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COMMENTARY

A Flipped-Classroom Model that Integrates Basic and Clinical Sciences in a New Medical School; the First 2 Years at the Alabama College of Osteopathic Medicine

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Introduction

It has been more than a century since the Flexner Report first documented the variation in premedical school applicant exposure to the sciences [1]. The recommendations of the Flexner Report resulted in the teaching of a more solid knowledge foundation of the basic sciences. Since the implementation of these recommendations, the knowledge base of basic sciences and clinical sciences has continued to grow while the length of medical school has remained constant [1, 2]. Although the amount of information has expanded, we continue to use a traditional 2 plus 2 curricular model (2 years of basic sciences followed by 2 years of clinical sciences) with the main efforts of integration of the basic and clinical sciences occurring in the first 2 years of the curriculum. Before entering medical school, students are required to complete a minimum set of prerequisite courses. However, a number of enrolled medical students have taken additional undergraduate or graduate courses beyond the prerequisites in anatomy, biochemistry, or physiology. In addition, some students have completed advanced degrees in individual disciplines such as physiology or microbiology. This results in a substantial variation in the level of exposure to the basic sciences for matriculating students.

For most Alabama College of Osteopathic Medicine (ACOM) students, medical school is more demanding than any of their previous training because many have not learned to integrate the basic sciences with each other and then to integrate that information with the clinical sciences. ACOM students begin learning how to integrate the basic sciences with each other during their first week. At the same time, the clinical sciences are correlated to what they are studying in the basic sciences. The goal of this learning approach is to shape the integrated knowledge into the clinical skills they will need to successfully complete their clinical rotations in years 3 and 4. Medical students must integrate basic science information and clinical science information both vertically and horizontally [3–6], and to do this successfully, they must learn in a way that is different from their past learning experiences [7]. In our curriculum, students enroll in a series of system-based courses beginning with Anatomical Sciences and Molecular Medicine, which is an umbrella for basic sciences consisting of biochemistry, genetics, physiology, genetics, microbiology, introductory pathology, and pharmacology. In this and the latter system courses, horizontal integration occurs across the disciplines. While taking the system courses, our students also enroll in a course called Primary Clinical Skills (PCS). The PCS course occurs in each of the four semesters of the first 2 years. The topics in PCS can correlate with each system being taught. For example, during the cardiovascular system course, PCS students learn to diagnose hypertension and read ECGs. This is where vertical integration [7] starts to take shape. A significant part of the cardiovascular course involves developing clinical skills. In the PCS course, our students are exposed to medical simulation cases where either simulators or standardized patients enhance the learning experience. Like other programs, our students learn to integrate the anatomical sciences and basic sciences with the clinical sciences and even with the social and behavioral sciences [8]. Our students also enroll in a course called Foundations in Modern Healthcare (FMH) during the first 2 years. In the FMH course, the students receive information through interactive lectures and small group discussions. FMH topics range from medical ethics and professionalism to inter-professional collaboration and cultural

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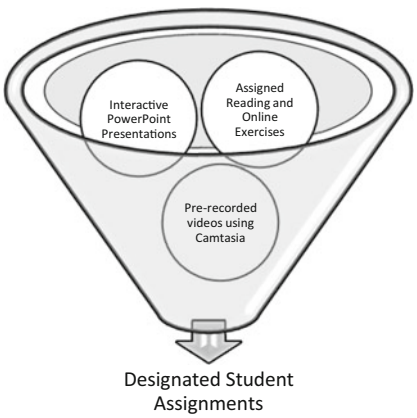
awareness. Integration of osteopathic manipulative techniques and osteopathic principles (OPP) is also critically important and is a vital part of the fabric of our educational program [9]. The OPP course content is coordinated with each system in our curriculum. As illustrated below, beginning with the year 1, fall semester courses, our students are not only learning the core basic sciences but also completing other courses simultaneously to help bridge the basic and clinical sciences.

According to Fink, students need to learn how to learn first [10]. From the beginning of medical school, students must relearn how to learn. Until that point in their education, many have relied on memorization of the facts to succeed without a real incentive to integrate the material with the curriculum as a whole. Also, students often lack the skills or motivation to learn how to integrate information. They map and connect the different kinds of knowledge they learn, sometimes without awareness of the necessary initiative needed to learn the information. Integration of information acts to reinforce information learned from multiple sources. As educators using a traditional curriculum, we can often teach in a manner that covers the objectives of our own disciplines, but then ask the students to assimilate that knowledge and be prepared for integrated board exams without first integrating the lessons ourselves. As educators at ACOM, we integrated our own disciplines to facilitate the process of integration and lead by example. Integration of basic and clinical science within and across courses is a very difficult and challenging task for any established medical institution [11], and it is especially challenging for a new institution. The challenge of integration is intensified at our school because we have limited faculty and staff [12]. However, this also works to our advantage as it reduces the communication challenge [13]. We have witnessed that integration requires the collaboration of an entire team of educators who most often have different training backgrounds, levels of expertise, and mastery of educational tools available to deliver the curriculum content. We used three instructional elements designed to help students with the integration process. These were designated student assignments (DSAs), basic science correlations (BSCs), and clinical integration sessions (CISs). Originally, the BSCs were focused on integration of basic sciences within a clinical context and the CISs were focused on clinical problem-solving. The difference between BSCs and CISs has become less distinct over time and collectively are called "Integration Sessions."

The Purpose of Designated Student Assignments

We want to enable students to connect different kinds of knowledge to optimize retention and academic success and hope this connection between basic science and clinical sciences will translate into becoming successful practicing physicians and lifelong learners. DSAs are structured independent learning assignments [12]. DSAs are usually paired with a sequential problem-based session that challenges students to apply the knowledge learned in the DSAs. The format of the DSA is determined by the discretion of the instructor or instructional team. One type of DSA format utilized by the faculty at ACOM is a reading assignment that follows the recommendations of Klatt et al. [14], keeping the time to complete the reading to a 1-h time slot that appears on the student schedule as classroom time. DSAs are also created using interactive PowerPoint presentations created with Camtasia. We found the student response to the Camtasia recordings to be very positive [15]. Student satisfaction was much greater for DSAs which included Camtasia pre-recorded instruction of biochemistry compared to other curriculum delivery formats [15]. Completion of online exercises using SoftChalk and the use of iBooks are other methods used to prepare DSAs. For the anatomical sciences, a successful form of instructional eLearning delivery was created using Adobe Captivate in the form of self-directed Learning Modules [16, 17]. All of these instructional methods funnel into what becomes a DSA as illustrated in the diagram below.

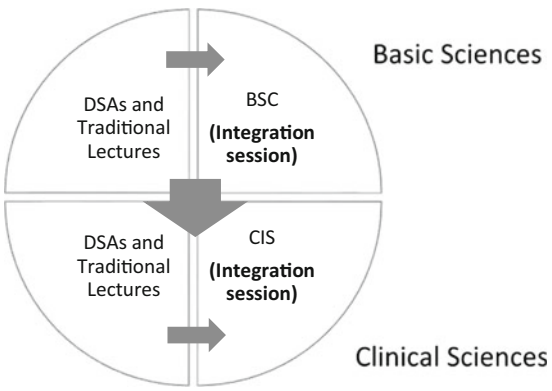


The use of DSAs gives autonomy to the students because they are able to complete the DSA at any time before the

corresponding problem-based sessions. With our learning management system, we can monitor when and how many times the students accessed the uploaded files related to the DSAs prior to participating in the in-class sessions. At other professional schools, autonomy-enhanced student motivation is associated with better learning, academic success, and less exhaustion produced [18]. In order to make DSAs more consistent, we have adopted structural guidelines for the DSAs regardless of the format used to deliver content. Each DSA must have a list of clear learning objectives that highlight the major points associated with that DSA. In addition, each DSA must have a built-in assessment of student understanding of the material in the DSA. DSAs are placed on the curriculum schedule just the same as a scheduled class. They are not add-ons; therefore, students have no reason for not completing the DSAs. We feel this is a key to making the flipped-classroom work.

The Purpose of the Integration Sessions

Our DSAs assigned by basic science faculty are typically followed by integrated sessions we call basic science correlations (BSCs) where attendance is mandatory. These sessions use a setting which involves clinical cases with questions that apply the basic science concepts underpinning the case. Some DSAs also contain embedded self-assessment material [16]. Likewise, clinical faculty follow their DSAs with a clinical integration session (CIS) that challenges students to use clinical reasoning to work through exercises such as vignettes. In general, each integration session is typically preceded by sessions consisting of 2–3 DSAs or sometimes interactive lectures. During any integration session, board-style written questions or clinical vignettes provide the opportunity for the student to apply what is learned from the completion of these sessions. The successful application of what was learned in a DSA could be viewed as having mastered the DSA content assessed in the integration sessions. The diagram below best illustrates the model in practice we have where DSAs and lectures precede the integration sessions.



The integration sessions are interactive and utilize different approaches which aim at engaging the students. One approach we use is TurningPoint, which is an audience response system. This approach allows students to answer multiple choice questions which can be presented in a board-style format during the session. Participation in these sessions is mandatory; however, we do not grade their responses. We avoid methods such as daily quizzing in each session because it has been shown that having daily quizzes does not necessarily increase student satisfaction [19], which we believe is an essential component in the success of each session. Using an audience response exercise in these sessions is a formative learning approach since the percentage of students who answered each answer choice is displayed for the entire class after the polling has closed. This is useful for both professors and students alike since it allows an instant assessment of material mastery. Before the results are presented, the floor is open for students to discuss their individual choices and why they believe it to be the correct answer, which leads to student participation and engagement. In addition, we strongly encourage students to explain why incorrect choices are wrong, which strengthens deductive reasoning. We have used different approaches to present each integrated session and encourage the class's collective participation. One approach we have used is a Jeopardy-like exercise where students are part of a team and must solve a case together and then submit a collective response. This exercise encourages a fun, competitive atmosphere as students compete to submit the first correct response. We can create an integrative approach to teaching using integration sessions because there can be more than one professor representing different disciplines involved in the construction and delivery of the integrated session. Also, during each session, the floor can be open for discussion of the answer choices among the different disciplines. In some integration sessions, we have used mannequin-based simulation with the assistance of various faculties, including clinicians to instruct clinical pharmacology [20]. This approach was well received, not only with active participation during the session but also as evidenced by positive exam results. This format proved to be an effective tool in the instruction of pharmacology [20]. One of the significant benefits of utilizing faculty from different disciplines involved is that problem areas are identified before benchmark exams, and they can be addressed on site. For example if a question on biochemistry arises, the faculty member representing that discipline is present, or if the question is clinically oriented, a clinician is also present to assist and lead in the discussion during the integration sessions.

A Flipped-Classroom Model

Incorporation of both basic science and clinical faculty into integrated sessions is a process constantly under review in

order to maximize their effectiveness. In essence, this is a flipped-classroom model where information is processed in the DSAs and then integrated during the integrated sessions. The DSAs are assigned by both clinicians and basic scientists addressing the topic from the perspective of the professors' respective disciplines. Implementing this model from the start takes planning and preparation. It has been documented that faculty need more time to prepare a flipped classroom [21]. Likewise, the process of integration in our teachings can demand even more faculty time and resources as well. The presence of multiple faculty members across disciplines in these integrated sessions not only reinforces the concepts assigned in the DSAs by emphasizing the link between the disciplines but also seamlessly incorporates the information into a coherent message. Based on student feedback, perception to these integrated sessions has been very positive [20], and by presenting clinical and basic science material in a single session, the connections between disciplines become much more evident.

By integrating both basic and clinical sciences into a single session, our students can learn the topics as a whole and not as a series of fragmented pieces loosely held together. By example, we show our students the value of integration and that the various disciplines are not independent but are part of a larger narrative as a whole. We experienced some growing pains in the process of implementing this model of integration, but despite the challenges, there have also been opportunities for improvement. A tremendous amount of time was spent developing policies and procedures on how to integrate our curriculum. Inclusion of direct student feedback allowed us to make immediate modifications, which led to positive outcomes. The challenges of a new medical school implementing an integrated curriculum such as ours are not unique to our medical school program [12, 22]. Overall, our students have adjusted better to the clinical transition which occurs between the first and second years because we started integrating early with our curriculum. Our faculty have embraced our curriculum model, which has created more opportunities for bridging basic and clinical sciences by working together across the disciplines and specialties. In this manner in our program, we are developing a culture that creates more opportunities for curricular innovations and faculty-student interactions.

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References

1. Flexner A. Medical education in the United States and Canada. New York: Carnegie Foundation for the Advancement of Teaching; 1910.
2. Norman G. Medical education: past, present and future. Perspect Med Educ. 2012;1(1):6–14.
3. Vidic B, Weitlauf HM. Horizontal and vertical integration of academic disciplines in the medical school curriculum. Clin Anat. 2002;15(3):233–5.
4. Eisenstein A et al. Integration of basic science and clinical medicine: the innovative approach of the cadaver biopsy project at the Boston University School of Medicine. Acad Med. 2014;89(1):50–3.
5. Laksov KB, McGrath C, Josephson A. Let's talk about integration: a study of students' understandings of integration. Adv Health Sci Educ Theory Pract. 2014;19(5):709–20.
6. Patel VL et al. Knowledge integration and reasoning as a function of instruction in a hybrid medical curriculum. J Dent Educ. 2005;69(11):1186–211.
7. Brauer DG, Ferguson KJ. The integrated curriculum in medical education: AMEE Guide No. 96. Med Teach. 2015;37(4):312–22.
8. Schapiro R et al. Integrative cases for preclinical medical students: connecting clinical, basic science, and public health approaches. Am J Prev Med. 2011;41(4 Suppl 3):S187–92.
9. Steele KM, Baker HH. Clearly distinct: outcomes of initiative to increase integration of osteopathic principles and practice at West Virginia School of Osteopathic Medicine. J Am Osteopath Assoc. 2009;109(11):579–90.
10. Fink LD. Creating significant learning experiences: an integrated approach to designing college courses. 2013th ed. San Francisco: Jossey-Bass; 2013.
11. Goldman E, Schroth WS. Perspective: deconstructing integration: a framework for the rational application of integration as a guiding curricular strategy. Acad Med. 2012;87(6):729–34.
12. Hernandez MJ, Riggs K, Wright BE, McMannus C, Baker SD, El-Sawi N. Challenges and opportunities in the implementation of a paperless curriculum at a new Osteopathic Medical School. in Experimental Biology. San Diego, CA: FASEB; 2014.
13. Wright, B.E. and M.J. Hernandez. Creation and Implementation of a two year preclinical curriculum using multiple teaching approaches at a new osteopathic medical school in Experimental Biology. 2014. San Diego, CA: FASEB
14. Klatt EC, Klatt CA. How much is too much reading for medical students? Assigned reading and reading rates at one medical school. Acad Med. 2011;86(9):1079–83.
15. Bradbury M. Implementing active learning at a new medical school and student response to a different learning formats. Int Assoc Med Sci Educ Nashville, TN. 2014.
16. Foster J.D. The Use of Interactive computer-based learning modules in the teaching of medical School Histology. in International Association of Medical Science Educators 18th Annual Meeting. Nashville, TN. 2014
17. Foster J.D. Development of interactive computer-based gross anatomy and neuroanatomy learning modules. In American Association of Clinical Anatomists 31st AACA Annual Meeting. Orlando, FL; 2014.
18. Kusurkar RA, Croiset G. Autonomy support for autonomous motivation in medical education. Med Educ Online. 2015;20:27951.
19. Palmen LN et al. What is more effective: a daily or a weekly formative test? Perspect Med Educ. 2015;4(2):73–8.
20. Hernandez MJ, Walker D, Hataway J, Ciccone C. The use of live streaming from the simulation center to the lecture hall: a case presentation of serotonin syndrome. In International Association of Medical Science Educators. Nashville, TN; 2014.
21. McLaughlin JE, Roth MT, Glatt DM, Gharkholonarehe N, Davison CA, Griffin LM et al. The flipped classroom: a course redesign to foster learning and engagement in a health professions school. Acad Med. 2014;89(2):236–43.
22. Hernandez MJ, Kessler B, Bradbury M. Reflections on the first academic school year of a new medical school, in International Association of Medical Science Educators. San Diego, CA: JIAMSE; 2015.