RESEARCH ARTICLES

Active-Learning Processes Used in US Pharmacy Education

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Objective. To document the type and extent of active-learning techniques used in US colleges and schools of pharmacy as well as factors associated with use of these techniques.
Methods. A survey instrument was developed to assess whether and to what extent active learning was used by faculty members of US colleges and schools of pharmacy. This survey instrument was distributed via the American Association of Colleges of Pharmacy (AACP) mailing list.
Results. Ninety-five percent (114) of all US colleges and schools of pharmacy were represented with at least 1 survey among the 1179 responses received. Eighty-seven percent of respondents used active-learning techniques in their classroom activities. The heavier the teaching workload the more active-learning strategies were used. Other factors correlated with higher use of active-learning strategies included younger faculty member age (inverse relationship), lower faculty member rank (inverse relationship), and departments that focused on practice, clinical and social, behavioral, and/or administrative sciences.
Conclusions. Active learning has been embraced by pharmacy educators and is used to some extent by the majority of US colleges and schools of pharmacy. Future research should focus on how active-learning methods can be used most effectively within pharmacy education, how it can gain even broader acceptance throughout the academy, and how the effect of active learning on programmatic outcomes can be better documented.

Keywords: pharmacy education, active learning, teaching, survey

INTRODUCTION

Pharmacy education is changing, and this change is being driven by a call for curricular innovation as well as an explosion of new pharmacy programs.[1,2] The number of pharmacy programs increased by 45% between the years 1996 and 2008.[2] As competition among colleges and schools increases, faculty members will be expected to accept the challenges that this new generation of pharmacy education presents. As noted by Oblinger, "the aging infrastructure and the lecture tradition of colleges and universities may not meet the expectations of students raised on the Internet and interactive games."[3]

A 2009 review addressing future competencies in professional education highlights the need for learner-centered instruction and points to problem-based learning (PBL) and inquiry-based learning as means to accomplish this.[4] PBL has a long history in medical education and has been used successfully in pharmacy education to teach diabetes, pharmacotherapy, pharmaceutics, medicinal chemistry, and pharmacoeconomics, as well as many other subjects.[5-9] Students entering their advanced pharmacy practice experience (APPE) reported confidence in the material they had been taught using PBL, specifically medical information, basic science content regarding disease states, and patient-specific drug regimen evaluation.[10] Compared with PBL, inquiry-based learning has had less of an impact to date on pharmacy education. Disease-focused discovery maps have been used to help students assimilate concepts across the curriculum.[11] Inquiry-based learning has been used extensively in K-12 education and improves student attitudes about science.[12] Other strategies for active learning used in pharmacy education include but are not limited to process-oriented guided inquiry learning (POGIL),[13] case studies,[14-17] computerized tutorials and modules,[18-21] audience response systems,[22,23] and team-based learning.[24,25]

The knowledge base in the field of healthcare continues to grow, but it is impossible to increase semester length or class time proportionally. Thus, moving forward, faculty members must recognize that active-learning strategies may be a valid way to address the increasing

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knowledge base by facilitating the training of pharmacy graduates who can find, process, analyze, and apply new information with their patients and their colleagues.[26,27]

Faculty members are being challenged by the academy to "adopt a philosophy of evidence-based education."[1] For the Bill Gatton College of Pharmacy, this project represents the first step toward this new philosophy, considering that the purpose of this project was to document the current national trend of engaging students through various processes, collectively termed *active learning*. In an attempt to make education culturally relevant to the current generation of learners, traditional approaches to classroom management may no longer suffice, and it is increasingly important to understand how others are successfully implementing curricular innovation.[26,28,29] These data will help colleges and schools of pharmacy throughout the United States compare their use of active learning to a benchmarked standard specific to pharmacy education.

METHODS

A comprehensive literature search of medical and education databases evaluating the use of active-learning strategies in health-science education was conducted by a medical librarian and then sent to the authors for review. The authors reviewed each abstract for relevant articles and compiled a list of documented active-learning strategies. These strategies were then categorized and included in an anonymous survey designed to assess active-learning strategies used in US colleges and schools of pharmacy and the extent to which they are used. No comprehensive surveys of active learning in pharmacy or any other health science discipline were found by our literature search. Approval was obtained by the East Tennessee State University (ETSU) Institutional Review Board in November of 2009.

The online survey (available from authors on request) was evaluated by local faculty member volunteers for comprehension and functionality. It was then distributed by e-mail via the American Association of Colleges of Pharmacy (AACP) faculty member roster during the spring of 2010. A 2-week follow-up e-mail was sent to all potential respondents as a second request to participate in the project. The survey was closed after 4 weeks. Several active-learning strategies were given as options for survey respondents to indicate their use of various techniques. While this list was certainly not all-inclusive, it included some of the most prevalent strategies used in pharmacy and science education. Table 1 briefly summarizes the techniques given to the survey respondents as response options. No descriptions were included in the survey itself. Checkbox Survey (Checkbox Survey Solutions, Inc., Watertown, MA) was used to distribute and collect survey data. Responses were compiled and statistical

Table 1. Active-Learning Strategies Included in a Survey of US Colleges and Schools of Pharmacy Regarding Curriculum Content

Strategy	Brief Description
Audience response system / clickers	Use of remote control devices by students to anonymously respond to multiple-choice questions posed by the instructor[39]; can be integrated into traditional lectures, often termed "active lecture"[40]
Discussion-based learning, including deliberative discussion	Use of communication among learners (both synchronous and asynchronous) as a teaching modality; can be used with other strategies such as case studies[41, 42]
Interactive-spaced education	Use of repetition of content at spaced intervals combined with testing of that content; developed and used heavily within the context of medical education[43, 44]
Interactive Web-based learning	Use of web-based modules to deliver content and assess student understanding in an interactive format[45]
Patient simulation	Use of human patient simulators in a laboratory environment to teach providers to respond to a variety of physiological emergencies and situations[35]
POGIL/ discovery learning	Use of exercises specifically designed to lead teams of students through the stages of exploring data, developing concepts based on that data, and applying the concepts[37]
PBL, including case-based learning)	Use of cases or problem sets meant to be explored in self-managed teams of students (with a facilitator); PBL sessions precede any discussion of content by instructor[37]
Team-based learning	Use of small student groups to facilitate discussion, case study exploration, or other aspects of content; preparation required in advance and content integrated throughout the class by the facilitator (expert)[46]
Traditional laboratory experiences	Use of traditional laboratory and benchtop experiences to provide hands-on learning experiences

Abbreviations: POGIL = process-oriented guided inquiry learning; PBL = problem-based learning.

analyses were completed using SPSS 16.0 (SPSS Inc., Chicago, IL). Chi-square tests were used to compare nonparametric data. Logistic regression analyses were used to detect correlations between respondent variables and to determine whether active-learning strategies were used. Results of logistic regression analyses were reported as odds ratios with 95% confidence intervals.

RESULTS

Invitations to participate in the survey were e-mailed to the 2,013 individuals in US and affiliated colleges and schools of pharmacy who held a faculty appointment, as determined by their AACP roster listing and 1,179 completed the survey instrument (59% response rate). Of the 120 colleges and schools of pharmacy recognized by AACP at the time of survey distribution, a response was received by at least 1 faculty member from each of 114 colleges and schools, yielding an institution response rate of 95% of all US colleges and schools of pharmacy.

Sixty-two percent of survey respondents taught at public institutions. Respondents were classified as members of public institutions for purposes of this survey if the college or school was located within a public university, regardless of whether public funds were provided at the college level. The majority of respondents (72%) were from institutions with pharmacy education programs established prior to 1996.

Most survey respondents (95%) identified themselves as full-time faculty members holding the rank of assistant professor, associate professor, or professor. Fifty-one percent of respondents were pharmacy practice or clinical faculty members, while 25% were basic sciences or pharmaceutical sciences faculty members. Seventy-nine percent of respondents described their curriculum as traditional/linear, somewhat integrated, or somewhat problem-based, while only 16% described their curriculum as completely integrated or completely problem-based. Overall, 87% of the 1,179 respondents reported the use of at least 1 active-learning strategy in their classroom activities, with PBL being most commonly reported (71%). Over 83% of respondents reported the use of 2 or more active-learning techniques. Survey results are listed in Table 2.

Table 2. Demographics of Respondents to a Survey on Active-Learning Use in US Colleges and Schools of Pharmacy, N=1179

Variable	Responses, %
Type of institution	
Public	62
Private	38
Age of program	
Established before 1996	72
Established after 1996	28
Rank	
Assistant professor	41
Associate professor	32
Professor	22
Instructor/lecturer	3
Other	2
Department	
Pharmaceutical/basic sciences	25
Pharmacy practice/clinical	51
Social/behavioral/administrative sciences	9
Other	15
Curriculum type	
Traditional/linear	20
Somewhat integrated	42
Completely integrated	15
Somewhat problem based	17
Completely problem based	1
Other	5
Active learning strategies	
PBL including case-based learning	71
Discussion-based learning	50
Team-based learning	47
Audience response systems/clickers	45
Patient simulation	25
Traditional laboratory experiences	19
Interactive Web-based learning	16
POGIL/inquiry/discovery learning	12
Interactive spaced education	4

Abbreviations: PBL = problem-based learning; POGIL = process-oriented guided inquiry learning

The median percentages of workload devoted to classroom teaching and classroom time devoted to active learning were 30% and 25%, respectively. For participants who did not incorporate active-learning techniques, the 50th percentile of teaching time was approximately 20%, compared with approximately 30% for those who did engage their classes in active-learning strategies. This difference indicates that participants who used active learning tended to have higher teaching workloads compared with those who did not. The majority of respondents spent less than 40% of their time in the classroom engaged in active learning (Figure 1). A logistic regression analysis showed an overall significant correlation between use of active-learning techniques and an increase in teaching load (Table 3), when categorized in ranges of 20% extending from 0% to 100% ($P = 0.035$). However, when evaluating individual ranges, no significant difference was found between the group with a teaching load of >80% compared to the group with <20%.

Other factors significantly correlating with using active-learning strategies included faculty age, faculty rank, and department. As age increased, the likelihood of using

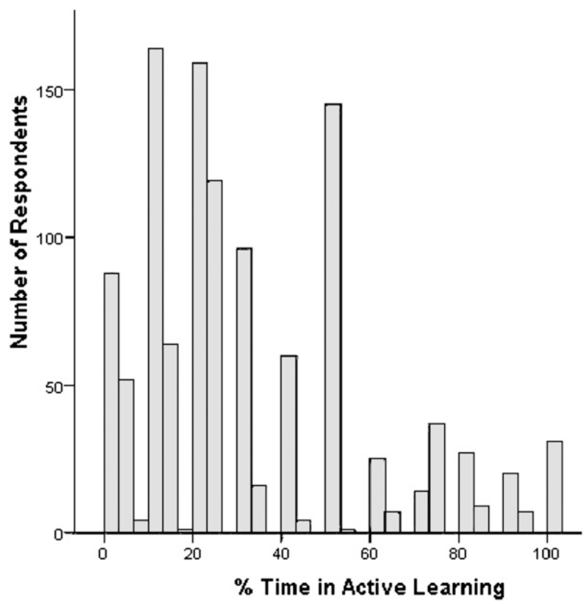

Figure 1. Percent of Time Engaged in Active-Learning Strategies

active-learning strategies decreased by approximately 3% for each year increase in age ($P = 0.001$). The impact of age was similar to that of years in an academic job. Respondents who had fewer than 5 years' teaching experience reported a 92% frequency of using active learning, compared with 85% of those teaching more than 25 years. Faculty rank usually correlates with age and years in service; likewise, in our study, 93% of assistant professors were using active-learning strategies vs. 91% of associate professors and 87% of full professors. Faculty members in

Table 3. Correlation of Select Variables with Use of Active-Learning Strategies in the Classroom

Variable	Odds Ratio	95% Confidence Interval
Age (per year increase)	1.0	– 0.96 - 0.99
Faculty member rank		
Professor	1.0	-
Associate professor	1.6	– 0.95 - 2.60
Assistant professor	1.9	1.17 – 3.13
Primary department		
Pharmaceutical/basic sciences	1.0	-
Pharmacy practice/clinical	3.5	2.25 – 5.47
Social/behavioral/administrative sciences	3.4	1.48 – 7.64
Teaching load (% time)		
<20	1.0	-
20–39.9	1.7	1.07 – 2.69
40–59.9	2.0	1.15 – 3.54
60–79.9	2.4	1.10 – 5.23
>80	6.1	0.56 – 2.76

departments of pharmacy practice (or any clinical faculty members) and faculty members in the social/behavioral/administrative sciences were more than 3 times more likely to use active-learning strategies compared with faculty members teaching in departments of pharmaceutical or basic sciences ($P < 0.0001$ and $P = 0.004$, respectively). This corresponds to 81% of basic science faculty members vs 94% of clinical faculty members using active learning.

Neither institution type (public vs. private) nor institution age (programs beginning prior to 1996 vs. those beginning after 1996) correlated significantly with the use of active learning. Institution age, however, did show a trend toward greater use of active learning at newer institutions (odds ratio – 1.7; [95% CI 0.999-2.919]).

DISCUSSION

As active-learning techniques have been encouraged in pharmacy education, an increase in the use of technology has often followed. Many of the techniques investigated in this survey either directly or indirectly increased the use of technology during the student's learning experience. Whether the use of technology directly influences the educational experience has not been definitively determined; however, several studies evaluating specific technologies have found positive results, primarily derived from user preferences.[22,30-36] Ernst and colleagues also have demonstrated that additional active-learning exercises resulted in increased student examination scores compared with historical controls.[32]

The academy has embraced active learning, as demonstrated by the high rate of survey participants reporting use of active-learning techniques (87% of respondents). While the majority of respondents in the current study acknowledged using PBL, one limitation could be that this study included case-based learning as a descriptor in this group. Thus, faculty members who used cases in non-PBL teaching methods could have chosen PBL as a survey response. True PBL implies that students are not given any information prior to receiving their assignments (problems), which empowers them to direct their own learning with a facilitator who only guides them during the process. Future research could focus on differentiating PBL from other case-based strategies, such as discussion- and team-based learning in which students use cases only to reinforce and expound upon subjects in which they have already been instructed. Audience response systems (ARS) also seem to be a popular instructional tool that is easily embedded, even within traditional lectures.

In this survey, the likelihood of a faculty member using active-learning strategies decreased with increased faculty member age. This is likely related to the finding that assistant professors use more active-learning strategies compared with professors (93% versus 87%, respectively). It also may relate to the length of time the respondent had been in an academic job, as junior faculty members and 92% of faculty members teaching less than 5 years used some form of active learning.

Perhaps this finding warrants discussions regarding pedagogical philosophies at the level of the institution and the academy as a whole. Ideally, all educators would engage in pedagogical strategies that demonstrate superior student learning and satisfaction, and these improved outcomes would convince more senior educators to adopt these newer teaching philosophies. However, all educators realize the significant time and risk investment involved in implementing new teaching strategies, and with highly motivated students, such as those in a doctor of pharmacy (PharmD) program, faculty members often do not see the necessity of such an investment. Junior faculty members often have greater exposure to faculty development opportunities because of the requirements of promotion and/or tenure; thus, they may be instituting active-learning strategies at the course-development stage rather than altering established instructor-centered content. If the trend of higher percentages of newer faculty members adopting active learning continues, it could ultimately result in senior faculty members having increased exposure to innovative teaching techniques as well.

Another interesting finding was the increased use of active-learning techniques as classroom teaching workload increased. Faculty members with classroom teaching workloads above 20% used these strategies more often than those who spent less than 20% of their time teaching in the classroom. However, there was no significant difference in the use of active-learning strategies by faculty members who spent >80% of their time in the classroom, compared to the <20% group. Because of the small number of respondents with high teaching workloads (5.8%), these results should be interpreted cautiously. Overall, these data indicate that faculty members who spend more time teaching are more likely to use contemporary teaching strategies designed to engage students. Perhaps individuals who are passionate about classroom teaching are more likely to use evidence-based and/or newer teaching strategies. One possible confounder of this connection is the difficulty faculty members and administrators have in defining workload. Those who are more engaged in classroom assignments and thus more likely to use active-learning strategies may be those who invest more work time per credit hour.

The other significant finding was the decreased likelihood of basic and pharmaceutical sciences faculty members to use active-learning strategies (81% vs. 94%). While one hypothesis for this finding is that it is easier to engage in these strategies in clinical courses where cases and other clinical applications can be used for demonstration, several methods have been endorsed for the past 2 decades by the National Science Foundation (NSF). POGIL, PBL, and peer-led team learning (PLTL) all have been evaluated extensively in the undergraduate basic sciences, with POGIL and PLTL showing positive results, particularly in chemistry courses.[13,37] While PBL has benefits, particularly in the clinical setting, students' performance on science examinations after taking a PBL course has been observed to be lower.[38]

These data ultimately will be used for internal assessment at our college. They also might be valuable to other institutions as a benchmark of active-learning use in pharmacy education, as no other similar studies were found in a prospective review of the literature, but these data should not be interpreted as showing superior outcomes for active-learning strategies. These results should encourage the academy to further evaluate the evidence of their techniques and assess and publish outcomes-based data for evaluation.

CONCLUSION

We found that active learning has been embraced overwhelmingly in pharmacy education, based on a majority of colleges and schools using some active-learning techniques in their curricula. While some factors (ie, faculty member age and rank, department, and teaching workload) seemed to correlate with active-learning techniques being used, continued discussion and research should be devoted to this topic to elucidate how active-learning methods can be used most effectively in pharmacy education, how it can gain wider acceptance throughout the academy, and how its effect on programmatic outcomes can be documented.

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