A Systematic Approach to Integrating an Audience Response System into an Undergraduate Physical Education Teacher Education Program

Sean Bulger and Emily Jones

Abstract

As technological advances continue to influence the methods by which we communicate, manage information, and entertain ourselves, educators must keep pace with these changes by integrating technology when it supports content delivery and enhances student learning. There is considerable potential for technology use across all content areas, but it appears that physical educators are lagging behind with respect to this professional expectation. Recent studies demonstrate that physical education teacher education (PETE) faculty are also not using technology to support or enhance their instructional practice. The purpose of this paper is to describe the integration of an audience response system into a PETE undergraduate and graduate program of study. The handheld clickers enable students to respond to instructor-posed questions during class. The student responses are recorded and can be displayed which facilitates the provision of corrective feedback, assessment of learning, analysis, and dissemination of results.

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Technology affects the methodologies by which teachers across disciplines and developmental levels communicate, collect and manage information, deliver instructional content, provide feedback to learners, and assess student achievement (Solomon & Schrum, 2007). As technology continues to advance over time, educators are challenged to integrate it into their teaching to enhance teacher efficacy and effectiveness, improve student comprehension, and achieve instructional or managerial tasks that cannot to be accomplished using alternative approaches (Castelli & Fiorentino, 2008). This integral relationship between technology use and teaching is perhaps best summarized in the International Society for Technology in Education (ISTE) Standards for Teachers (2013) which describe that across content areas, teachers need to develop the capacity to plan, manage, instruct, assess, and reflect on student learning using technology for the following purposes: (1) Facilitate and Inspire Student Learning and Creativity; (2) Design and Develop Digital Age Learning Experiences and Assessments; (3) Model Digital-Age Work and Learning; (4) Promote and Model Digital Citizenship and Responsibility; and (5) Engage in Professional Growth and Leadership.

Despite the significant potential for instructional technology to positively impact student learning across all educational settings and the related standards for teacher preparation programs, numerous concerns persist that physical educators are lagging behind with respect to this professional expectation and may not apply technological innovations to support or enhance their instructional effectiveness (Gibbone, Rukavina, & Silverman, 2010; Ince, Goodway, Ward, & Lee, 2006; Jones, Bulger, & Wyant, 2011). A number of personal and contextual factors are likely to have contributed to this problematic trend including pre-existent teacher attitudes toward technology, restricted

curricular space, related costs and financial constraints, limited experience using instructional technology, infrequent opportunities to observe effective modeling, and inadequate teacher preparation (Cheon, Song, Jones, & Nam, 2010; Cuban, 2011; Ertmer & Ottenbreit-Leftwich, 2010; Gibbone et al., 2010; Koc & Bakir, 2010; Park & Ertmer, 2007; Vannatta & Beyerbach, 2000; Wepner, Ziomek, & Tao, 2003).

In the interest of facilitating more effective technology use among teacher candidates in physical education teacher education (PETE), Jones et al. (2011) recommend that programs adopt systematic approaches to integrating technology that include establishing a conceptual framework to guide its use, exploring teacher candidate biographies and perceived barriers, using evidence-based approaches for technology integration, critically examining model programs that are effective, and focusing integration efforts on the most impactful technologies. Furthermore, PETE faculty should seek to create additional efficiencies by aligning instructional technology integration efforts with broader campus-wide initiatives that allow for collaboration and the sharing of resources including hardware, software, technical expertise, and instructional support.

Toward that important outcome, faculty members at a large, land-grant university secured a teaching innovation grant to support the systematic integration of an audience response or clicker system across an undergraduate PETE curriculum. The employed audience response system had been previously adopted university-wide to facilitate increased student engagement and interactivity in the classroom. The handheld devices enable learners to respond to instructor-presented questions in a digital format. Student responses are recorded and displayed in real-time which allows for immediate feedback and discussion, performance analysis and grading, and dissemination of results in report

form. While the general use of this instructional technology in higher education settings has been well documented, this paper extends the knowledge base by describing the process used to integrate an audience response system into PETE undergraduate and graduate programs of study as well as the resultant lessons learned.

Description of the Involved PETE Program

As recommended by Kay (2006), when discussing the use of any instructional technology in teacher education, it is helpful to incorporate a description of the related context. Within the involved PETE program, pre-majors (students not yet accepted into a program of study) are required to complete the university general education requirements and a series of foundational courses prior to program application and admission to teacher candidacy (see Figure 1). The probationary courses within the major include an introduction to physical education, anatomy, biomechanics, motor development, motor learning, and special populations. These courses address the various sub-disciplines of physical education teaching that are considered to represent foundational content knowledge within the field (Wiegand, Bulger, & Mohr, 2004). Following program admission, teacher candidates complete four semesters of sequentially arranged courses in health and physical education that are focused on providing the subject matter knowledge, pedagogical knowledge, pedagogical content knowledge, and technological pedagogical content knowledge required of an effective beginning teacher.

These semesters are organized around a developmental continuum that teacher candidates progress through following a lock-step format: Curriculum and Instruction Theory, Elementary School (ages 6-11), Middle School (ages 12-14), and Secondary School (ages 15-18). Each semester incorporates multiple practice teaching opportunities

in a variety of settings including school-, community-, and university-based physical education programs. During the final two semesters in the program, teacher candidates engage in their capstone experiences which focus on post-college transition, self-reflective practice, and conceptual integration. As the signature feature of the capstone experience, teacher candidates are required to complete two student teaching placements at the elementary, middle, and/or secondary levels. Each student teaching placement is eight weeks in length and successful completion is compulsory for program graduation and the granting of teaching licensure within the state.

Audience Response System Integration

Working within this context, PETE faculty members responded to an internal call for funding proposals related to support for the integration of technology into the curriculum. As previously described, there is significant potential for technology use in physical education but recent studies have demonstrated that teachers in schools and teacher education faculty may not be using it to effectively support or enhance their instructional practices (Jones et al., 2011). As technological advances continue to influence the methods by which we communicate, manage information, and entertain ourselves, teacher educators must keep pace with these changes by integrating various technologies when they enhance content delivery and contribute to student learning in a meaningful way. The purpose of the involved grant proposal was to systematically integrate a broader campus-wide clicker technology initiative into the PETE undergraduate and graduate programs of study. The handheld clickers are an instructional technology that enables students to respond to instructor-posed inquiries during class using a variety of question formats. Student responses are recorded and available for

immediate display which allows for discussion, feedback, assessment, grading, analysis of student performance, and reporting of results in real-time.

Rationale for Use of Clicker Technology

The reported advantages of clicker use in the classroom are well-documented including higher levels of student engagement in active learning, increased student participation and more effective classroom interaction, enhanced communication and feedback regarding student comprehension of course content, and provision of an alternative form of assessment to complement traditional grading (Caldwell, 2007; DeBourgh, 2007; Martyn, 2007; Micheletto, 2011; Morse, Ruggieri, & Whelan-Berry, 2010; Premuroso, Tong, & Beed, 2011). The most significant benefit of clicker use, may extend to its impact on teaching behavior within the classroom as faculty eliminate or reduce time allocated for lecture in favor of instructional approaches that place greater emphasis on peer instruction and interactive student engagement (Caldwell, 2007). Inherent in their design, clickers increase student engagement by enabling "all students to respond to all questions asked by the instructor" during a class session (Caldwell, 2007, p. 11). In other words, effective use of clickers in the classroom prevents students from a adopting a more passive role with respect to their in-class participation and the resultant learning that takes place.

Underlying Principles for Clicker Integration

Audience response systems have been shown to positively impact student motivation for learning and engagement in a range of instructional settings. College and university instructors in a variety of disciplines have effectively used clickers to promote increased student learning, active engagement, and motivation. The related knowledge

base is rich with recommendations for best practice related to clicker use and instructional planning, attendance, communication, peer learning, grading, technology management and reduction of student frustration, and effective question development (Caldwell, 2007). For the purposes of this specific project, three guiding principles were identified in the related literature and shared with faculty as the basis for a gradual, strategic, and systematic integration of the audience response system across the curriculum. It was determined that the clickers would be used in PETE courses to (a) Set-up Learning, (b) Develop Knowledge, and (c) Assess Learning (see Figure 2). An initial instructional benchmark was that all faculty members would incorporate a minimum of one related clicker episode per classroom session. The instructors were also provided with a framework for guiding their use of the clickers which incorporated the instructional sequence illustrated in Figure 3.

The grant proposal incorporated a series of meetings among the primary investigators and representatives from the office of instructional technology to share resources, develop guidelines for best practice with respect to clicker use, and organize the purchasing of the related technology. Results of those meetings were then communicated with PETE faculty members through professional development workshops developed to introduce everyone to the mechanics of technology use, brainstorm ideas for integrating clickers into various course formats, and initiate the instructional planning process in selected courses. Following these meetings, faculty members were tasked with developing a formal action plan for using the clicker technology in their own courses. Near the mid-point of each semester, instructors using clickers in their courses shared an overview of their clicker efforts and experiences at a regularly scheduled faculty meeting.

Strategic and Phased Clicker Integration

Within the existing lock-step format of the PETE curriculum, a phased approach to integrate the clickers across an entire program was adopted. An initial three-semester integration schedule included incremental use of the clickers in select cohort courses (see Figure 4). Starting with the two most recently admitted cohorts, students were introduced to the clickers in lecture-based classroom settings (16-week courses). Instructor feedback during the first semester of integration suggested there was a moderate, but not unmanageable, learning curve with the devices. As a result, some instructors described using the most basic functions of the device until they experienced regular success and a perceived level of familiarity with the clickers before progressing to using more advanced functions (e.g., self-paced polling). It should also be noted that at this stage of integration, the clickers were not utilized in the field experience portion of any course. Some students were familiar with the devices because of previous use in other university-level general education courses; if willing, students were encouraged to assist their peers in learning to use the clickers.

The second phase of the integration schedule involved the use of the clickers again in lecture-based classroom settings (1 and 3-week courses). Students in this phase were both undergraduate and graduate level who had no experience with audience response technology. Enrolled undergraduate students consisted of those in their third and fourth semesters of the PETE program (five semesters in total). Several instructors used the clickers in the previous semester which facilitated greater variety of use and enhanced familiarity with the clickers.

The third and final integration semester involved use of the clickers in all four

semesters prior to student teaching in the PETE curriculum. At this point, the newly admitted cohort of students were the only ones being introduced to the clickers for the first time, while the rest had been oriented either in the first or second integration semesters. Unique to this semester was the use of the clickers in field-based settings (10-week courses) and the number of new instructors using the clickers to deliver, reinforce, and assess knowledge of content. Because of this, several brainstorming sessions were held to discuss meaningful integration and effective management strategies (e.g., use of multimedia to prompt responses, use of authentic or situation based questions, delegation of persons responsible for clicker distribution and collection, etc.) of the clickers in this new setting. Admittedly, use of the clickers in the field-based settings remains a work-in-progress and further development of these strategies is needed.

The strategic and phased approach used to integrate clickers across a PETE program was dependent on student and instructor willingness to engage, explore, and experiment with a device that when used effectively, can enhance the teaching and learning environment. Using the first integration semester as a pilot allowed instructors and students to adjust and adapt to challenges as they arose and helped to inform subsequent integration semesters. Furthermore, and possibly more importantly, the phased approach allowed instructors to become familiar and confident with the device. Anecdotally, this produced a positive outlook on the technology and provided instructors time to gradually explore functions and features of the device and how they effectively integrate to enhance their pedagogy.

Sample Course Application of Clickers

This section provides an overview of clicker use within one of the required

courses in the PETE undergraduate curriculum. The course is completed during the second semester after program admission and introduces teacher candidates to the foundations and components of health-related fitness, appropriate curriculum for K-12 programming, effective teaching principles, and assessment of health-related fitness. The class meets one day per week for a 3-hour time block and is delivered in a blended format (combination of online and face-to-face interaction). Cooperative learning is used as the primary instructional model and the students work in teams on problems and projects within a teaching-learning environment that promotes positive interdependence and individual accountability. Toward that end, teams are formed after the initial class meeting and maintained across the entire semester. In addition to the individual accountability system (course grading), students have the opportunity to earn bonus points toward their final course grade based on study team performance during in-class activities.

Prior to and during a typical lesson, the following instructional system is adhered to: (a) Pre-class preparation involving access to online study guide materials and assigned readings; (b) Entrance requirement during which study teams meet at the start of class to review readings and any content requiring further clarification; (c) Teacher question and answer session focused on difficult areas from the assigned readings; (d) Quiz based on the assigned readings; (e) Brief study break following quiz completion; (f) Lecture and discussion session that is intended to extend the content learned in the weekly readings; and (g) Lecture response during which the study teams work in small group format to complete brief case studies highlighting key concepts. The 3-hour time block proved to be particularly conducive to clicker use and allowed for multiple applications of the

technology each week.

Course orientation. The clickers were used during the initial class meeting to poll students with respect to selected demographic questions and provide a basis for study team selection and course pre/posttest administration. These steps were observed to be of critical importance in that the students should be introduced to the protocol for using the clickers at a very early point of the semester with continual reinforcement.

Set-up learning. The clickers were used at the start of each class (Entrance Requirement) to provide an advance organizer for the lesson. This clicker episode was instructor-paced and consisted of several multiple-choice questions derived from the readings to provide a preliminary check-for-understanding prior to completion of the weekly quiz. The instructional sequence previously described in Figure 3 was followed: Question, Discuss, Respond, and Lecture. The automated response system allows for various grading configurations and students earned 1-point for responding to each question and 1-point for each correct response. The points earned did not contribute to the individual course grade but factored into study team point totals.

Assessing Learning. The clickers were also employed at the mid-point of each class period (Reading Quiz) to assess learning with reference to the assigned readings. This clicker episode was self-paced (roughly 20-minutes) and consisted of student responses to 25 multiple choice questions derived from the readings. The students were provided with a hard-copy of the question sheet and recorded their responses using the clickers. One point was earned for each correct response which contributed to individual grades through synchronization with the employed web-based course management system. Additionally, the grading feature within the automated response system enabled

the course instructor to view student quiz performance in real time and tailor the subsequent lecture to those areas where difficulties were observed.

Developing Knowledge. The clickers were also used toward the latter part of each class session (Lecture and Discussion) to emphasize key points and stimulate increased peer-to-peer interaction during lecture. This clicker episode was instructor-paced and consisted of 2-3 multiple-choice questions integrated into lecture PowerPoint slides. These questions were used intermittently throughout the lecture to engage students in periodic checks-for-understanding, prompt peer discussion, and clarify difficult content through the provision of instructor feedback. In the interest of establishing a consistent routine for clicker use, the instructional sequence described in Figure 3 was applied. The points earned did not contribute to the individual course grade but was factored into team point total. An alternative interactive instructional technology, Immediate Feedback Assessment Technique (IFAT), was employed to formally assess comprehension of the lecture content during the lecture response component of the class. The IFAT involves the use of scratch-off forms (think instant lottery games) which also allow for immediate affirmation and/or corrective feedback as students work individually or in small groups to complete brief application tasks or case studies prior to exiting class.

Key Lessons Learned

Faculty members met periodically to discuss the audience response system integration, debrief on the process, and discuss progress. These reflective discussions are summarized in the following subsections: Successes, Pitfalls, and Words of Advice.

Successes

As illustrated in Figure 4, the clicker technology was integrated across three

semesters with an initial focus on earlier courses within the program of study. This incremental approach was decided upon so that the integration process remained manageable and faculty experienced some early success incorporating the technology within their instruction. It also allowed for a relatively small group of motivated faculty to pilot the initial integration efforts in advance of its broader application. One concern related to the use of any instructional technology, remains its management and the preparation of students to use it effectively and efficiently. In this specific situation the faculty members, all of whom had limited previous experience using the clickers, agreed upon a standard protocol for managing, introducing, and teaching with the audience response system. For example, common verbiage with respect to the clickers was developed for use in all course syllabi and there was a consistent protocol for distributing and collecting clickers across semesters. While faculty were provided with basic principles (see Figure 2) and recommended instructional sequences (see Figure 3), they were also encouraged to make modifications based on their unique classroom environments. Several faculty members, for example, adopted the additional step of re-polling after an initial individual clicker response and class discussion period with considerable success.

Pitfalls

As with any new technology, the involved instructors did experience several difficulties during their initial attempts at adopting the audience response system. Fortunately, the clickers purchased were very intuitive in their use and faculty experienced limited technical problems. The few problems that did occur were attributed to user error. The more substantial challenges experienced related to the development of

effective questions or prompts. In other words, the multiple choice, true/false, numeric, short answer, and/or polling question formats need to be written in a manner that challenges students to think critically. Instructors readily observed that questions which fell short of this requirement and were more factual in nature did very little to stimulate discussion and reduced the instructional process to an exercise in button-pushing. Other potential pitfalls stemmed from the infrequent use of the clickers which negatively impacted both faculty and student buy-in in some instances and an over-reliance on the use of question responses for grading purposes which prompted students to be less interested in the discussion due to their focus on simply providing the correct answer.

Words of Advice

Perhaps the most significant take-home messages from this project relate directly to the influence of clicker use on teacher behavior. As summarized by Bulger, Mohr, and Walls (2002), "formal lecture represents an archaic model defined by instructor as deliverer and student as receiver. This model exemplifies one-way communication and perpetuates an incomplete model of education. Accordingly, teachers must create a dynamic educational environment that affords students the opportunity to practice every concept that they are learning" (Ace 3: Engagement section, ¶ 1). While most teacher educators are well versed in this basic premise, when confronted with the competing responsibilities of teaching, advising, research, grant writing, and service it is sometimes easy for university faculty to loose site of this fundamental principle and resort to lecture-based approaches based on time constraints, convenience, and comfort level. Use of an audience response system necessitates that instructors re-think their approach to teaching by focusing less on content delivery and more on meaningful student engagement. The

clickers were found to be most effective when faculty provided an interactive episode every 15 minutes or so during a lesson. This increased focus on student engagement, is also reflected in the need for the involved faculty to think critically about question development in order to move past simple recall of facts or figures to higher order levels of questioning regarding conceptual understanding, application, critical thinking, self-monitoring and reflection, and/or experiments.

Future Direction

Based on the successes experienced during the piloting of the audience response system or clickers, faculty members have proposed a number of alternative possible uses. For example, one group of researchers within the college employed the clickers to collect and share in real-time community member perspectives during a series of "town hall" meetings at the onset of a participatory action research project. From an instructional standpoint, the use of the audience response system in field-based courses and practicum experiences has yet to be investigated although several faculty members have speculated as to its potential application in those settings for the purpose of collecting student learning data and/or enhancing post-lesson reflection and discussion. From a program administration standpoint, an immediate priority relates to the construction of a bank of pilot-tested clicker question formats that are accessible and have been found to work in the classroom setting.

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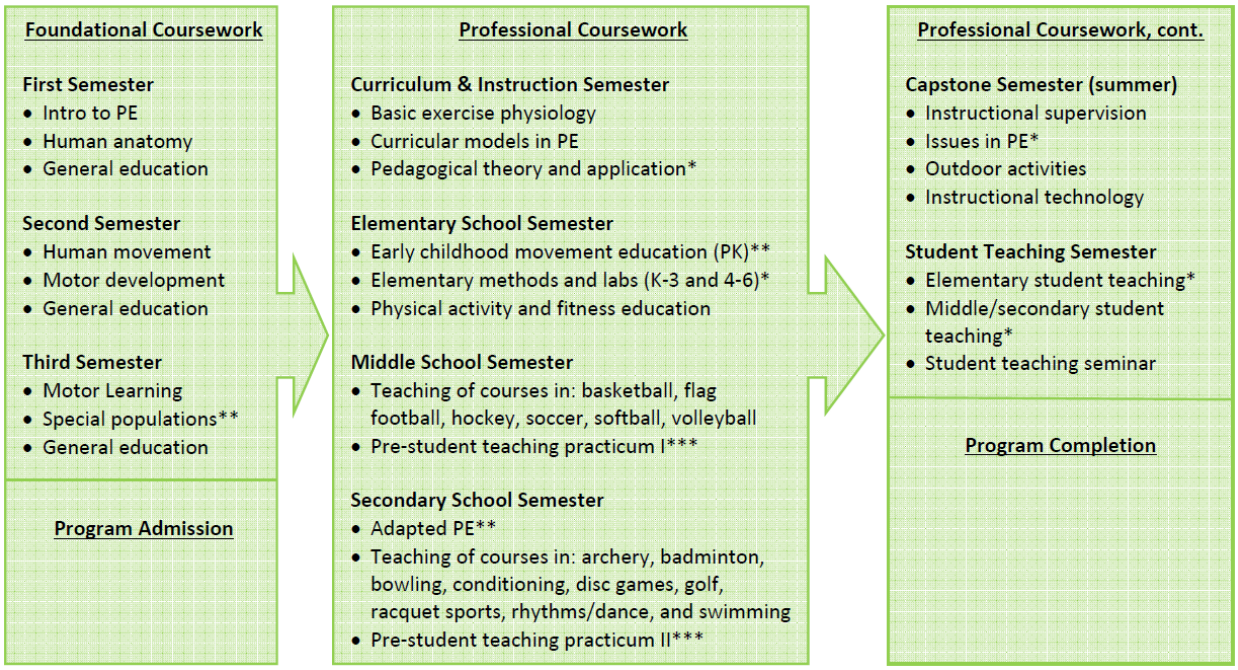

Figure 1. **Physical education teacher education curriculum including practicum teaching opportunities in school (*), community (**), and university-based (***) settings.**

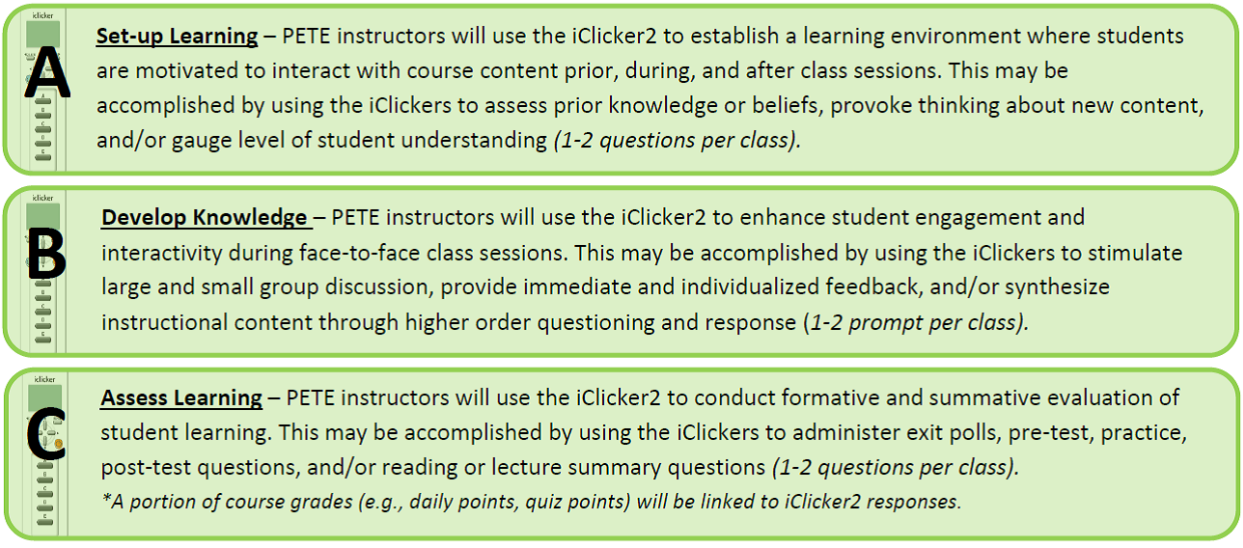

Figure 2. **Principle uses of audience response systems within courses.**

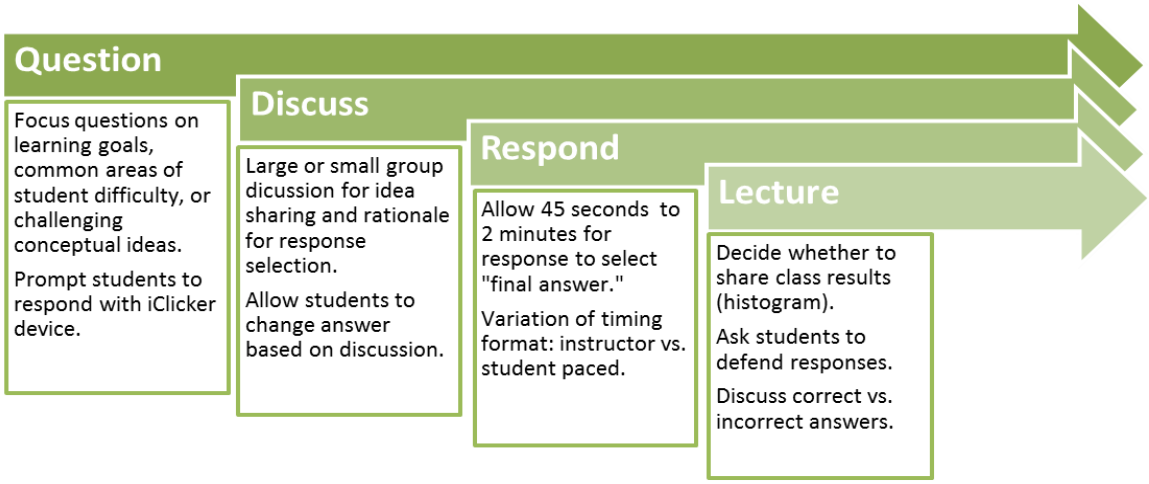

Figure 3. **Recommended instructional sequence for in-class audience response system application.**

Spring 2013			
	Course	**Course Format**	**Instructor / Frequency**
Curriculum & Instruction Block	**PET 233** Pedagogy Theory & Application	Lecture & Field Experience	Instructor / AA
	PET 228 Curriculum	Lecture	Instructor / AB
Elementary School Block	**PET 349** Elementary Fitness Education	Lecture	Instructor / AC
	PET 350 Teaching Primary PE	Lecture & Field Experience	Instructor / AD
	PET 369 Teaching Lower Elementary PE	Lecture & Field Experience	Instructor / AE
	PET 379 Teaching Upper Elementary PE	Lecture & Field Experience	Instructor / AD
Summer 2013			
	Course	**Course Format**	**Instructor / Frequency**
Capstone Semester	**PET 452** Outdoor Leisure Pursuits	Lecture & Field Based	Instructor
	PET 483 Professional Issues in PE	Lecture	Instructor
	PET 485 Supervision in PE	Lecture	Instructor
	PET 441 Instructional Technology in PE	Lecture	Instructor
PETE Masters Courses	**PET 673** Instructional Technology in PE	Lecture	Instructor
	PET 605 Professional Issues in PE	Lecture	Instructor
	PET 686 Final Teaching Practicum	Lecture	Instructor
Fall 2013			
	Course	**Course Format**	**Instructor / Frequency**
Curriculum & Instruction Block	**PET 233** Pedagogy Theory & Application	Lecture & Field Experience	Instructor / AA
	PET 228 Curriculum	Lecture	Instructor / AB
Elementary School Block	**PET 349** Elementary Fitness Education	Lecture	Instructor / AC
	PET 350 Teaching Primary PE	Lecture & Field Experience	Instructor / AD
	PET 369 Teaching Lower Elementary PE	Lecture & Field Experience	Instructor / BA
	PET 379 Teaching Upper Elementary PE	Lecture & Field Experience	Instructor / BA
Middle School Block	**PET 339** Volleyball	Field Based & Field Experience	Instructor / BB
	PET 340 Soccer	Field Based & Field Experience	Instructor / BC
	PET 341 Basketball	Field Based & Field Experience	Instructor / BD
	PET 342 Flag Football	Field Based & Field Experience	Instructor / CA
	PET 344 Hockey	Field Based & Field Experience	Instructor / CA
	PET 358 Softball	Field Based & Field Experience	Instructor / CB
Secondary School Block	**PET 354** Archery/Bowling	Field Based & Field Experience	Instructor / CC
	PET 448 Golf	Field Based & Field Experience	Instructor / BC
	PET 451 Secondary Fitness Lab	Field Based & Field Experience	Instructor / BA
	PET 452 Outdoor Leisure Pursuits	Field Based & Field Experience	Instructor / CD
	PET 453 Dance	Field Based & Field Experience	Instructor / BA
	PET 460 Tennis/Badminton/Pickle ball	Field Based & Field Experience	Instructor / DA
	PET 477 Adapted Lab	Lecture	Instructor / DB

Figure 4. **Schedule for audience response system integration across multiple semesters.**