

Constructing an Online MCAT Preparation Program as an Alternative to On-Site Preparation for Medical School

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Abstract

Based on a successful five-week summer program, we constructed an online alternative to prepare Hispanic students to take the Medical College Admission Test (MCAT). We used input from student premed advisors, students, a faculty mentor, a Verbal Reasoning coach, and the program administrator. Online activities were provided to support the student commitment of 10-12 hours per week for 12 weeks. We included didactic material, an online community, individual coaching, daily announcements, and structured activities to maintain student interest throughout the 12-week program. This case study may provide guidelines on the elements necessary to a successful online program.

Keywords: online learning, Medical College Admission Test, MCAT, diversity, Hispanic students, mentoring

1. Introduction

1.1 Programs to Prepare Underrepresented Students for Success in Medical School

For many years, United States federal and state funds have supported premedical enrichment programs to encourage minority and disadvantaged students to pursue medical careers. Traditional programs have embraced bringing the students to medical school campuses and exposing them to the medical school experience which includes, but is not limited to, meeting the faculty, experiencing medical courses, shadowing of a diverse realm of specialties, and admission advice (Murray-Garcia & Garcia, 2002; Parrish, Daniels, Hester, & Colenda, 2008; McDougle, Way, & Yash, 2008; Blakely & Broussard, 2003; Giordani et al., 2001; Crump, Byrne, & Joshua, 1999; McGlenn, Jackson, & Bardo, 1999; Thomson, Ferry, King, Martinez-Wedig, & Michael, 2003; Lieberman, et al., 2010). This may also be accompanied by intense academic preparation for the Medical College Admissions Test (MCAT), a standardized test of academic preparation for medical school in the United States (McGaghie, 2002). Until 2012, the MCAT consisted of three multiple-choice sections in the Biological Sciences, Physical Sciences and Verbal Reasoning (now called Biological and Biochemical Foundations of Living Systems, Chemical and Physical Foundations of Biological Systems, and Critical Analysis and Reasoning Skills [CARS]) and an essay writing component, administered during one four-hour period. The essay was eliminated in preparation for major changes that included the addition of a section on Behavioral Health (Psychological, Social and Biological Foundations of Behavior) and a greater emphasis throughout on critical thinking skills.

1.2 Preparing Students with a Five-Week Summer Preparation Program

From 2011 to 2013, we conducted an on-site summer five-week MCAT preparation program for 50 undergraduate rising juniors and seniors. The students came from across Texas and were predominantly Hispanic. We modelled the program on existing undergraduate summer programs in our institution, but designed our courses from the ground up. We contracted faculty for the science courses (biology, chemistry, organic chemistry, and physics). We added a biostatistics course to introduce the concept of public health, article dissection to improve analytical capabilities, CPR certification, personal health and wellness, a library workshop focused on finding and validating scientific/medical information online, one-on-one mentoring sessions for rising seniors, and shadowing opportunities across disciplines and in our medical student run clinic. We recruited a senior

science editor to create the Verbal Reasoning course, teach learning skills and hold personal statement workshops.

1.3 Constructing an Online Program

Despite our best efforts, students continued to be underprepared for the MCAT, the major roadblock to their entrance into medical school. We sought to devise a method to best prepare and motivate students to pass the MCAT, focusing on what could be accomplished in an online environment, constructed with limited resources, and provided asynchronously so that students could work the program into their schedule. Within this framework, engagement and self-motivation were intrinsic to the voluntary nature of the program and lack of non-completion repercussions. We first looked for similar programs at other institutions and found none reported in the literature. To construct our online program, we identified the problems to be addressed by this program, the key players and their roles in the development and administration of the program, and the resulting elements the program would need in order to be successful. This program may serve as a case study of how to construct an online program with students matriculated at other institutions.

1.4 Literature Reivew

By its nature, study for the MCAT is a voluntary undertaking resting on the day-to-day motivation of the individual to achieve and enter medical school. Additionally, our online program was free to students and conducted outside of their undergraduate institution courses. Only the student could choose to maintain momentum. Dennis, Bunkowski, and Eskey (2007) presented a classical literature review of motivation which offered strategies to sustain motivation with the idea of creating deeper learning experiences for the student. In particular, the authors proposed a campaign of directed actions with specific goals that would connect with today's students. Learners need to understand clearly what is expected of them and what actions demonstrate comprehension in order to motivate them. Learners must each be empowered with control of their learning (Dennis et al., 2007).

This motivation becomes even more important in terms of outcomes. Artino (2007) claimed a direct relationship between student choice of the online environment (choosing to participate in a course, having taken courses previously in an online environment, or intent to take further online courses) and student satisfaction, perceived learning, and task value. Perceived successful engagement in an online environment led to more successful engagement in the learning experience. While this study was limited in scope, the author concluded that a learner-reported positive online learning experience provided intrinsic motivation, potentially sustainable by further positive experiences. Positive engagement within the online classroom and program would motivate the student to more positive engagement.

Could the advisors/facilitators be the pivotal success factors? Woodthorpe, Shaw, Hauck, and Beaven (2009) concluded that tasks non-essential to grades were perceived as having minimal value, and teacher-guided motivation was crucial to sustaining participation and perceived value. Fritz (2011) also found that self-motivation is not always the answer and that instructor input was crucial to creating self-motivation. Instructor-initiated motivation, Fritz (2011) argued, could be positive and successful. In this study, the author found that underperforming students were accessing the content management system 39% less than more successful students.

1.5 Research Design

We concluded that student buy-in to a study plan through adoption of provided options, refinement, or joint creation would give ownership of the process to the student and create better engagement. The online classroom and engagement with advisors would be judgement free and each result would be a positive step along the individual's path. Clear expectations and mentorship would be key to maintaining student motivation and engagement.

2. Method

2.1 Problems to be Addressed

We used lessons learned from our on-site program to develop an online, asynchronous MCAT preparation program. Feedback from instructors (including basic science course grades, practice exams, and student engagement) from students (including course reviews and overall program reviews) and staff observations led us to conclude that a broader scope of **engagement** was needed to prepare these students. We observed that our students spent no more than three weeks preparing for the MCAT, not more than three to four hours each week, and were inconsistent from week to week. Our students also worked, were committed to extensive family

activities, and dedicated time to multiple student organizations. Students also tended to use one review source, often outdated, or attempted to memorize text books. Very few sought resources online. Based on these observations, we concluded that students needed **structure** to study; a plan on what to study, how to study, how long to study, and why to study; and access to a mentor/advisor. Informal reviews of the literature and online resources such as WikiPremed and the Student Doctor Network indicated that three to four months of self-preparation were standard in order to obtain a competitive score on the MCAT (Student Doctor Network, 2017; Wetzel, 2017). Because of their disadvantaged status, we believed our students would require more **time**, daily **supervision**, and outside **motivation**. Realistically, asking students to commit to 10 to 12 hours a week was practical only as long as we structured a time-specific plan. We used Canvas Instructure to provide a platform to deliver the engagement, structure, time commitment, supervision, and motivation students needed (Table 1).

Table 1. Program Layout in Canvas (engagement, structure, time, supervision, motivation)

Type	Description	Purpose	Maps to
Daily Announcements	Inspirations, links to resources, study skills, important information on the program	Provide motivation for students to continue	Motivation
Didactic Modules	Weekly science assignments + Verbal Reasoning	Provide intellectual content and study strategies	Engagement, Time, Supervision
Discussions	Weekly topics were posed on Monday and students encouraged to discuss them through the end of the week	Allow for student interaction with peers to support and encourage intellectual curiosity	
People	Contact information provided	Peers to contact each other	Motivation
Files	Readings, pdfs, etc.	Houses additional resources	Motivation
Quizzes	Exercises related to the topics of that week (see Table 3)	Provide both a means of self-assessment and another form of accountability	Supervision

2.2 Key Players and Their Roles

We identified five key players who would need to contribute to the program to make it successful: the campus premedical (pre-med) advisor, the student participants, the faculty advisor, the Verbal Reasoning coach, and the program administrator. The premed advisor would identify premed students whose grades were good, but who needed additional help in preparing for the MCAT. Students would agree to commit 10-12 hours a week to a rigorous 12-week program. The faculty advisor would commit time each week to an online synchronous hour for discussion and advice, as well as provide guidance to program attendees. The Verbal Reasoning coach would recreate instruction on Verbal Reasoning in the online environment and provide additional instruction in study habits, time management, and test preparation. The program administrator would gather all materials, devise a program, build the online environment, administer the program, and help students with administrative issues (i.e., how to log on, problems with connecting, etc.).

2.3 Elements of the Program

Our experience with an on-site summer program and knowledge of similar postbaccalaureate programs (Murray-Garcia & Garcia, 2002; Parrish, Daniels, Hester, & Colenda, 2008; McDougle, Way, & Yash, 2008; Blakely & Broussard, 2003; Giordani et al., 2001; Crump, Byrne, & Joshua, 1999; McGlenn, Jackson, & Bardo, 1999; Thomson, Ferry, King, Martinez-Wedig, & Michael, 2003; Lieberman et al., 2010) indicated that students would need didactic materials, a path through the 12 weeks of the program, encouragement to continue, feedback on their progress, and a sense of community.

3. Results

3.1 Timeline of Events

We developed the program over the fall of 2013. We constructed a 12-week online asynchronous program in Canvas using established best study practices, based on a review of commercial study programs, Wiki Premed, and the Student Doctor Network online materials (Student Doctor Network, 2017; Wetzel, 2017). Some of the material from the Student Doctor Network is now available in book form (Becker & Burnett, 2010).

3.2 Contributions of Program Partners

3.2.1 Pre-Med Advisors

To build accountability into the system and strengthen ties with available resources at their home institutions, qualified candidates were required to apply through their pre-med advisor. Pre-med advisors served as recruiters and gatekeepers. Because some students are non-traditional, pre-med advisors also identified graduates who might be good candidates for medical school. We asked the advisors to supply an unofficial transcript and a short recommendation for each student. A review committee of medical school faculty (MDs and PhDs) assessed the records of each student and recommended those most likely to benefit from admittance into the program.

3.2.2 Students

Forty-nine unique students enrolled in the MCAT Online Program and 123 unique students attended the on-site program. Table 2 below provides the demographic characteristics and follow-up results for both groups. Demographically, the two groups were similar: slightly more female than male, mostly Hispanic and other minorities, and many reporting a language spoken at home other than English. For both cohorts, a large number could not be followed up. Of those reporting their career path, slightly more of the online students reported attending medical school (39% versus 26%) but both cohorts reported the same percentage (12%) pursuing some a healthcare profession other than medical school.

Table 2. Demographic characteristics and outcomes for online program and summer attendees

	Online Program attendees (n=49)	Summer attendees (n=123)
Demographics		
Gender (male, %)	19 (39%)	54 (44%)
Race/Ethnicity (not non-Hispanic White, %)	44 (90%)	112 (91%)
First Language not English (n, %)	33 (67%)	110 (89%)
Outcomes		
Attended medical school	19 (39%)	32 (26%)
Other Health Care field	6 (12%)	15 (12%)
Other career path	0	4 (3%)
Still in school/lost to follow up	24 (49%)	72 (59%)

Students in the online program were required to have a 3.5 overall Grade Point Average (GPA), a 3.6 science GPA, and to have completed the required science courses. Students invited into the program received intensive orientation the first week (Figure 1). They were introduced to the Canvas program site and given a tour of the different sections. They were instructed in how to join online discussions and shown where they could contact each other, the course administrator, or the faculty mentor.

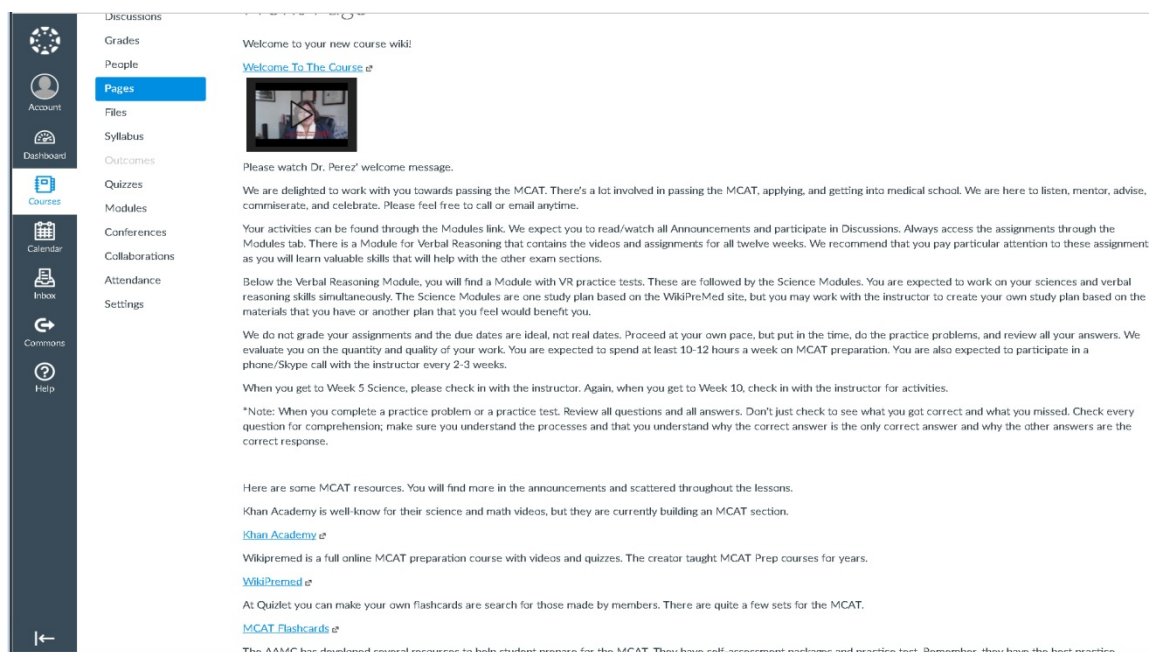


Figure 1. Screenshot of Canvas website for Online MCAT Preparation Program

Students were encouraged to keep up with the weekly timetable (Table 3) and to work in the Canvas classroom at least four days of the week. They submitted assignments to demonstrate participation, but not for grading. They were responsible for reviewing each of their practice questions and ensuring that they understood why the correct answer was the only appropriate answer and why each of the other answers were incorrect. This process helped show the students how to take responsibility for their own learning.

Table 3. Sample weekly schedule of activities

Week 3	Wikipremed (Science) Plan	Activities	Deliverables
	Assignment 1	Work, Energy, and Power (videos, reading, vocabulary review, crossword puzzle, practice questions, review questions and make notes, flashcards) Work, Energy, and Power Quiz	Answers to crossword, practice questions, notes, and quiz
	Assignment 2	Discussion (Provide response to discussion question, respond to 2 classmates)	Responses to discussion questions
	Assignment 3	Momentum and Impulse (videos, reading, vocabulary review, crossword puzzle, practice questions, review questions and make notes, flashcards)	Answers to crossword, practice questions, and notes
	Review	Review weeks 2 and 3 readings, conceptual vocabulary, and physics subtopics outline	
Week 3	Verbal Reasoning		
	Reading Plan	Reading Plan: video on creating a reading plan for humanities, social sciences, natural sciences, and technology, creating reading lists, and sources of readings, practice critical reading not skimming	Reading lists
	Assignments	Take Verbal Reasoning Practice 2, review answers and note types of mistakes, record in spreadsheet, plan readings	Update spreadsheet with test results and types of mistakes

3.2.3 Faculty Advisor

The faculty advisor recorded a “welcome” video for students to view during the orientation. The advisor also attended each weekly meeting (conducted in Canvas) during which topics related to the MCAT and medical school were discussed. The advisor provided guidance to program attendees via Skype, phone, and email.

3.2.4 Verbal Reasoning Coach

The Verbal Reasoning component was given its own 12-week module as this was another area in which our students needed more instruction because many spoke English as a second language and their science-based education provided limited opportunities to enhance their verbal reasoning skills. This section included videos, PowerPoint presentations, and forms for the students to document their progress. At the students’ request, the instructor did a real-time sample test, talking through the questions while selecting answers; she then graded her responses and talked about why she missed some of the questions (e.g., confusing wording, trying to hurry, mental fatigue).

3.2.5 Program Administrator

The Program Administrator gathered materials, set up the online classroom, assembled and send out the daily announcements, set up online discussions, and provided a conduit for classroom activities.

3.3 Structure

In the online classroom, we laid out twelve weeks of modules focused on the science portion of the MCAT, primarily drawn from the structure provided by Wiki Premed and our own structure devised for the Verbal Reasoning section. For example, in Week 3, students studied the following for Chemistry: modern periodic properties, chemical bonding, intermolecular force, organic functional groups, stereochemistry, and molecular spectroscopy; for Physics, they studied nuclear physics and atomic theory; for Verbal Reasoning, they devised an outside reading plan to help them increase reading speed and sensitivity to context in interpreting texts. For the science topics, we chose Wiki Premed because it initially focuses on physics, which was a problem area for most of our students. In addition, Wiki Premed had videos, was free, and was readily available to all students. We asked students who followed these modules to obtain the ExamCrackers study guides to support the activities. Alongside the Wiki Premed activities, we added links to other lesson sites and academic resources.

3.4 Other Online Resources

Other sections of the Canvas course provided additional resources to reinforce retention and learning (Table 1). A daily announcement section was used to offer alternative three month study plans, general study tips and MCAT specific study tips, inspirational quotes and articles, tip of the day, topic specific resources, online MCAT resources, recommended apps, course announcements, video resources, life tips, and just for fun (Figure 2). The announcements were a daily reminder that real people were involved with the student’s preparation and actively seeking to support their efforts. A people section housed contact information for students and faculty, but also allowed us to view student time in the classroom and progress in the activities. The file section housed reading materials, relevant pdfs, Excel sheets, and other uploaded materials.

Announcement Title	Author	Date
MCAT Flashcards - some free, some pay	Berengaria Navarre, MS	May 13, 2016
Pre-Med Summer Reading List	Pre-Med/Life Staff	May 13, 2016
Build Effective, Efficient Study Habits for Medical School		May 13, 2016
Kimball's Biology Pages and other bio resources	Kimball's Biology Pages	May 13, 2016
6 Critical Thinking Skills You Need to Master Now	Grant Tiluson	May 11, 2016
Inspiring Stories There's a story behind every application.	Berengaria Navarre, MS	May 10, 2016
Punctuation and Grammar - They're not just for special occasions		May 10, 2016
How I got a 525 (from Reddit)	Berengaria Navarre, MS	May 9, 2016
AAMC - Creating a Study Plan for the MCAT Exam		May 9, 2016
AAMC Sample FL Score Conversion Tables	Berengaria Navarre, MS	May 6, 2016
510 is the new 30 - Scoring the MCAT		
The MCAT on Reddit		
AAMC MCAT2015 Mini-Test e-book		
Reflection is the Most Important Part of the Learning Process		
Reddit Wiki on 2015 MCAT Feedback		
Study Plans from SDN		
Free Biochemistry Textbook and Lectures	Oregon State University's Dr. Kevin Ahern and Dr. Indira Rajagopal	May 24, 2016
Physics Review Sites	Wisebridge Learning Systems	

Figure 2. Screenshot of daily announcements

3.5 Open Communication

A key component in the design and implementation of the program was the mentorship and advisorship. Each student received a phone call to discuss the program before they were admitted and were required to participate in one-on-one phone calls at least every two weeks. Students who did not work within the online classroom in a given week were emailed and then called. Calls were framed as a positive way to get the student “back on track” as opposed to a punitive measure. We often reiterated that students could call our offices during office hours and we would arrange phone calls outside office hours. All student emails were answered within 24 hours. Students readily availed themselves of the opportunity to speak with us about the MCAT, study plans, medical school admissions, personal statements, personal and family issues that affected their studies, or simply to connect with someone that day in a judgement-free space.

4. Discussion

The MCAT is a valid prediction of success in medical school, particularly passing the US Medical Licensing Examination (USMLE) Step 1 test (Julian, 2005). Online materials for the science are readily available; by themselves, they will not assure success. Online students require engagement, structure, a time commitment, daily supervision, and outside motivation. In particular, satisfaction with an asynchronous online course and perceived learning have been linked to clear course design, interaction with instructors, and active discussion with other students in the course (Swan, 2001). Our program provided all of these, by gathering materials, developing new content, scheduled online discussions, and providing personal contact with both the program advisor and the program administrator.

Although our intent was to provide an alternative to on-site MCAT preparation, we quickly realized that this program needed an intensive time commitment in order to help students with their plan of study. Initially, students started out with the plan in our learning management system, Canvas. As the students progressed, we worked with them individually to access progress and to tailor the plan to meet their needs. We worked to eliminate weaknesses and to increase the number of practice questions done and reviewed. We helped them to

decide how often they took practice tests and to interpret the results. We helped them decide test dates and when it was prudent to postpone. We also devoted many hours to reinforcing students' commitment to the program. All students required regular encouragement, support, and advice. When their efforts did not meet their expectations, they required intense mentoring.

The Verbal Reasoning portion of the test, now called Critical Analysis and Reasoning Skills (CARS), directly addresses the ability to apply critical thinking skills. Success on this section has been directly tied to student performance on the USMLE Step 1 test, administered after the first year of medical school and an important measure of retention (Julian, 2005). At the time this program was developed, no online sources provided guidance for this section. After the Program was administered, the Verbal Reasoning instruction was published in book format to benefit other students (Toombs Smith, 2014). Critical thinking skills have long been recognized as essential to student development into independent learners (Halpern, 1999). Khan Academy (2017) now devotes a section of its MCAT Preparation area to CARS.

Although its predictive value has been called into question (Donnon, Paolucci, & Violato, 2007), the MCAT remains an important fixture (some would say a roadblock) of the path into medical school. Students prepare to take the MCAT in a variety of ways, from the most structured to the most disorganized. These methods include individual study, informal or formal groups, such as undergraduate premed groups (Rumala & Cason, 2007), using study texts, online resources, or in formal classes such as those offered by The Princeton Review (2017) or Kaplan Test Prep (2017). Ranging from a few weeks to an entire summer, these programs can cost over \$9,000 for a six-week program (not including room and board). The usefulness of these professional preparations methods has recently been called into question (McGaghie, Downing, & Kubilius, 2011).

Universities have increasingly turned to the online environment for some or all of their instruction, to reduce costs while maintaining quality (Twigg, 2003). For medical school, preparation may include an additional post-baccalaureate year to increase the likelihood of success (Lipscomb, Mavis, Fowler, Green, & Brooks, 2009). Disadvantaged students continue to matriculate to and stay in medical school at rates below those of majority students (Sullivan & Mittman, 2010; Odom, Roberts, Johnson, & Cooper, 2007). Because their presence is important in the medical workforce (AAMC, 2017), efforts will continue to find ways to help such students succeed.

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