Creating Learner-Centered Classrooms: Use of an Audience Response System in Pediatric Dentistry Education

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Abstract: Research suggests that the exclusive use of lecture in the classroom hinders student learning. The advent of compact electronic wireless audience response systems has allowed for increased student participation in the classroom. Such technology is utilized in medical education. This article describes the use of an audience response system in a "quiz bowl" format to facilitate and improve the comprehension of student dentists in core concepts in pulp therapy for the pediatric patient.

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At the postsecondary education level, lecturing is virtually synonymous with teaching. Effective lecturers can:

1. communicate the intrinsic importance, relevance, and application of the subject matter in a dramatic and personal manner;
2. provide students with a thoughtful, scholarly role model to emulate;
3. describe subject matter that is otherwise unavailable (that is, original research not yet published);
4. organize learning material in ways to meet the particular needs of a given audience; and
5. deliver large amounts of information if certain conditions are met.[1]

The teaching methods of educators and the ways they design courses contribute to deep learning as much as students' study strategies and the unique characteristics of individual students.[2,3] For most disciplines in higher education, however, the communication of information, knowledge, and skill sets is related to traditional lecture-style exchanges.

Research suggests, conversely, that the exclusive use of lecture in the classroom hinders student learning. Lectures in which audience members remain passive participants in the learning process yield disappointingly low retention rates of factual information.[4] According to Bonwell and Eison,[5] learning by computer-based instruction (CBI) can be equally as helpful as more conventional lecture-based methods. Depending on the nature of the material and the specific learning objectives, CBI pedagogy may be more effective. Based on nearly 200 studies, these authors asserted that students' average achievement rose from the 50th to the 61st percentile. Compared to those taught by traditional methods, students in CBI classrooms also learned their lessons in two-thirds of the time. There is considerable evidence that student-centered approaches, aimed at fostering deep learning, including problem-based,[6] self-directed study,[7] and reflective[8] learning can be effective learning experiences if well designed and used by motivated students.

The advent of compact electronic wireless audience response systems (ARS) has permitted increased student participation during lectures. While the use of such technology has been reported several times in the medical education literature,[9-13] there is little discussion of its use in dental education.[11] This article describes the use of ARS in a "Pediatric Dentistry Pulp Quiz Bowl" to facilitate and improve student dentists' comprehension of core concepts in pulp therapy for pediatric patients.

Methodology

The University of Kentucky Teaching and Academic Support Center (TASC) is responsible for the hardware associated with the portable ARS system that can be used in any classroom/teaching facility. Faculty members may have access to the software (Synthesis 2000®) through TASC. Since the use of ARS was novel to the pediatric dentistry curriculum and the instructors were unsure of student acceptance, computer-based instructional technology (that is, ARS) was used to motivate third-year student dentists to demonstrate, through simulated case scenarios, their comprehension of treatment of pulpal pathology in children in only one two-hour interactive session. Handouts and reading assignments were distributed to each student dentist two weeks prior to the scheduled class meetings. In class, each individual was given an electronic wireless audience responder (Figure 1). Fifteen questions, representing the core concepts in pulp therapy for the pediatric patient, were posed at various points throughout the PowerPoint discussion. Most questions were linked to case-based scenarios (Figure 2). Five multiple-choice responses, one of which was correct, were displayed on the screen. Each question and its corresponding multiple-choice responses were read aloud. Students were given fifteen seconds to formulate a response, which was registered through the audience responder system. The software system then graphed a composite representation of the class's response. While over 50 percent of the class generally chose the appropriate responses, the instructor was able to redirect and explain any incorrect answers chosen.

At the end of the quiz bowl, individual students' scores were tabulated by the responder system. The exercise, which did not have a bearing on the student's course grade, provided a means of self-assessment by allowing students to gauge their own perceived level of understanding and preparation. Rewards (gift certificates for food, video rentals, etc.) were given to the top three performers in the class.

The use of an audience response system has been integrated into the third-year pediatric dentistry curriculum for two consecutive years. Through the use of an objective and subjective traditional-style questionnaire, students of each class were asked to anonymously evaluate the quiz bowl. The evaluation tool employed Likert-type questions with a scale from 1 (disagree) to 5 (agree). Of the 103 students who participated in the ARS-supported classes, nearly 76 percent returned completed surveys. Seventy-four percent of respondents agreed that the use of the ARS provided an opportunity for students to assess how well they understood the information presented in lectures (Table 1). Seventy-seven percent agreed that the ARS helped to reinforce basic concepts discussed during the lecture (Table 2). The majority also thought that the use of the ARS motivated them to learn the key concepts of pulp therapy for the pediatric dental patient (Table 3). Students confirmed that the pediatric dentistry course was the first course in the curriculum to utilize such instructional technology (Table 4).

Discussion

Schackow et al. have asserted that the use of ARS-enhanced lectures improved post-lecture quiz performance in family medicine residents.[9] While no attempt was made in the current study to examine test outcomes, students' survey responses suggest they perceived the ARS system to be helpful in learning the course material. Other educators have found

Figure 1. Sample ARS handheld unit

the integration of audience response systems as an effective means of actively engaging students during lectures.[10] Verbal and written feedback from third-year student dentists at the University of Kentucky revealed similar outcomes. Students offered such comments as "we had fun and learned a lot," "excellent," and "loved it." Students appeared attentive and receptive to the novel teaching approach. Feedback instantly provided by ARS on what and how well students are learning can be used to help refocus teaching efforts to improve the efficiency and effectiveness of student learning.[14]

Conclusion

Schleyer stated that in computer science "the emphasis is not on information, but how it is repre-

Susan is a four-year-old who is brought to your office by her father for a routine oral examination. Among other things, you identify a deep carious lesion on # I. There is no history of pain. No abnormal radiographic findings are noted. All soft tissues are within normal limits. Two weeks later, in the process of removing all the caries, the vital pulp is exposed. Based on the information you currently have, what type of pulpal therapy is indicated?

A. Pulpectomy
B. Extraction
C. Pulpotomy
D. Direct pulp cap
E. No treatment is indicated at this time

Figure 2. Sample of case-based scenario

Table 1. Evaluation tool, sample one

The "Pediatric Dentistry Pulp Quiz Bowl" provided me an opportunity to assess how well I understood the information presented during the lectures.

	Disagree 1	2	3	4	Agree 5
Class of 2005	0	0	1	12	27
Class of 2006	0	0	0	7	31
TOTAL N=78	0 0%	0 0%	1 1%	19 24%	58 74%

Table 2. Evaluation tool, sample two

The "Pediatric Dentistry Pulp Quiz Bowl" reinforces basic concepts discussed during the lectures.

	Disagree 1	2	3	4	Agree 5
Class of 2005	0	0	1	12	27
Class of 2006	0	0	0	5	33
TOTAL N=78	0 0%	0 0%	1 1%	17 22%	60 77%

Table 3. Evaluation tool, sample three

The "Pediatric Dentistry Pulp Quiz Bowl" motivated me to learn the key concepts of pulp therapy for the pediatric dental patient.

	Disagree 1	2	3	4	Agree 5
Class of 2005	0	0	2	13	25
Class of 2006	0	0	0	7	31
TOTAL N=78	0 0%	0 0%	2 3%	20 26%	56 72%

Table 4. Evaluation tool, sample four

In my experience, PDO 834 was the first course (thus far) in the curriculum at the University of Kentucky College of Dentistry that utilized the ARS type of computer technology.

	True	False
Class of 2005	38	2
Class of 2006	38	0
TOTAL N=78	76 97%	2 3%

sented, processed, manipulated, and managed."[15] To a certain extent, such is true for dental education. While the material is of vital importance, in the eyes of the student learner the representation/presentation of said material is critical. Bonwell and Eison found that active inquiry, not passive absorption, is what engages students. The authors further asserted that active inquiry should pervade the curriculum.[5]

The use of electronic wireless audience response systems in dental education represents a method to communicate critical material in an engaging and challenging fashion. It affords participants the opportunities for immediate feedback and highlights areas of study requiring more focus. The intent of the pilot project was to show there is increased motivation by student dentists to learn core concepts in pulp therapy when encouraged through the use of effective instructional technology such as the audience response system. Pee et al. have called for innovative teaching and learning in undergraduate dental education.[16] The pilot project at the University of Kentucky College of Dentistry is an attempt to build a learner-centered classroom. Based on feedback from our students, classroom use of ARS will be continued in the future.

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