

Active Learning and Competency Preconditioning: Strengthens Osteopathic Medical Student Performance, Physician Attributes and Competency Assessments.

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Abstract

Abstract: The medical education has been reliant on didactic lectures which are predominantly teacher centered learning method. The competency based medical education was introduced in North America and with this came the paradigm shift in how schools conceptualize curriculum and measure the outcomes to learning. This new and modern approach started a change away from the traditional lecture based and teacher centered curriculum to more student centric by using various tools. The competency-based education is vastly regarded as an outcome-based approach to design, implement and evaluate the curriculum using widely accepted competencies. AACOM recommends seven core competencies with in which you have various indicators which address the student's performances. The main purpose of this research is to utilize active learning tools to assess the competencies in the first year of medical school which will provide better academic outcome, physician who is knowledgeable and satisfies all the competencies as needed by the Licensure authority. **Materials & Methods:** The study was conducted at medical school during the first semester of medical school and included 145 students. Various active learning tools like, team-based learning, quizzes, popup quizzes, case discussions were used to assess the competency in biochemistry and genetics course, and they were compared to questions based on concepts delivered by traditional lecture method. **Results:** The student's performance on high stake examination after the active learning session on the content and concepts delivered and learnt had a statistically higher average percent point in the second, third and fourth examination. The average Diff (p) for second, third and fourth examination to the questions being considered for the study were (Diff p= 0.84, 0.83 and 0.92) with positive moderate correlation for second examination ($r= 0.535$) and strong positive correlation for third and fourth examination ($r=0.745$ and $r=0.856$) with their final biochemistry grades. **Conclusion:** The study does not prove that active learning methods are the best way to deliver curriculum for competency based education system, but there are some positive and significant data that has emerged which does convince that these active learning methods may be better suited for providing and assessing the competencies .

Introduction

Lecture based curriculum continues to be largely utilized in medical education across the globe. However, with the paradigm shifts in medical education and advancements in information technology, we have been forced to modify and alter the way we deliver medical education to gen X students and the millennials (1). Historically, medical education has been oriented toward didactic lectures which are predominantly teacher centered learning. Many scholars believe that this strategy has a limited scope for critical thinking and predominantly promote passive learning, while encouraging the adult students to rely on their preexisting knowledge to build more information. To develop curiosity, to inspire critical thinking and to narrow the knowledge gap in professional education and field of practicing medicine and improve learning outcomes, it is necessary to foster life-long learning in medicine. Based on Edgar Dale's "The Cone of Learning" model, which incorporates several theories related to instructional design and learning processes, one can conceptualize how people learn and retain knowledge (2). Based on this model and

various other article, after two weeks most students tend to recollect only 10 % of what they had read or heard in comparison to nearly 90% of what they are involved in doing (3). This is the basis of “experiential learning” and “action learning” (4). Active learning mostly encompasses a variety of educational methods which are intended to facilitate pupil involvement in learning process in comparison to lecture based approach to medical education (5, 6). Many researchers have used various types of innovative teaching and learning methods to promote active learning environments but also at the same time obtain additional measurements of change in knowledge and feedback regarding curricular content and improvement (7).

Active learning methods such as problem-based learning, audience response system and social media usage (Podcasting, Twitter & Facebook) have been shown to improve student participation and attention, increase classroom attendance, reinforce key concepts and content, and becomes a medium for communication between student and teacher. This improves instruction and enhances learning performance and retention of the presented material (8, 9, 10). Many subject-specific curricula remain focused and dedicated to delivering content detail with less importance placed on the development of student competence and confidence in their field of study. Essentially, this overburdens the student with factual, disintegrated knowledge that is compartmentalized, and in essence, lacks complete intellectual relevance which inhibits acceptance by the present generation student. This does not help the students become confident and self-reliant in situations they may encounter later in training or as a physician, thus rendering them ineffective (11). This discord between how the information is provided, how the information and knowledge is utilized, led to further modification and modernization of the approach utilized for content delivered and methods of assessing outcomes. To overcome such deficiencies, the educators and leaders had to work collaboratively and collectively to identify an effective, innovative approach, which we know as competency based medical education.

The competency based medical education was introduced in North America at the start of 21st century, and with this came the shift in how schools conceptualized curriculum and measured the outcomes of learning. The competency-based education is vastly regarded as an outcome-based approach to design, implement and evaluate the curriculum using widely accepted competencies. The widely accepted competency framework in medical education is the one provided by the ACGME Outcomes project. In 2007, the American Association of Colleges of Osteopathic Medicine (AACOM) created a workgroup to look at the core competencies for osteopathic medical students. The primary focus of this workgroup was to help osteopathic medical schools define and integrate the osteopathic core competencies into their curriculums. The main idea behind this workgroup was to create a set of performance indicators that would be common to all the students studying osteopathic medicine, though the schools were also allowed to develop additional performance indicators depending on their areas of mission or focus. AACOM recommends seven core competencies within which various indicators which address the student’s performance (11). The seven core competencies to be utilized by osteopathic medical schools are Osteopathic Principles and Practices, Medical Knowledge, Patient Care, Interpersonal and Communication Skills, Professionalism, Practice Based Learning and Improvement and Systems-Based

Practice. If these competencies are practiced properly, they ensure the achievement of professional competency and not merely the recall of medical information and retention of knowledge (12, 13).

Many articles have been written and much research is being conducted, on the importance of core competencies to be attained, milestones to be achieved and satisfied for a curriculum to be deemed successful in every way. However, there is a different school of thought which may disagree with competency-based curriculum, or to give undue importance to active learning tools and the extent of its use to deliver effective and successful curriculum (11). Modern day medical education is viewed as, a curriculum driven by outcome-based approach to design, implement, assess, and evaluate the course, using an organized framework of competencies and milestones (14). The core competency workgroup has identified seven core competencies which are the performance indicators, that should be reached by all osteopathic medical students.

Various methods are at the disposal for educators to not only make competent physicians but also improve the outcome in high stakes examination, which include but are not limited to flipped classrooms, gamification, podcasting, twitter, Facebook, problem-based learning or case based learning and integrated modular curriculum (15, 16, 17). Therefore, these tools both in class and on social media (out of class), need to be used creatively and effectively to improve student participation and their academic outcomes.

The main purpose of this research is to utilize various available active learning tools to assess the AACOM AOA competencies in biochemistry course during the first year of medical school. This should ultimately lead to better academic outcome and will help create a knowledgeable physician that satisfies all the competencies as required by the Medical school and Licensure authority (18, 19). The main focus of this study is to see how the core osteopathic competencies such as medical knowledge, professionalism, practice-based learning and improvement and interpersonal and communication skills can be assessed and utilized in basic sciences courses like biochemistry, which will encourage and motivate faculty and educational department in various schools to include competencies assessment from the initial formative years of a medical student(20, 21). This study may also provide the basis for using the active learning tools in curriculum enhancement based on observation, and medical content management in real time and with efficiency.

Materials And Methods

Participants:

This study was carried out at Kentucky College of Osteopathic Medicine, Pikeville during the Fall term with first year medical students, when students participate in biochemistry & genetics, gross anatomy, histology and cell biology, osteopathic patient care and osteopathic manipulative medicine courses. This study included all the students enrolled in the Fall term. There were no exclusion criteria as every student who is admitted into the osteopathic medical school will be part of this observational and analytical study. Class population demographics were acceptably diverse with approximately 30% of the students

were from the Kentucky and rest of the students belonging to other twenty-eight states in USA. Every student was expected to attend the lecture classes and active learning sessions which were in form of team based case discussion, formative quizzes, and take-home quizzes.

Study Protocol:

The students have access to canvas which is the university wide learning module software which provides access to online lecture materials, accessory reading resources and lecture capture videos. For this study we used modified team-based learning module which is a type of widely accepted active learning tool. For the sessions, the students were advised to come prepared for the sessions and all the relevant content and information was made available on canvas. For active learning sessions the student group was randomly selected by assigning every student a number and then running these number through web-based software to divide them into random groups. Every student was notified about their group numbers and members in advance. On the day of the sessions, the students were asked to select one member who will act as group leader and group liaison, another member who will act as scribe and another member will act as peer grader. The grading rubric was provided to the group grader. In total there were 4 sessions and every group was made of 10–12 students who would all rotate with roles in different active learning sessions. These sessions were used to assess professionalism, medical knowledge, practice-based learning and improvement and interpersonal and communication skills. It was the responsibility of the members with specific roles to encourage and involve all the other members in their group and help assess the grades fairly. The active learning method is used for knowledge acquisition. The students are expected to learn in a small group setting, collaborate with their colleagues and learn in a self-directed session which is facilitated by the faculty and student leader of the group. The student should come prepared to the session by reading the lecture notes, journal article, textbook or web-based information for the session. The first active learning session was used to create a trend and path to go forward over the semester. During the session the students in group were encouraged to provide evidence for the solution or answer they provide. The answer provided by the group was expected to be accepted by everyone based on scientific reasoning and not by guess.

The main objective of this session was to analyze and observe the importance of such sessions in long-term retention of the core concepts learnt during the period of learning and its significance during assessment of content delivered. The student's participation and involvement were measured using a standard assessment form used in small group session and it was the responsibility of the grader to be fair and honest during this assessment.

The core competencies which were assessed are AACOM's Osteopathic Core Competencies for medical students which include Medical Knowledge, Professionalism, Interpersonal and communication skills, and Practice based learning and improvement. These four competencies are the focus of assessment during this study.

Following these sessions, the students were then assessed again on the core concepts addressed in the active learning module during their high stake's examination. The students at our medical college write

four high-stake examination in each semester following a four- or five-week period of learning medical concepts and content. The assessment for medical knowledge competency was done by asking multiple choice questions based on the concept addressed in the active learning sessions and tagging these questions for outcome measurements.

Results

All the 145 students enrolled in biochemistry class were osteopathic medical students. The students were evenly divided with 51% being female students and 49% being male students (**Table 1**). The age of the learner group ranged from 20 year to 40 years, and they all had similar educational background and they had a GPA that was close to the mean GPA for the class while entering the school. There were no exclusions made while performing the tasks or during the analysis of the results of the study.

A total of 40 cases were used during the active learning module during the semester, these could be grouped into 6 broad categories based on the general concepts addressed in the didactic lectures, the categories are general biochemistry, synthetic and degradative metabolism, nutritional biochemistry, disorders, biotechnology and genetics. The concepts which were assessed during the active learning are assessed again during the block examinations in form of clinical vignettes and tagged with the competencies to be assessed and analyzed post examinations for the performance.

In our study we have used multiple forms to assess the competencies, they were assessed during lecture's using audience response system, then in the active learning sessions using modified team-based learning modules, formative quizzes in class, take home quizzes and lastly during their high-stake examination. The competencies in educational setup are understood as observable and measurable outcomes, if combined with practice can create a competent physician.

The statistics for the study was compiled at the end of the academic year and analyzed for any significance. We analyzed the students' outcome using the Pearson correlation system through SPSS data analysis software. This method was utilized to assess the impact of using modified TBL technique on students' acquisition and retention of medical knowledge and then measure the outcome based on their performance in high-stake examination. This method was used to address the competency domain involving the medical knowledge. Typically, students' write four high-stake examination in a semester. For this research the concepts delivered through the active learning method were embedded into the examination and those questions were monitored for their performance. Every examination had around seven to eight questions from the core concepts and objectives addressed during the modified TBL session. The other competencies such as professionalism, communication and interpersonal skills and practice-based learning and improvement were assessed during the active learning sessions and various other formative assessments throughout the semester. As described earlier the scribe from the group was given the task of assessing the students for their participation, involvement, communication skills and professionalism.

The results of the study correlated well with the hypothesis of the study and the desired outcome. The student's performance on high stake examination after the active learning session on the content and concepts delivered and learnt had a statistically higher average percent point in the second, third and fourth examination. The average discrimination index for the questions which were tagged to the medical knowledge competency (tagged questions) was Diff (p) as 0.75 with a weak positive correlation ($r=0.390$) to their final grades in biochemistry course. The results of the analysis after the first session were better, the average Diff (p) for second, third and fourth examination to the questions being considered for the study were (Diff $p= 0.84, 0.83$ and 0.92) with positive moderate correlation for second examination ($r= 0.535$) and strong positive correlation for third and fourth examination ($r=0.745$ and $r=0.856$) with their final biochemistry grades (**Table 2**). The statistical analysis of the student performance in various assessment sessions correlated well with their final grades in the biochemistry ($r=0.844$).

The mean average discrimination index for all the other questions (untagged questions) on the respective examinations were comparable to that of the questions being considered for assessing the competency. The Diff p for the rest of the questions in different examinations was 0.794, 0.780, 0.813 and 0.867 respectively (**Table 3**).

The outcome for analysis of the other competencies during the active learning session were all satisfactory. The professional competency assessed by their presence and participation during the session had an average of 100%.

The domain involving interpersonal and communication skills had a mean average of 78% (Diff $p= 0.78$) and practice-based learning and improvement domain had a mean average of 81% (Diff $p=0.81$). Both the values are in the satisfactorily range.

Discussion And Conclusion:

This article reports on the study performed to assess the utilization of ACGME competencies in the first year of osteopathic medical students in their biochemistry course. In general, the competencies are assessed during the clerkship or clinical years, but seldom used in the basic sciences courses. During the active learning session, the students were completely engaged in the task at hand, discussed about different challenges, and arrived at the conclusion after thorough debate. The medical students tend to be competitive, but this activity fostered group relationships.

The results of this study indicate that the active learning sessions, do have a favorable effect on students' academic outcome. There was clear indication that this method improved academic outcome on certain concepts and along the way helped foster an important competency domain, which is medical knowledge. Though the results showed positive outcome for the knowledge acquisition through active learning sessions, but the results were not drastically different to the knowledge acquisition through conventional learning and teaching methods. One reason for comparable results obtained by two different methods of learning can be explained by different methods of learning of learner group or the

difference in strategies used for learning. But clearly the analysis of other determinants in competency domain was favorable based on the participation and assessment by facilitators and group scribe.

To discuss the study further, one aspect must be kept in mind if you want to use the competency assessment through active learning sessions in a traditional curriculum, to have designated and reserved time for such sessions. As these sessions can be used to facilitate the required competency development. It must be acknowledged that these sessions are extremely effective to influence the non-participant and shy learner's gain the necessary confidence and platform to channelize and put forth their opinion in a collegial and open environment (20, 21). The earlier the students are exposed to such sessions, the better it is for them. In medical curriculum, the knowledge plays an integral role in expertise development. Based on the data analyzed, we did not find any negative impact of utilizing active learning sessions in acquisition of medical knowledge. It is expected that the students who participated in these active learning sessions may be better prepared in clinical practice due to early exposure and assessment of different competency domains (22, 23).

Other aspect of utilizing active learning sessions was to expose students to other competency domains which they will eventually be assessed on which are, professionalism, interpersonal and communication skills and practice-based learning and improvement during their preclerkship and clinical years. But with the changing curriculum and basic science courses following more clinical approach, it is also ideal that we may use the various assessment domains in medical biochemistry courses.

This article or study does not prove in any way that active learning methods are the best way to deliver curriculum for competency based education system, but there are some positive and significant data that has emerged which does convince that these active learning methods may be better suited for providing and assessing most of the competencies but not all of them. Though we do feel there is a need to continue this study further and see how the student learner cohort perform on the assessed competency domain during the clinical years in medical school.

Declarations

Conflict of Interest: There was no conflict of interest for this research.

Ethics Committee Approval: This study is exempt from IRB ethical committee approval.

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Tables

Table 1. Student population demographics

Gender	n	%
Male	70	48
Female	75	52

Table 2. Mean percentages for student group for Medical knowledge competency

Examination	Diff(p) Competency tagged	“r” value	Diff(p) Untagged question
Block I	0.75	0.390	0.794
Block II	0.84	0.535	0.780
Block III	0.83	0.745	0.813
Block IV	0.92	0.856	0.867

Competency tagged: questions being tested based on concepts delivered using active learning sessions. **Untagged:** questions being tested based on concepts delivered using conventional delivery(lecture).

Table 3: Results for Professionalism, Interpersonal skills and communication, Practice based learning and improvement domains

Competency domain	Diff(p)
Professionalism	1.0
Interpersonal skills and communication	0.78
Practice based learning and improvement	0.81