a graph sheet
- 6) Submission of a short paper, called a report paper after discussion

From our experiences of managing classes, responses of the students are quite good and positive;" I have understood what sport biomechanics does", "I realize how useful the motion analysis is", and "If we had taken these kinds of lessons in the year of freshman students, we would have more interest in sport biomechanics." Despite some impediments and limitations, we should encourage to implement these active learning approaches so that we can explore students who will be potential fans and supporters and talented students who will be a researcher and frontier in our discipline. The following may be another example of active learning of a long span.

Sport technique optimization project

- 1) Videotaping of students' sport techniques
- 2) Optimization loop of sport techniques with the application of biomechanical knowledge and rules of thumb, and discussion with instructors and adviser:
Observation -> Evaluation -> Diagnosis -> Identification of technical faults and limiting factors -> Selecting and designing methods for improvement (-> Practice)

CONCLUDING REMARKS: A question will arise as to whether we have explored, discovered and established new concepts, principles and theories which are useful and contribute to the improvement in performance and prevention of injuries until now. In a glance at some sport biomechanics textbooks, we could be aware that small number of principles are described: counter-movement, stretch-shortening cycle, swing motion, kinematic and kinetic chains, transfer of mechanical energy and so on. Are these sufficient to contribute and bridge the gap between research and practice? More importantly, we have to seek for effective ways to apply knowledge of sport biomechanics such as effective data feedback to teaching, coaching, training and rehabilitation, which would most attract PEHSS students.

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