

The Whole Mix: Instructional Design, Students, and Assessment in Blended Learning

Sa'ad Laws, Ross MacDonald, and Ziyad Mahfoud

Introduction

The academic library of today is more a presence than a space. Where once it may have been more common to find your librarian at the reference desk, now as often as not we are found in the classroom. Just as we have sought to become masters of our databases, information tools and services, so now we need to concern ourselves with instruction. To this end, librarians must be cognizant of how and if our instructional message is effectively and efficiently reaching students. Instructional design is one way for librarians to structure content and delivery so that learning is successful and sustained. The following case details the experiences of librarians utilizing instructional design to facilitate a blended learning experience that aspires to create a constructivist-learning environment. While attempting a project like this may seem to involve a plethora of working parts, highly specialized knowledge and appear overwhelming, with the right design framework and instructional know-how, it can be achieved.

Teaching Evidence Based Medicine at Weill Cornell Medical College In Qatar

Before the detail of how librarians at Weill Cornell Medical College in Qatar (WCMC-Q), implemented a blended methodology within an evidence-based

medicine (EBM) course is discussed, it is important to first mention something about the college, itself, and about the course.

WCMC-Q is the first medical college in Qatar and was formed in 2001 under the auspices of Qatar Foundation in partnership with Weill Cornell Medical College in New York. Today, the College is a medical education leader in the region with over 260 enrolled students from more than 30 countries.

The EBM course is a component within the larger Medicine Patients and Society I (MPSI) course that all first-year medical students are required to take. The EBM course is comprised of four sessions that are typically spread over two months. During these sessions, students learn how to translate clinical scenarios into searchable questions, find relevant clinical research and evaluate clinical research with the aim of individualized patient care.

Traditionally, a course director, several clinicians, and several librarians have taught this course. After attending a lecture about various topics related to clinical quantitative evaluation, students were broken into four groups for breakout group sessions. A librarian and clinician were assigned each group and spent 2-3 hours presenting new material in addition to reviewing and working through a written clinical case. The librarians traditionally used a combination of slide

Sa'ad Laws, MA, MLIS is Information Services Librarian, Distributed eLibrary, Weill Cornell Medical College in Qatar, e-mail: sal2018@qatar-med.cornell.edu; Ross MacDonald, Ph.D is Information Services Librarian, Distributed eLibrary, Weill Cornell Medical College in Qatar, e-mail: rsm2003@qatar-med.cornell.edu; Ziyad Mahfoud, Ph.D is Associate Professor, Department of Health Policy and Research, Weill Cornell Medical College, New York, Weill Cornell Medical College in Qatar, e-mail: zrm2001@qatar-med.cornell.edu

presentations and librarian-led demonstrations as the primary methods of instruction of both the basics of EBM and their application to clinical cases.

In 2014, the librarians and the course director altered the format of the course to include live, simulated patients as a means of active learning. The result of this inclusion meant that two class sessions that were typically dedicated to librarian and clinician instruction would now be largely replaced by the new simulated components. It became apparent that the presentation of cases using simulated patients would be time-consuming and would considerably reduce the class time available to the librarians for instruction. To address this shortfall in time, a blended learning approach was adopted that would combine preparatory online work with applied classroom sessions.

Blended Learning

The idea of blended learning, while not new to education, is a mode of instruction that has only recently started to gain traction with librarians. Before examining the benefits and applications of blended learning, it may be beneficial to define blended learning. Moskal, Dziuban and Hartman note that placing an exact definition on blended learning is difficult because of the fluidity between what constitutes traditional face-to-face and e-learning instructional models.¹ However, many have given blended learning a comprehensive definition of a combination of traditional face-to-face and online learning experiences. For instance, Kaplowitz notes that “This approach takes advantage of the flexibility and convenience offered by online learning, allowing learners to have much more flexibility and control over their own learning while still maintaining the interactive and interpersonal aspects of the F2F format.”²

A concern that some educators and librarians may have is with the effectiveness of blended learning as an instructional model. In reviewing the literature several studies have indicated that there is either no significant difference or some benefit in the inclusion of elements of eLearning, as opposed to strictly traditional face-to-face learning.³⁻⁵ In a study examin-

ing the efficacy of blended versus traditional learning of graduate level public health students, Kiviniemi found a significant benefit in both course scoring and student satisfaction for blended students over those receiving traditional instruction.⁶

When constructing blended courses it is important to not exclusively focus on content at the expense of form and methodology. An area of note in Kiviniemi's study is student's ability to control the pace of learning and, “allow them to pause when they noticed their attention flagging, rewind when there was a point they wanted to hear again and revisit a class session if they wanted to clarify a muddy point.”⁷ The ability for students to control the pace of their own learning is congruent with Mayer's multimedia design principles, specifically the “pacing effect.”⁸ He notes “when a learner can control the pace of presentation, such as by clicking a ‘CONTINUE’ button after each segment, the learner is more likely to be able to engage in complete cognitive processing and thus deeper learning.”⁹ The pacing effect is also exemplary of student centered learning, which is a hallmark of the blended learning model.

Instructional Design

To facilitate a blended course, or any course for that matter, it is imperative to also consider the design of the course. Librarians focusing on instruction must consider how to best present content to students and, in doing so, what strategies will work best. To facilitate this, many librarians are now using some form of instructional design to construct courses that are not simply filled with high-level content, but that are designed to facilitate learning and engagement in students.

Defining instruction design can be summed up in its ability to be both systematic and facilitate learning. Bell and Shank describe instructional design as “the systematic creation of an educational experience that will help students achieve a specified set of learning outcomes.”¹⁰ To better understand instructional design, it is essential to grasp the elements of which it is comprised. Although there are many models that are used to design instruction, essentially every model

is, in some way, based on the ADDIE (analysis, design, development, implementation, and evaluation) model of instructional design.¹¹ As Booth notes, one of the reasons that the ADDIE model is so ubiquitous is because, “it describes the sequence by which any object, interaction or experience—from an online tutorial to a hydrogen-powered car—is developed and assessed.”¹²

Although the idea of incorporating a blended learning methodology with the EBM course was in some part a matter of circumstance, it did also speak to some learning gaps that had become apparent from earlier iterations of the course. In previous editions of the course librarians had become conscious, through in-class and homework assessments, that students were not wholly competent in the various information literacy aspects of the EBM process, specifically formulating and structuring a search, as well as search evaluation. With this in mind, WCMC-Q librarians knew that constructing a course that incorporated blended learning would be in jeopardy of repeating earlier mistakes, if the course was not designed systematically.

To facilitate this process of designing the EBM course, the librarians decided to deconstruct all of the library-oriented portions of the course. The librarians primarily utilized the ADDIE model of instructional design for its simplicity and empirically tested value.¹³ What follows is an examination of how librarians used the five components of the ADDIE method to design the EBM course.

Analysis

In the analysis phase of the ADDIE process, the designer determines if there is a problem and, if so, what is it. A needs assessment can help the designer gain a fuller understanding of the problem. Bell and Shank note that in the needs assessment, “the goal is to remove uncertainty about the learning gap before any attempt is made at developing the instructional product.”¹⁴

Before attempting to design the EBM course, the librarians knew that to assess an instructional need it

would be imperative to assess students. Farmer suggests that the analysis phase of the design should provoke questions such as, “what do students need, and what are their present skills? What is the nature of the learning environment and its constraints?”¹⁵ There are several ways to answer these questions, such as through student surveys, student artifact analysis, instructor interviews, syllabi analysis, as well as course websites.¹⁶

To examine what needs the students in the EBM course librarians selected four points of data: previous assignments, surveys, librarian reflections and assessment of technical skills. Analysis exposed two major issues within instruction. First, librarians and instructors recognized that students had trouble articulating clinical cases into answerable questions, in addition to formulating logical and competent searches for those questions. Students learn the fundamentals of searching (i.e. keywords, Boolean) in previous courses, however they showed difficulty connecting these skills within EBM. Additionally, students, both directly and indirectly, indicated that they lacked motivation and failed to see the relevancy of the course within a larger context. This was corroborated by librarian reflections of the course. Several studies have shown that when EBM instruction is interactive and demonstrates relevance to clinical outcomes, students perform better and are more motivated to learn.¹⁷⁻¹⁸

Examining the students’ technical skills was of special interest to librarians because of the addition of the online content within the blended model. Before incorporating technology based instructional components, librarians needed to know that students were ready. Campbell notes that, “the danger of incorporating new technologies into library instruction without conducting a thorough analysis of the students technology skills is that the students may have a significant gap in their skill set when it comes to using technology.”¹⁹ Because misjudging technical skills could be detrimental to the success of the course, librarians assessed student technological skills in other courses to determine how transferable they would be. General consensus was that students were proficient enough

with multimedia, course management software and a variety of databases, that there was no concerns that they would not be able to utilize any potential technologies that EBM course would employ.

Additionally, and perhaps most importantly, librarians preformed a task analysis of the steps that learners needed to take to competently and comprehensively preform an EBM task. The task analysis is critical because its connection to the later development of instructional objective in the design phase. The task analysis takes information from those closely involved with the task, in this case EBM, and attempts to identify the essential parts needed to competently complete the task and break them down to a granular level. Kumar, Ochoa & Edwards note that the “diversity in students’ information literacy skills evidence in the research reinforces the need to identify those skills and design program-specific or course-specific instruction that addresses the needs of the group of students in a course or program.”²⁰

Design

The design phase is the point where the designer can take the information that was gathered in the analysis phase and begin to create a plan that will bridge the gaps that were identified. The primary product of this phase is the composition of learning objectives that will form the basis for instruction.²¹ First, the designer must identify instructional objectives that will guide the learning process and specify what the learner must do and achieve in order to competently and independently assume ownership over as task. Next, the designer must develop assessment measures and strategies so that it can be determined that the learning objectives have been fulfilled. Finally, instructional strategies upon sound learning theory are developed to support learning.

In constructing learning objectives for the EBM course, librarians began with the task analysis that was built in the previous phase to determine what the essential segments of the EBM process are. Using these, the segments were formulated to include three essential elements, a condition for the action to take

place, an action and a performance standard related to the action.²² For instance, when building objectives for constructing a PICO, the following was developed, “*Given a clinical case, student will identify appropriate PICO elements fully and in their correct categorization.*”

Next, librarians created assessment strategies to measure if objectives have been reached. Assessment should link to the objectives, so that what is being assessed is directly related to the objective itself. Taking the previous PICO objective example, the librarians developed the following assessment strategy, “Students, as a large group, will be provided with a clinical case and asked to identify each PICO element from the case. Students will be questioned about the reasoning for their selection by the instructor and other students with the expectation to defend their decisions.” While many assessments, such as the example above, can be formative and used for guiding instruction and student performance, others can be summative (such as an exam), or confirmative and made to measure the sustainability of learning over time.²³

Finally, the designer should determine how instructional strategies will be used to assist learners. Having a firm understanding of learning theories will aid the designer and instructor immensely at this stage. An effort was made within the EBM course to develop strategies consistent with a constructivist framework. Cooperstein and Kocevar-Weidinger suggest constructivism possess qualities in which, “learners construct their own meaning, new learning builds on prior knowledge, learning is enhanced by social interaction, and meaningful learning develops through ‘authentic’ task.”²⁴ As such, librarians strove to build formative and summative assessment activities that are authentic, allowed students to construct meaning, and used social interaction.

Development

In the development phase the objects that are defined by the structure previously established in the design phase are created. This can typically entail creating handouts, websites, lectures, assessment tools or

slides. This can be a cyclical process in which the object starts as a prototype, the product is produced, a formative evaluation takes place, and finally revisions are made.²⁵

With the learning objectives establishing a general framework, the next phase called for librarians to produce the objects and materials that would support student learning. In the EBM course this phase resulted in two efforts, creating online modules that would support the blended learning methodology and evaluating and redesigning existing materials that exit with the face-to-face environment.

In the past the major considerations for instructional materials and objects was based content. However, as Clark notes, “it’s not the medium that causes learning. Rather it is the design of the lesson itself and the best use of instructional methods that make the difference.”²⁶ For the EBM course, Librarians specifically looked to constructivist and multimedia theory to promote active and authentic learning.

When developing online modules for the EBM course librarians paid special attention to how information was presented. As much as possible, the module attempted to apply Mayer’s multimedia effects.²⁷ For instance, when creating online material librarians used the *Personalization Effect*, that suggest that learning and motivation is increased with narration and text that speaks to the learner as part of the learning process and not external to these efforts.²⁸

Additionally, online modules attempted to further apply constructivist-learning methodologies wherever possible. Students begin many of the EBM online modules by working through clinical case scenarios with the help of a narrator, further along students are confronted with other scenarios and are asked apply knowledge without assistance. Based on the choices that students make, they are presented with specified feedback that helps them to formulate their learning experience. In this way, scaffolding is used to successively allow students to become more independent and motivated. McLaren notes that a “learner-centered design understands the need to offer learning support while at the same time encourages independent learning.”²⁹

Implementation

In the implementation phase, the design and development are completed and the wheels of the instruction are set into motion. In the EBM course students were presented with the blended learning component one-week prior to face-to-face instruction began. Students were instructed to view and complete all activities for all nine modules and then take a short assessment (a multiple choice quiz) after each module. The modules were placed within Canvas, the college’s learning management system, in such a way that students were required to view and complete the assessment of each module in a sequential order. While the outcome of these assessments played no part in their final grade, students were told that completion was mandatory.

On the first day of formal EBM training, students were given a shot cumulative quiz covering information in the online modules to gauge their cumulative comprehension and to function as a pre-assessment. During face-to-face instruction, materials that were covered in the modules were reviewed but the extent and time allotted to formally instructing content on these subjects was dramatically reduced compared to previous years’ classes. In addition, more emphasis was placed on having students actively engage with the materials, so that they could test their new skills.

To make sure that the EBM course succeeded, it was important that the online components did not exist in isolation and that there was a connection to face-to-face instruction. To connect what students learned online, librarians constructed activities that would allow students to test new knowledge within authentic task, such as utilizing problem-based learning case scenarios. For instance, students were asked to examine clinical case scenarios in groups. The students constructed individual elements within the EBM process, such as PICO and search strategies, but also needed rationalize how these pieces worked together. Cooperstein and Kocevar-Weidinger note that, “students must think about and process the activity, not simply replicate an action, in order for learning to take place.”³⁰

Librarians also used other techniques that obliged students to reflect on why they did what they did. For instance, Schiller suggests the use of the Socratic method within information literacy.³¹ This method is especially useful in EBM when students either have erroneous or misguided ideas of how EBM works. In this method students are not instructed explicitly through traditional instructor-centered means, but through “an instructor using questions to prod students into critically examining their opinions.”³²

Evaluation

Previously we have mentioned formative assessments to help gauge and direct student learning. It is at this point, after the instruction has been delivered, that summative assessment takes place. Bell and Shank suggest that, “the best way to do that is to have clearly identified objectives at the beginning of the project that allow for effective assessment at the end of the project.”³³ The summative question for most instructional projects will ask if the learning gaps have been effectively addressed.

For librarians in the EBM course, the main performance and learning gaps pertained to PICO development, clinical question formulation, and database searching in addition to motivation and relevancy of the course to the practice of medicine. Two methods were used to determine if instructional goals were met in this course. First, librarians examined students EBM assignments to determine if student understanding of the different facets of EBM is evident. Additionally, student motivation and understanding of the relevancy of EBM to the practice of medicine were gauged through several surveys that students completed throughout the course.

Students were surveyed at three points during the course: immediately after completing the online modules; after completing two classroom sessions; and third, at the end of the course, having completed a further two classroom sessions.

To begin with, two questions in the first survey specifically addressed student preference viewing

course materials relating to the basics of EBM. Seventy-seven per cent of students reported enjoying the e-learning environment for this purpose as opposed to the learning in-class (figure 1). However, when questioned as to their preference for online, in-class, or a blended approach, 74% of students indicated a preference for the combination approach (figure 2). Together, these results suggest that while student acceptance of the e-learning mode of delivery was high, the majority of students inherently preferred an approach that linked their online learning with activities in the classroom. This was in line with the implementation philosophy adopted for the course, incorporating in-class clinical scenarios and Socratic questioning to reinforce material previously seen online.

Students were also questioned regarding how well they thought the e-learning modules had prepared them for applying their basic knowledge of EBM in the classroom. As shown in figure 3, the proportion of students who thought the e-learning modules were adequate preparation was only slightly more than half the class; however, this increased markedly after two classes (95%) and remained high after they had par-

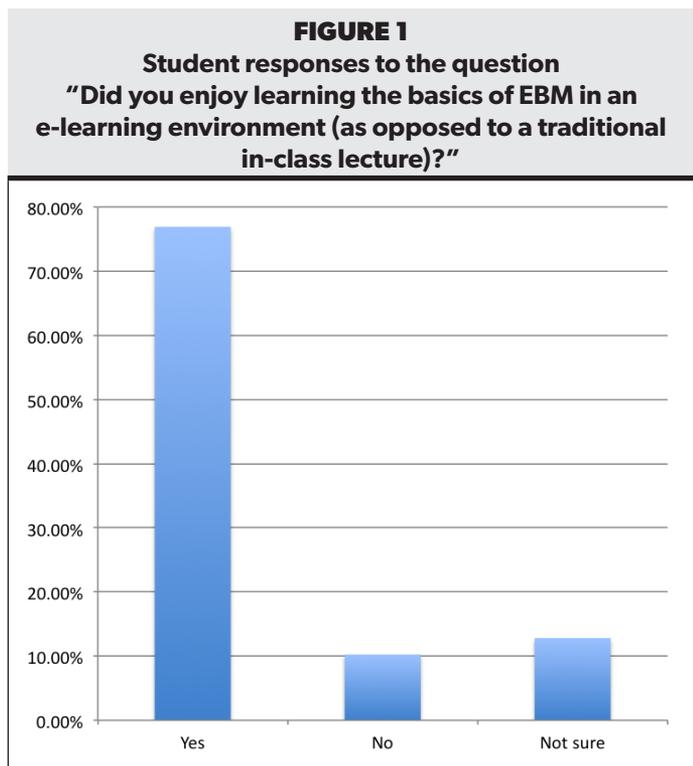
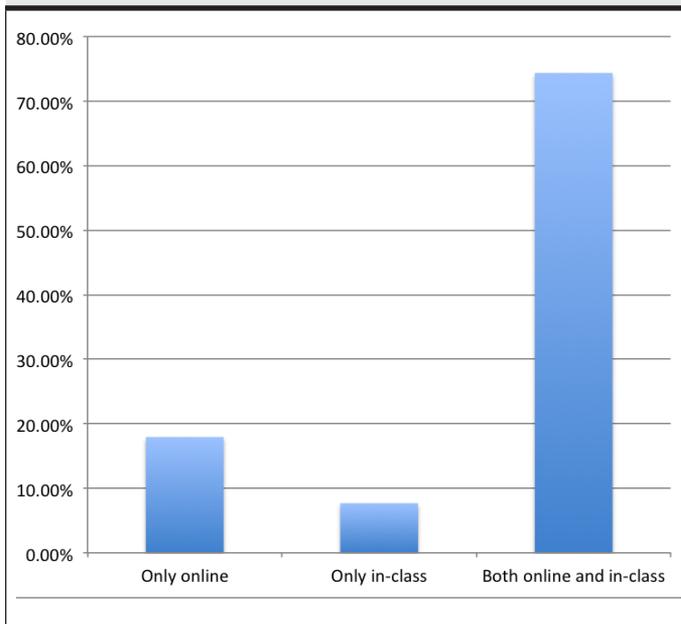


FIGURE 2
Student responses to the question of EBM in an e-learning environment



ticipated in all four classes (90%). Concurrently, the proportion of students who considered they had not been inadequately prepared by the e-learning modules fell from 10% to 2.5% and 5% respectively. The relatively low initial positive response appears to reflect a conservative view among 35% of the students that they could not be sure how well prepared they were for something they had never experienced.

To determine the effect, if any, of the blended learning environment on student performance, student grades for the questions addressing PICO, clinical question formulation, and database searching were examined. Student scores on these questions were compared with the scores from the previous year’s course, which had been taught in a traditional classroom-only format with no e-learning component (figure 4). (This comparison was performed for only the first two sessions as the last two classroom sessions varied considerably in design and content between years.). It is appar-

FIGURE 3
Student responses to the question: “After viewing the EBM e-learning modules, do you feel adequately prepared and ready to apply what you have learned?”, immediately after completing the modules, after completing two classroom sessions, and finally after completing all four classroom sessions.

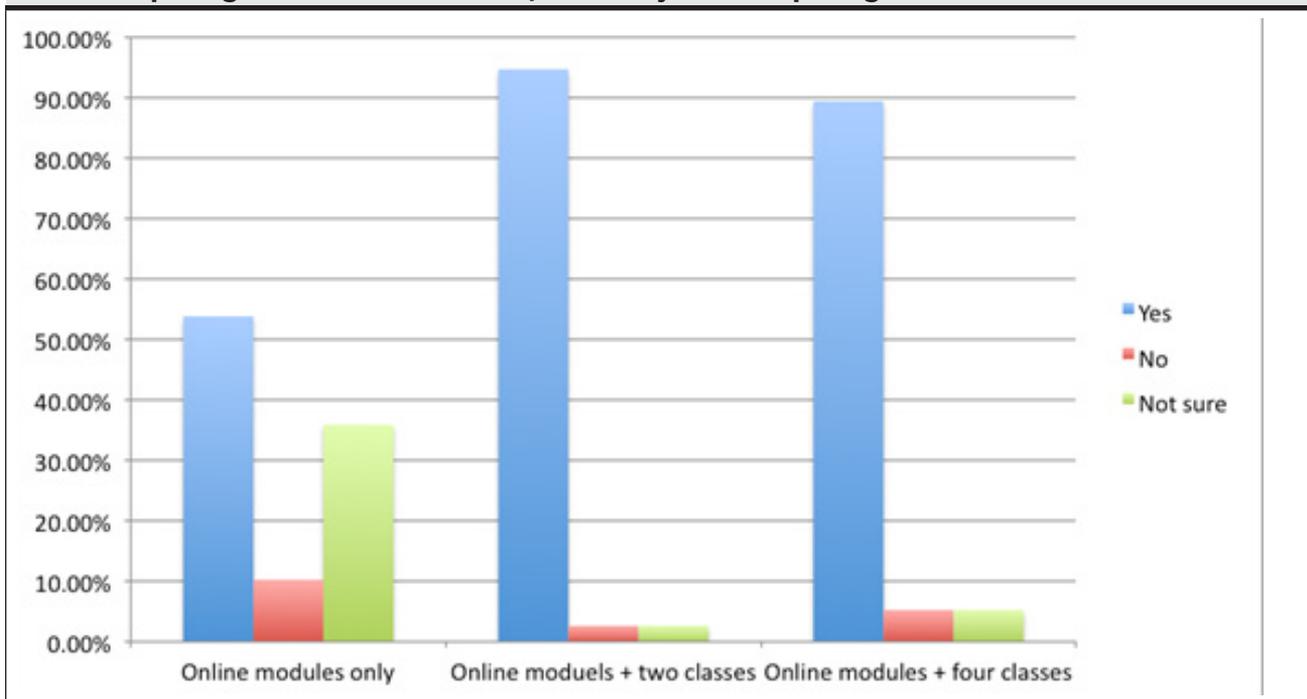
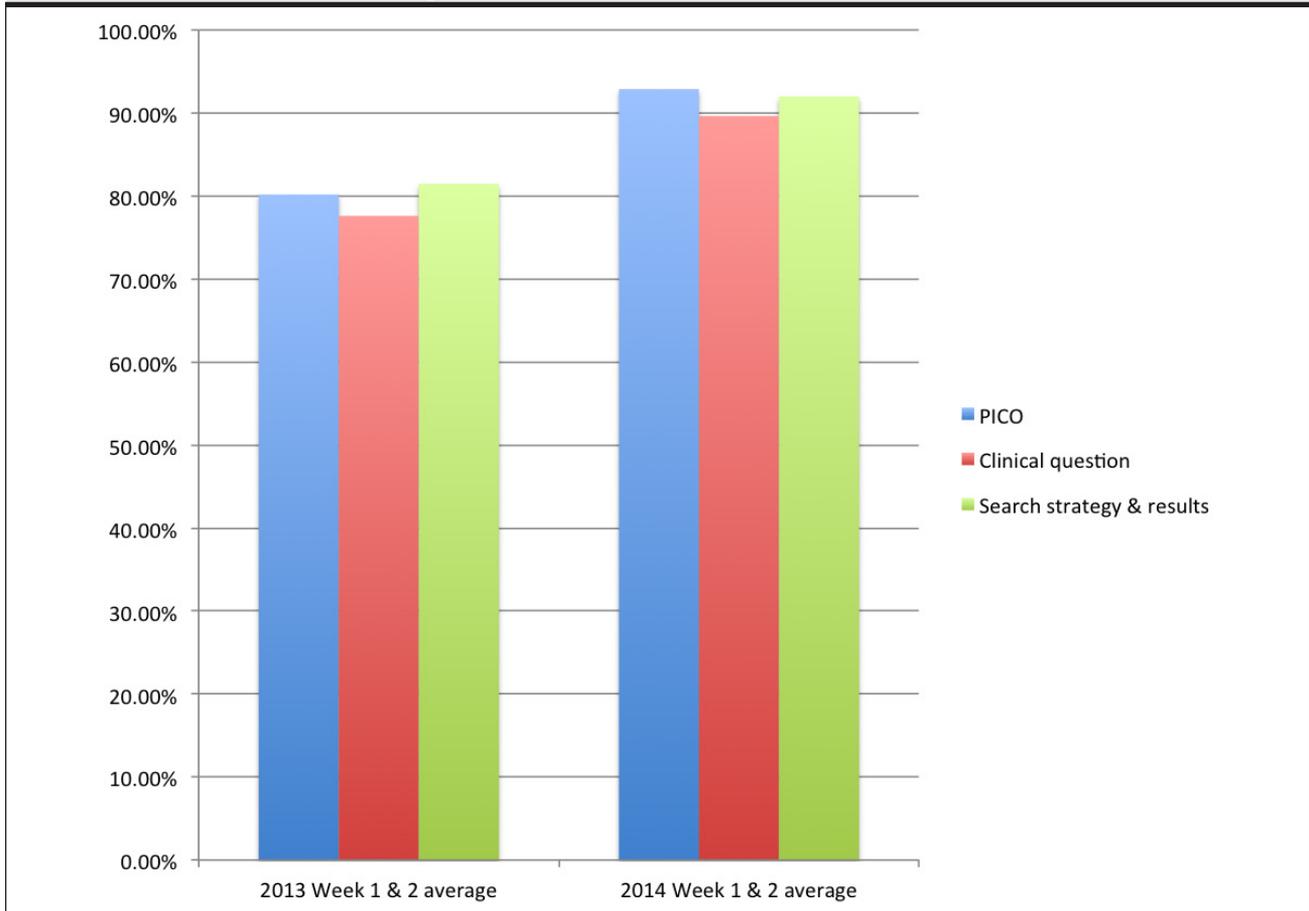


FIGURE 4
Comparison of average student scores in three questions (PICO, clinical question formulation, and database searching) over the first two classroom sessions in 2013 and 2014



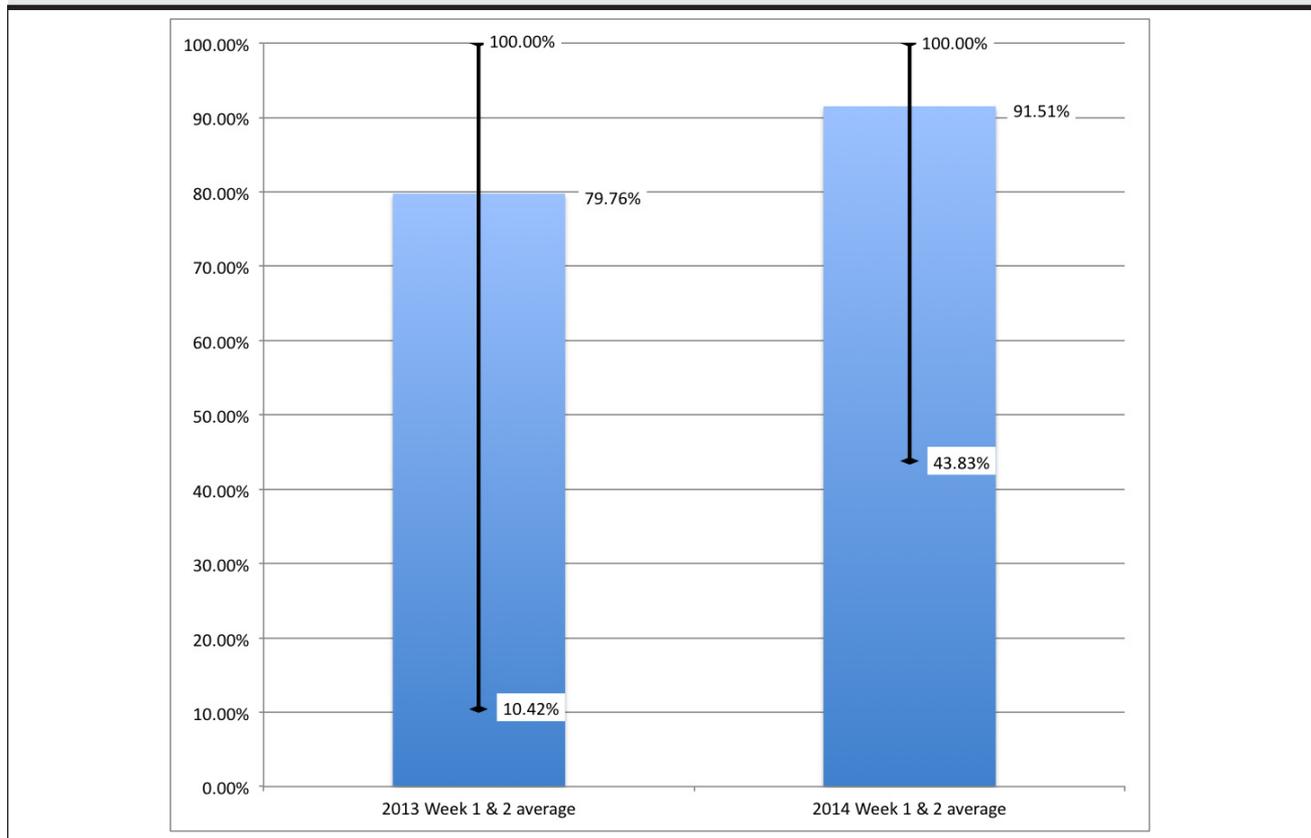
ent that there was an increase in average score for all questions of approximately 10%. Comparing the aggregate of these scores (figure 5) showed an overall improvement in score of approximately 11%. More strikingly, the lowest scores in the class rose from under 11% to nearly 44%. There was no increase in the highest scores, as individual students managed to achieve 100% in both years.

Conclusion

Using ADDIE and the instructional design methodology has made a tremendous impact on every aspect of the EBM course at WCMC-Q. Previous adaptations of this course were content driven and instructor-centered. However, with a new focus on not only the content within the course, but also how

that content is delivered to students, the course has seen multiple gains. Students now see the course as relevant and meaningful. The blended learning approach adopted here proved to be a good fit with the learning preferences of the students: not only did they like the online mode of delivery, but they preferred it combined with in-class reinforcement. Students' perception of themselves as being well prepared by the e-learning modules actually increased with exposure to in-class activities that required them to apply their online learning. Finally, comparison of student scores in the first two sessions indicated a considerable increase in learning. While average student scores increased, the comparatively large increase in the lowest class scores suggest there was a particular advantage to students who would

FIGURE 5
Comparison of average, minimum, and maximum student scores from three questions combined (PICO, clinical question formulation, and database searching) over the first two classroom sessions in 2013 and 2014



otherwise have struggled with the application of the basics of EBM to clinical scenarios.

Using the instructional design and the ADDIE model is a massive benefit to librarians. Any librarian, with the right skills, creativity and determination, can build interesting and effective instruction that is learner-centered and objective-oriented. Although the above case is one of a blended learning environment in a medical school, it is easy to see how this approach can be applied to very small, one-shot courses or large and sustained efforts. Additionally, because ADDIE is very flexible and non-linear, it allows for great variation and specificity. One of the most evident and beneficial elements that come from using instructional design is that it allows the librarian to move away from the content- and instructor-orientated models of instruction that we often see. Instruc-

tional design places emphasis on the construction of learning and not on content. Because of this, librarians can focus on what is of real importance and work towards outcomes that are real and sustained.

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