RESEARCH

Concurrent Use of an Audience Response System at a Multi-Campus College of Pharmacy

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Objective. To assess the impact of an audience response system (ARS) on student engagement at a multi-campus college of pharmacy.

Methods. An online questionnaire was designed and administered to measure the impact of an ARS on student engagement, distance education, projected use, and satisfaction among pharmacy students for a course delivered across 3 sites via synchronous video transmission.

Results. Students reported that use of the ARS made it easier to participate (85.3%) and helped them to focus (75.7%) in classes when the lecturer was physically at a different site. They also valued that the ARS allowed them to respond anonymously (93.2%). A minority of students indicated that use of the ARS was distracting (11.8%).

Conclusions. Implementation of an ARS was associated with positive student perceptions of engagement and may improve feelings of connectedness among students at schools with multiple sites. Use of ARSs could also represent a cognitive intercession strategy to help reduce communication apprehension.

Keywords: audience response system, clicker, distance education, student engagement

INTRODUCTION

Long, rambling lectures plague the modern classroom, leading Maclaughlin and Mandin to popularize the tongue-in-cheek term “lecturalgia” (painful lecture) to describe the resulting ailment suffered by students.¹ Methods and tools to reduce lecturalgia, promote active learning, and improve student engagement increasingly are sought as education of healthcare professionals evolves from the predominant curriculum delivery mode of lecturing. Student engagement has been transformed from a buzzword into a movement, buoyed by initiatives like the National Survey of Student Engagement (NSSE) and co-opted by institutions looking to satisfy Quality Enhancement Plan requirements.^{2,3} One method suggested to elevate student engagement is the use of audience response systems (ARSs).^{1,4,5}

ARSs have been used in medical education since the 1970s, but have become more popular in the last 5 to 10 years.^{6,7} Since their inception, ARSs have been adopted as an interactive tool in a variety of health professions courses

and disciplines including pharmacy, medicine, dentistry, and nursing.^{4,8-15} An ARS allows a professor to pose a question to the class, typically in the multiple-choice format seen on many board examinations, and then the students respond by pressing the button on their response cards or “clickers” that corresponds to what they believe is the correct answer. At the end of a specified amount of time or at the instructor’s discretion, the professor uses ARS software to display the frequency of responses for the class’ aggregated answers to a given question. The correct answer then can be displayed onscreen or the professor can lead a discussion on why each of the incorrect answers is unsuitable and then reveal the correct answer. There are many variations of this process, such as asking ARS questions intended to stimulate dialogue rather than simple assessment of a factual item¹⁶⁻¹⁸ and using techniques such as think-pair-share.¹⁹ Until recently, ARSs suffered from a technological limitation that precluded clickers from being used concurrently at universities with multiple geographically distinct sites while still allowing for real-time data aggregation. Other models for the use of ARS at more than one site were available, such as integrating smartphones and computers, but suffered from the same problems as any system when additional variables are beta tested. Previously, this limitation prevented the adoption of an ARS at Nova Southeastern University College of Pharmacy.

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The anonymity that an ARS confers may be of particular relevance in pharmacy education as testing a sample of over 10,000 pharmacy students revealed that at least 1 in 5 scored high for *communication apprehension*.²⁰ Communication apprehension is defined as “an anxiety syndrome associated with either real or anticipated communication with another person or persons.”²¹ Communication apprehension can be exacerbated in active-learning situations when a student is asked or expected to participate.²² Cognitive intercession strategies such as systematic desensitization techniques may reduce communication apprehension.²²⁻²⁴ The use of ARSs may be a way of implementing interactive learning strategies in the classroom while minimizing communication apprehension.

This study assessed the effect of concurrent implementation of ARS at 3 campuses on student perceptions of *engagement*. For the purposes of this article, the term engagement refers to the cognitive and behavior aspects of the word including student participation, connection, interaction, and focus in the classroom. This definition is more in line with the cognitive and behavioral aspects of engagement, rather than as a checklist item or simple metric.

METHODS

Selection and Use of an Audience Response System

Nova Southeastern University College of Pharmacy has campuses at Fort Lauderdale, FL, West Palm Beach, FL, and Ponce, Puerto Rico. Classes for these 3 sites are broadcast via synchronous, interactive video, which allows students to pose questions during class regardless of the site from which the lecture originates. As a means to increase student engagement, promote active learning, and address communication apprehension, especially in those students at distant sites, an ARS was adopted for use in the Drug Information Resources course that was taught in the second semester of the first pharmacy year (P1). The college selected the TurningPoint (Turning Technologies, LLC, Youngstown, Ohio) ARS for implementation, primarily because of the vLink feature which allowed aggregation of data from multiple sites via clickers and USB receivers. vLink also allows smartphones and desktop and laptop computers to be used to respond, but those options were not used in this implementation. Students who were enrolled in the course had to purchase an audience response device (ie, a clicker). The ARS was used in the course for pretesting and posttesting, to stimulate discussion, and to promote self-reflective learning.

A 21-item survey instrument was developed with items designed to evaluate the impact of using the ARS on students' perceptions of engagement and distance education, attitude toward/feelings about use of ARS in other courses, and their satisfaction. A 5-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree,

5 = strongly agree) was used to measure general course satisfaction (3 statements), clicker-specific satisfaction (10 statements), impact on distance education (4 statements), and projected use in other courses (4 statements). After the last course lecture that used the ARS was delivered, the survey instrument was distributed via WebCT (Blackboard, Inc., Washington, DC) to the 208 P1 students enrolled in the course (Fort Lauderdale, n = 122; West Palm Beach, n = 51; and Ponce, Puerto Rico, n = 35). Institutional Review Board (IRB) approval was secured for this study.

Raw data from the survey function were downloaded as a text file. SPSS, version 16, (SPSS, Chicago, IL) was used to analyze the data. Descriptive statistics were used to describe the data. A one-way analysis of variance (ANOVA) was used to examine and test significant differences between demographic characteristics and the perception items. Following ANOVA, post-hoc Duncan tests were performed. In each case, an α value of 0.05 was established *a priori* to test significance. The internal consistency of each multi-item measure was analyzed by calculation of Cronbach statistic.

RESULTS

One hundred seventy-seven survey instruments were received for a response rate of 85.0%. Approximately 64% of responding students were female. The 4 largest respondent subgroups were Hispanic (36.5%), white (27.0%), Asian (21.3%), and black (5.7%) students. Students' average age was 24 years (median, 22 years) with 72.4% between the ages of 19 and 24 years and 27.6% $\geq$ 25 years of age. The majority of respondents were located in Fort Lauderdale (58.6%), followed by West Palm Beach (23.6%) and Puerto Rico (17.8%), which paralleled the distribution across all sites for both responders and non-responders.

Cronbach alpha values of the survey items were 0.60 (general satisfaction measure, 3 items), 0.84 (current assessment, 10 items), 0.66 (impact on distance education, 4 items), and 0.88 (projections, 4 items), which suggest good validity and consistency of the instrument.

Engagement and Satisfaction

The majority of students (81.3%) strongly agreed or agreed that the ARS system made the class better (Table 1). Students' also agreed or strongly agreed that ARS encouraged participation in class (89.8%), allowed them to respond anonymously (93.2%), and made some topics clearer (71.1%). A small number of students had negative impressions of the ARS: 11.8% found the ARS distracting, 19.2% felt that the ARS slowed down the class, and 11.3% felt that the professor depended too much on the ARS.

Responses to 2 statements were significantly different based on age. Older respondents ($\geq$ 25 years) were

Table 1. Pharmacy Student Responses Regarding Engagement and Satisfaction After Completing a Drug Information Resources Course in Which an Audience Response System Was Used, N = 177^a

Survey Item	Strongly Disagree, No. (%)	Disagree, No. (%)	Undecided, No. (%)	Agree, No. (%)	Strongly Agree, No. (%)	Mean (SD) ^a
The use of response cards in this course encouraged me to participate in class	0	9 (5.1)	9 (5.1)	63 (35.6)	96 (54.2)	4.4 (0.8)
The use of response cards in this course encouraged others to participate in class	0	3 (1.7)	13 (7.3)	73 (41.2)	88 (49.7)	4.4 (0.7)
The use of response cards in this course was distracting	41 (23.2)	95 (53.7)	20 (11.3)	16 (9.0)	5 (2.8)	2.2 (1.0)
Because of the response cards, I participated more in this class than I normally do	2 (1.1)	17 (9.6)	8 (4.5)	72 (40.7)	78 (44.1)	4.2 (1.0)
I valued that the response cards allowed people to respond anonymously	1 (0.6)	5 (2.8)	6 (3.4)	79 (44.6)	86 (48.6)	4.4 (0.7)
The use of response cards slowed down the class too much	27 (15.3)	80 (45.2)	36 (20.3)	24 (13.6)	10 (5.6)	2.5 (1.1)
The professor depended too much on the use of response cards	42 (23.7)	96 (54.2)	18 (10.2)	17 (9.6)	3 (1.7)	2.1 (0.9)
The use of response cards helped make some topics clearer	3 (1.7)	20 (11.3)	28 (15.8)	86 (48.6)	40 (22.6)	3.8 (1.0)
I would rather use a response card to participate in class discussions than use the microphone	0	13 (7.3)	11 (6.2)	58 (32.8)	95 (53.7)	4.3 (0.9)
Overall, I think having the response cards made the class better	0	8 (4.5)	25 (14.1)	79 (44.6)	65 (36.7)	4.1 (0.8)
Attending class was worthwhile	2 (1.1)	1 (0.6)	6 (3.4)	78 (44.1)	90 (50.8)	4.4 (0.7)
I prefer courses with class discussion	9 (5.1)	21 (11.9)	35 (19.8)	68 (38.4)	44 (24.9)	3.7 (1.1)
I prefer courses where the professor just teaches without class discussion	21 (11.9)	93 (52.5)	31 (17.5)	22 (12.4)	10 (5.6)	2.5 (1.0)

^a Not all students responded to all items.

more likely than younger respondents to disagree/strongly disagree that “the use of response cards in this course was distracting” and “the use of response cards slowed down the class too much” ($p < 0.05$). White students were least likely to find use of the ARS distracting ($p < 0.05$). Students at the Fort Lauderdale campus were least likely to agree that they participated more in class than they would have without the ARS and that having the ARS made the class better ($p < 0.05$ for both items), whereas students in West Palm Beach preferred using the ARS rather than a microphone to participate in class discussions ($p < 0.01$). Almost all lectures originated from the West Palm Beach site and students from this site had a significantly more positive perception towards ARS than students at the other sites ($p < 0.01$), while students at the main campus in Fort Lauderdale had the least positive perceptions ($p < 0.05$).

Distance Education with Multiple Campuses and Projection

The majority of students believed that ARS made it easier to participate in a distance education course (85.3%) and helped them focus when the lecturer was physically at

a different campus (75.7%, Table 2). In terms of projection, students thought that the use of an ARS would help them to participate more in discussions in other courses (76.8%) and to pay attention in other courses (74.5%). In contrast, only 48% of students agreed that the use of ARS in other courses would result in an improvement in their grade. Black students were least likely to agree that ARS made them feel more connected to the class and least likely to feel that more courses should use ARS ($p < 0.05$ for both items) Table 3. Students at the West Palm Beach campus did not agree that ARS made them feel alienated from other sites and did agree that other courses should adopt ARS as it would help improve their attention and grades ($p < 0.05$ for all items).

DISCUSSION

This study assessed students’ perceptions on engagement in courses in which an ARS was used and attitudes about the use of an ARS at a multi-campus college of pharmacy. The data suggest that the use of an ARS increased students’ feelings of engagement as over 80% of students felt that the clickers encouraged them to participate in class more than they normally would have. While

Table 2. Student Responses Regarding Distance Education and Projection for Use in Other Courses After Completing a Drug Information Resources Course in Which an Audience Response System Was Used (N = 177)^a

Survey Item	Strongly Disagree, No. (%)	Disagree, No. (%)	Undecided, No. (%)	Agree, No. (%)	Strongly Agree, No. (%)	Mean (SD) ^a
The use of response cards helped me focus when the professor was lecturing from a different site	0	19 (10.7)	23 (13.0)	82 (46.3)	52 (29.4)	4.0 (0.9)
The use of response cards made it easier to participate when the professor was lecturing from a different site	0	9 (5.1)	17 (9.6)	90 (50.8)	61 (34.5)	4.1 (0.8)
When response cards were used, I felt more connected to the class	0	17 (9.6)	31 (17.5)	79 (44.6)	50 (28.2)	4.0 (0.9)
The use of response cards made me feel alienated from the other sites	44 (24.9)	94 (53.1)	22 (12.4)	11 (6.2)	6 (3.4)	2.1 (1.0)
The use of response cards in other courses would help improve my grade	3 (1.7)	24 (13.6)	65 (36.7)	54 (30.5)	31 (17.5)	3.5 (1.0)
The use of response cards in other courses would help me pay attention	2 (1.1)	17 (9.6)	26 (14.7)	94 (53.1)	38(21.5)	3.8 (0.9)
I hope more courses will adopt the use of response cards	5 (2.8)	13 (7.3)	51 (28.8)	70 (39.5)	38 (21.5)	3.7 (1.0)
The use of response cards would help me participate more in class discussions in other courses	3 (1.7)	15 (8.5)	23 (13.0)	94 (53.1)	42 (23.7)	3.9 (0.9)

^a Not all students responded to all items.

the majority (63%) of students did express a preference for courses with class discussion, a greater majority (94%) qualified that the anonymity offered by an ARS was of value. In fact, most (86%) students preferred to use clickers instead of microphones to participate in class.

Contrary to most courses at the college, the majority of lectures in this course were broadcast from the West Palm Beach site and those students had a more positive perception about use of the ARS than students at the other sites ($p < 0.01$). It is possible that having the lecturer physically in front of them for most class sessions affected West Palm Beach students' perceptions regarding the intervention and the course. Specifically, having a lecturer onsite may have unwittingly biased students at that location towards positive perceptions. Alternately, students at the site from which lectures for most courses were usually broadcast (ie, Fort Lauderdale) may have been biased towards less positive perceptions as they were accustomed to having a professor physically in front of them. These findings merit further exploration as they suggest that the physical location of a lecturer during a class that is broadcast to multiple campuses may impact instructor evaluations.

To date, the benefits and limitations of ARSs in a variety of settings in pharmacy education have been reported. Slain and colleagues reported that students who used an ARS ($n = 67$) were more satisfied with and had better examination scores in 3 courses over 2 years compared to students in the same courses when a traditional lecture format was used ($n = 65$).⁸ Liu and colleagues reported a higher quiz grade for those who used an ARS during a single 1-hour lecture compared with students who had to answer questions without use of an ARS.²⁵ However, when students were given a quiz 1 month later, the scores were similar between the groups, suggesting the initial positive effect of ARS may not be long lasting.²⁵ Cain and colleagues incorporated clicker questions in a chemistry and biology course and found that students ($n = 111$) preferred lectures in which an ARS was used because they believed it helped them maintain their attention during class and they benefitted from discussions generated after ARS use.¹⁰ Extra credit for answering questions correctly was also used as a strategy.

Trapskin and colleagues used an ARS in a clinical setting to teach pharmacy students ($n = 83$), pharmacists

Table 3. Comparison of Student Responses Based on Ethnicity and Site Location^a

	Ethnicity					Site			
	White	Black	Hispanic	Asian	F	FTL	PR	WPB	F
Use of response cards in this course was distracting	1.9 ^b	2.2	2.5	2.1	3.1	2.0	2.0	2.3	2.2
Because of the response cards, I participated more in this class than I normally do.	4.0	4.5	4.3	4.1	1.1	4.0 ^b	4.6	4.3	5.2
The use of response cards slowed down the class too much	2.7	1.9 ^b	2.3	2.6	2.4	2.6	2.3	2.3	1.8
I would rather use a response card to participate in class discussions than use the microphone	4.3	4.4	4.3	4.6	0.9	4.2	4.3	4.7 ^c	5.4
Overall, I think having the response cards made the class better	4.0	4.2 ^b	4.3	4.1	0.8	4.0 ^b	4.4	4.3	4.8
When response cards were used, I felt more connected to the class	3.8	3.6 ^b	3.9	4.1	2.4	3.8	4.1	4.0	0.2
The use of response cards made me feel alienated from the other sites	2.0	2.3	2.2	2.1	0.3	2.1	2.5	1.8 ^c	6.5
The use of response cards in other courses would help improve my grade	3.5	3.4	3.5	3.6	0.1	3.3	3.5	3.9 ^c	5.5
The use of response cards in other courses would help me pay attention	3.8	3.8	3.8	3.9	0	3.7	3.8	4.2 ^b	3.8
I hope more courses will adopt the use of response cards	3.6	3.0 ^b	3.9	3.7	2.4	3.5	3.8	4.1 ^c	5.2

Abbreviations: FTL = Fort Lauderdale, PR = Puerto Rico, WPB = West Palm Beach.

^a All differences between variables examined using one-way analysis of variance (ANOVA).

^b Significant difference ($p < 0.05$) determined post-hoc by Duncan test.

^c Significant difference ($p < 0.01$) determined post-hoc by Duncan test.

($n = 24$), and third-year medical residents ($n = 15$) appropriate use of an anticoagulation guide.²⁶ Using an ARS, participants answered 7 case-based multiple-choice questions before and after attending a 50-minute lecture. Post-lecture scores increased significantly for all groups and a majority of pharmacy students felt that use of the ARS increased their enjoyment of, involvement in, and understanding of the lecture. Kelley and colleagues used an ARS to deliver a one-time, case-based interactive assessment to pharmacy students ($n = 109$) immediately prior to the students beginning their advanced pharmacy practice experiences (APPEs).²⁷ The use of an ARS allowed the students to receive immediate feedback, which was followed by small group discussions led by pharmacy practice residents. The majority of students found the assessment useful and the residents reported that assisting with the exercise was helpful to them in developing precepting skills.²⁷

The above mentioned studies report use of ARS in a single setting. The only other published study that examined use of ARS in pharmacy at more than 1 site concurrently was conducted by Medina and colleagues to

determine the impact of using an ARS in a required oncology course with 121 students taught at 2 sites.⁹ Benefits reported by 7 focus group participants included having immediate feedback on their comprehension of lecture content and increased motivation to prepare for and attend the lecture. Perceived disadvantages included test anxiety and concerns about academic integrity. Faculty members observed increased class participation, visibility of the majority of students' thinking (ie, graphic depiction of percentage of students getting an answer correct or sharing a belief), and active learning. A limitation noted by the authors was only using small student focus groups for input. In contrast, our study surveyed a large number of students of various ethnicities at 3 different sites.

This study has limitations. First, pharmacy student attitudes at only 1 college of pharmacy were investigated; hence, the results from this study cannot necessarily be generalized to all colleges and schools. However, class distribution across 3 geographically distinct campuses as well as the diversity of the student population somewhat ameliorate this limitation. A second limitation is that there is no way of verifying the veracity of the students'

responses. As with all survey research, results may be biased by the social desirability effect. Respondents may be tempted to give their impression of a socially desirable response rather than what they truly think or believe. Assuring the students of the confidentiality of their responses throughout the process may have helped to reduce social desirability bias in this study. Finally, the study could have benefitted from additional evaluative measures including instructor perceptions of efficacy, as well as tools such as the NSSE-adapted Classroom Survey of Student Engagement.²⁸

Our study assessed the use of an ARS at 3 campuses and found that students believed having the system made the class better, encouraged participation, and conferred a desirable level of anonymity. The use of a multicampus distance education model like that at our college has continued to rise at pharmacy colleges and schools in recent years.²⁹ This increase in distance education in pharmacy has created a need for new teaching/learning methods to increase student engagement both in single classroom settings and those using multiple sites.⁴ The importance of using active-learning tools will increase as about a quarter of all US pharmacy colleges and schools (n = 26) have distant sites or branch campuses that use videoconferencing (Jeffrey W. Wadelin, Accreditation Council for Pharmacy Education, personal communication, March 8, 2011).²⁹

CONCLUSIONS

Implementation of an ARS enhanced student perceptions of engagement and may improve feelings of connectedness among students at pharmacy colleges and schools with multiple campuses. ARS may also represent a cognitive intercession strategy to help address communication apprehension via its use as a means to introduce students with high levels of communication apprehension to minimally intimidating active learning.

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REFERENCES

1. McLaughlin K, Mandin H. A schematic approach to diagnosing and resolving lecturalgia. *Med Educ*. 2001;35(12):1135-1142.
2. National Survey of Student Engagement. Assessment for improvement: tracking student engagement over time. Bloomington, IN: Indiana University Center for Postsecondary Research; 2009.
3. Southern Association of Colleges and Schools. Commission on Colleges. Resource Manual for the Principles of Accreditation: Foundations for Quality Enhancement, 2005. Decatur, GA.
4. Stewart DW, Brown SD, Clavier CW, Wyatt J. Active-learning processes used in US pharmacy education. *Am J Pharm Educ*. 2011;75(4):Article 68.
5. Johnson T, Meckelborg A. Student response systems: a cure for lecturalgia? In: *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications*. Chesapeake, VA: Association for the Advancement of Computing in Education; 2008: 4709-4717.
6. Ludwig J. Medical school teachers—there is a message from an airline. *Mayo Clin Proc*. 1973;48(4):294-297.
7. Ludwig J, Mitchell MM. The student response system: a 5-year Mayo medical school experience. *Mayo Clin Proc*. 1977;52(9):556-560.
8. Slain D, Abate M, Hodges BM, Stamatakis MK, Wolak S. An interactive response system to promote active learning in the Doctor of Pharmacy curriculum. *Am J Pharm Educ*. 2004;68(5):Article 117.
9. Medina MS, Medina PJ, Wanzer DS, Wilson JE, Er N, Britton ML. Use of an audience response system (ARS) in a dual-campus classroom environment. *Am J Pharm Educ*. 2008;72(2):Article 38.
10. Cain J, Black EP, Rohr J. An audience response system strategy to improve student motivation, attention, and feedback. *Am J Pharm Educ*. 2009;73(2):Article 21.
11. Rubio EI, Bassignani MJ, White MA, Brant WE. Effect of an audience response system on resident learning and retention of lecture material. *AJR Am J Roentgenol*. 2008;190(6):W319-W322.
12. Roy KH. Pilot investigation of the utility of a student response system in medical student lectures. *J Audiov Media Med*. 1996; 19(1):27-32.
13. Palmer NG, Yacyshyn JR, Northcott HC, Nebbe B, Major PW. Perceptions and attitudes of Canadian orthodontists regarding digital and electronic technology. *Am J Orthod Dentofacial Orthop*. 2005;128(2):163-167.
14. Pileggi R, O'Neill PN. Team-based learning using an audience response system: an innovative method of teaching diagnosis to undergraduate dental students. *J Dent Educ*. 2008;72(10):1182-1188.
15. Lymn JS, Mostyn A. Audience response technology: engaging and empowering non-medical prescribing students in pharmacology learning. *BMC Med Educ*. 2010;10:73.
16. Caldwell JE. Clickers in the large classroom: current research and best-practice tips. *CBE Life Sci Educ*. 2007;6(1):9-20.
17. Cain J, Robinson E. A primer on audience response systems: current applications and future considerations. *Am J Pharm Educ*. 2008;72(4):Article 21.
18. Premkumar K, Coupal C. Rules of engagement—12 tips for successful use of “clickers” in the classroom. *Med Teach*. 2008;30(2):146-149.
19. Bruff D. *Teaching with Classroom Response Systems: Creating Active Learning Environments*. 1st ed. San Francisco: Jossey-Bass; 2009.
20. Berger B, Baldwin HJ, McCroskey JC, et al. Communication apprehension in pharmacy students: a national study. *Am J Pharm Educ*. 1983;47(2):95-102.
21. McCroskey JC. Classroom consequences of communication apprehension. *Comm Educ*. 1977;26(1):27-33.
22. Berger BA, Baldwin HJ, McCroskey JC, Richmond VP. Implementation of a systematic desensitization program and classroom instruction to reduce communication apprehension in pharmacy students. *Am J Pharm Educ*. 1982;46(3):227-234.

American Journal of Pharmaceutical Education 2012; 76 (1) Article 6.

23. McCroskey JC. The implementation of a large-scale program of desensitization for communication apprehension. *Speech Teach.* 1972;21(4):255-264.
24. Khan T, Ejaz M, Azmi S. Evaluation of communication apprehension among first year and final year pharmacy undergraduates. *J Clin Diagnostic Res.* 2009;3(6):1885-1890.
25. Liu FC, Gettig JP, Fjortoft N. Impact of a student response system on short- and long-term learning in a drug literature evaluation course. *Am J Pharm Educ.* 2010;74(1):Article 6.
26. Trapskin PJ, Smith KM, Armitstead JA, Davis GA. Use of an audience response system to introduce an anticoagulation guide to physicians, pharmacists, and pharmacy students. *Am J Pharm Educ.* 2005;69(2):Article 28.
27. Kelley KA, Beatty SJ, Legg JE, McAuley JW. A progress assessment to evaluate pharmacy students' knowledge prior to beginning advanced pharmacy practice experiences. *Am J Pharm Educ.* 2008;72(4):Article 88.
28. Smallwood B. CLASSE: Classroom Survey of Student Engagement. <http://assessment.ua.edu/CLASSE/Overview.htm>. Accessed November 25, 2011.
29. Harrison LC, Congdon HB, DiPiro JT. The status of US multi-campus colleges and schools of pharmacy. *Am J Pharm Educ.* 2010;74(7):Article 124.