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Two Perspectives on the Effects of a Curriculum Change: Student Experience and the United States Medical Licensing Examination, Step 1

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Abstract

Background
Students' perceptions of curricular experience and study effort were compared for a traditional and a new integrative, interdisciplinary curriculum at a single institution. United States Medical Licensing Exam (USMLE) Step 1 scores were examined for subgroup interactions.

Method
Medical students from four cohorts completed an educational goals survey and USMLE Step 1. Analysis included subgroup performance based on admissions data.

Results
Students rated the new curriculum as more helpful in achieving educational goals. USMLE Step 1 was significantly higher for students in the lowest quartile of MCAT scores in the new compared with the previous curriculum.

Conclusions
To understand the outcomes of a large-scale curricular intervention, interactions of curriculum and aptitude should be examined.

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In 1994, the medical education committee of the University of California–Los Angeles (UCLA) School of Medicine developed an educational mission statement as the basis for beginning an intensive review of the medical student curriculum. In an attempt to better align the curriculum with the goals delineated in the mission statement, an extensive planning process was undertaken resulting in a new three-phase curriculum. Initial implementation began with a revised third-year clinical core followed by a system of colleges for fourth-year students.[1] In 2003, we implemented the Human Biology and Disease (HB&D) phase as a redesign of the basic science years. Despite warnings about the futility of large-scale curricular evaluations in the medical education literature at the time,[2–8] we set out to design a program evaluation study that would address the objectivist and constructivist views[6] of appropriate curricular outcomes, focusing on "what happens to the students"[4] as they experienced the new curriculum in addition to examining a more traditional outcome, performance on the United States Medical Licensing Examination (USMLE) Step 1. We also considered interactions between the type of curriculum and individual differences of learners, such as aptitude, that are well documented in the literature.[9,10]

The purpose of the present study was to compare students' perceptions of the curricular experience and study effort required, and scores on the USMLE Step 1, between two classes who experienced a traditional basic science curriculum composed of discipline-based courses with two classes who experienced the integrative, interdisciplinary HB&D curriculum. To better understand the interaction of curriculum and aptitude, we also examined the performance on the USMLE Step 1 of subgroups of students on the basis of their scores on the Medical College Admission Test (MCAT).[11]

Method

Curriculum description

The HB&D curriculum[12] was designed around three guiding principles: (1) the integration of basic, clinical, and social sciences is essential to clinical practice and research in the future, (2) application of knowledge requires both mastery of facts and deep understanding, and (3) learning for a lifetime is central to professional practice and research. Separate courses for each of the basic sciences were replaced by multidisciplinary block courses co-led by basic science and clinical faculty members. The blocks were organized around scientific themes and multiple, interrelated organ systems. Rather than following a normal to abnormal orientation, the blocks used pathology and pathophysiology as the stimulus for understanding the basic and social sciences across two iterations of each block, one in year one and the second in year two. Problem-based learning (PBL), standardized patients, multimedia instructional tools, and interactive laboratories were used to motivate learning and help students organize new material around its clinical application. Students were required to prepare written learning issues each week as part of PBL and to complete an ungraded online weekly quiz, both of which led to regular feedback from the faculty. Contact hours were limited to 24 a week, with a limit of two hours of lecture a day, to leave significant time for independent study and preparation for classroom activities. The doctoring

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curriculum[13] and PBL were included in both curricula, but PBL was increased in HB&D to twice a week for two years. The total number of curricular weeks in the first two years was reduced by six. Students in both curricula were required to pass USMLE Step 1 to graduate.

Participants

A total of 571 students from the graduation classes of 2005 to 2008 were included in the study. We analyzed USMLE Step 1 data for the classes of 2005 (N = 144) and 2006 (N = 148) who enrolled in the previous, more traditional curriculum, and classes of 2007 (N = 144) and 2008 (N = 149), who enrolled in the new HB&D curriculum. The end-of-year-one survey, our second outcome measure, was first implemented for the class of 2006. Thus, only data from the three most recent cohorts were available. Five students were excluded from analyses because their admission data were not available.

Evaluation measures

The end-of-year-one survey is an online, anonymous, but mandatory survey asking students to rate the degree to which the curriculum had helped them achieve the 10 goals in the school's educational mission statement and their agreement with five statements about the learning environment, using a five-point Likert scale (see Table 1). In addition, students reported study effort. Students also wrote comments about specific ways in which the curriculum had helped or hindered their achieving the goals. The survey was administered to only three of the classes under study. Two MANOVAs (one combining the 10 questions related to the mission statement, and another combining the five learning environment questions) contrasted the old and new

Table 1

Means, Standard Deviations, Significance, and Effect Sizes for End of Year One Survey Questions Comparing Previous and New Curricula

Outcome measure	Previous curriculum (N = 137)	HB&D curriculum (N = 293)	Statistical significance	Effect size (partial η^2)
Support for school's mission (*Did the past year support your development of the following:)**			$P < .001$‡	0.10‡
Skills for lifelong learning	3.6 (±1.0)	3.8 (±0.8)	$P < .05$	0.01
Commitment to humanistic, compassionate, and ethical care of the individual and family	3.8 (±1.0)	4.0 (±0.9)	$P < .05$	0.01
Skills in effective communication, and commitment to teaching colleagues	3.6 (±1.0)	3.7 (±0.9)	NS	NS
Integrating knowledge of basic sciences and clinical practice	3.7 (±1.0)	4.1 (±0.8)	$P < .001$	0.05
Integrating knowledge of social and behavioral sciences and clinical practice	3.2 (±1.0)	3.6 (±0.9)	$P < .001$	0.03
Understanding the scientific method and its application to both research and clinical practice	3.0 (±1.1)	3.4 (±1.0)	$P < .001$	0.04
Commitment to promoting the health and well-being of our community	3.5 (±1.1)	3.5 (±1.1)	NS	NS
Understanding of the special challenges and requirements of a pluralistic society	3.0 (±1.1)	3.3 (±1.0)	$P < .05$	0.01
Skills as a leader and team member	3.4 (±1.0)	3.5 (±1.0)	NS	NS
Ability to address complex societal and medical issues through a systematic, multidisciplinary, and collaborative approach	3.3 (±1.1)	3.5 (±1.0)	$P < .05$	0.01
Learning environment†			$P < .001$‡	0.11‡
I was provided with frequent feedback about my performance	3.3 (±1.0)	3.3 (±1.1)	NS	NS
My problem-solving ability increased as a result of first-year courses	3.7 (±1.0)	3.9 (±0.9)	$P < .05$	0.01
The balance between lectures and small-group learning seemed appropriate	3.2(±1.1)	3.8 (±1.1)	$P < .001$	0.06
Lab sessions assisted in my learning	3.2 (±1.2)	3.7 (±1.0)	$P < .001$	0.06
Faculty and students collaboration was central in the curriculum	3.4 (±1.1)	3.9 (±1.1)	$P < .001$	0.05
Study habits				
Number of hours/week studying alone	20.2 (±10.7)	19.4 (±11.7)	NS	NS
Number of hours/week studying with peers	4.7 (±5.7)	4.8 (±5.0)	NS	NS

* Likert scale: 1 = *not at all*; 5 = *a lot*.
† Likert scale: 1 = *strongly disagree*; 5= *strongly agree*.
‡ Omnibus MANOVA.
NS = not significant.

curriculum. Where the Levene's test indicated nonequality of error variance, we confirmed findings with nonparametric techniques. Two of the authors qualitatively analyzed students' narrative comments to identify themes and then coded the comments for each goal.

We compared USMLE Step 1 scores across the four classes using total MCAT scores, undergraduate GPA (uGPA), and demographic information to ensure that the cohorts were similar. To explore a possible aptitude–treatment interaction,[9] we divided each cohort into quartiles based on MCAT total score and all subscales and compared the traditional and HB&D curriculum in a 4 (quartiles) × 2 (curriculum) ANOVA. A χ^2 test was used to compare pass/fail ratios between these groups as well. We expressed effect sizes where possible as partial η^2. All analyses were carried out with SPSS, version 15.0 (SPSS Inc. Chicago, Ill). The UCLA IRB approved this research protocol.

Results

Effect of curricular change on end-of-year-one survey

The end-of-year-one survey was completed by all students in the classes of 2006 (traditional), 2007, and 2008. Both omnibus MANOVAs detected highly significant differences in answer patterns between the two HB&D cohorts and the traditional cohort (with effect sizes [η_p^2] of 0.10 and 0.11, respectively). Follow-up univariate testing revealed that students rated the new curriculum as more helpful to achieving the school's mission on 7 of the 10 goals (see Table 1). The strongest effects were found for questions that were the cornerstones of the HB&D curriculum: integrating basic and social sciences with clinical practice; and understanding the scientific method and its application in research and clinical practice.

Qualitative analysis of the written comments demonstrated that students credited specific features of the new curriculum in relation to the different goals. For example, of the 85 students in the class of 2008 who wrote comments about self-directed learning, 55 described aspects of PBL and the resulting weekly written learning issues. Importantly, the HB&D curriculum was credited for improving learning skills and deeper understanding (15 comments in the class of 2008). For instance, one student commented, "This year helped me hone in on ways that I learn most effectively and learning methods that allow me to retain information over long periods of time." In contrast, many students in the traditional curriculum complained on the emphasis on memorization (e.g., "I didn't feel like I learned lifelong learning skills. Instead the curriculum and tests fostered to cram it all in and focus on past exams to pass tests.") Also, the HB&D cohorts recognized how the overall curriculum structure helped them integrate basic and social sciences. As one student put it, "The curriculum is set up extremely well to show the links between basic science concepts and their clinical applications" On the other hand, a significant number of students in the traditional curriculum (11 out of 75 comments) thought that the curriculum hampered integration because "the layout of the classes makes it difficult to outright cross-relate courses."

Furthermore, students in HB&D cohorts evaluated the learning environment as more effective than the previous cohort on all aspects except increased feedback (see Table 1). Both cohorts reported equal hours of studying alone or in groups.

Effect of curricular change on USMLE, Step 1

There were no significant differences between the four classes in MCAT scores, uGPA, or demographic variables. The percentage of students that failed USMLE Step 1 on the first try went down from 6.2% for the previous curriculum to 2.1% for the new curriculum ($\chi^2 = 6.05$; $P = .014$). The ANOVA revealed a significant total MCAT quartile-by-curriculum interaction ($F = 3.08$; $P = .027$; $\eta_p^2 = 0.02$). Post hoc testing (Bonferroni-corrected t tests) indicated that Step 1 performance differed only for students in the first MCAT quartile ($t = -2.846$; $P = .01$; $\eta_p^2 = 0.05$), with HB&D students scoring slightly higher than previous cohorts (see Figure 1). Subsequent analysis of the MCAT subscales revealed a similar pattern for students in the first quartile of MCAT Physical Sciences ($t = -3.290$; $P = .001$; $\eta_p^2 = 0.072$) and Verbal Reasoning ($t = -2.360$; $P = .019$; $\eta_p^2 = .034$). This did not occur for the Biological Sciences subscale.

Conclusions

Stimulated by the lively discussion initiated by Norman and Colliver[2,3,5,7,8] about the value of evaluation research on large-scale curricular interventions, we were surprised by the ability of the goal-based survey and the USMLE Step 1 to identify meaningful differences for the new HB&D curriculum. Both authors argued that smart medical students will study to make up for any curricular intervention, particularly when the measure is a high stakes exam. However, HB&D students did not resort to more study than those in the previous curriculum. Perhaps, the studying that they did was

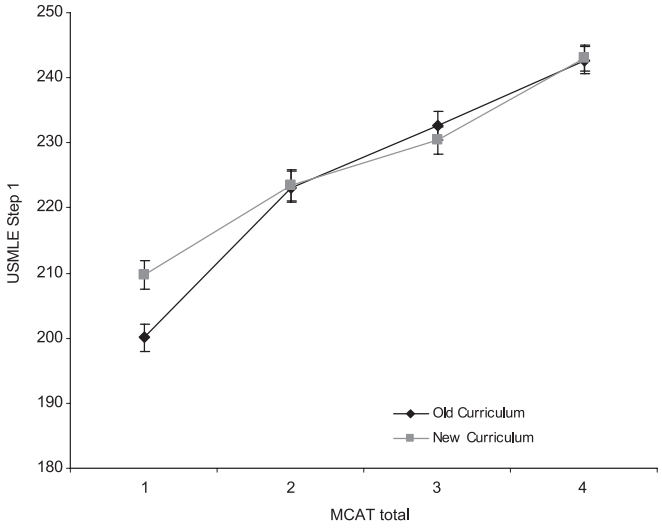

Figure 1 Mean USMLE Step 1 performance and standard error for the old and new curriculum as a function of total MCAT score (divided in quartiles).

more effective or that a subset of the students studied more while others cut back. Failure rates for first-time takers of the USMLE Step 1 dropped significantly among students in the HB&D curriculum. National averages[14] show that for both years 2003 and 2004, failure rates were approximately 7%, and they were 6% and 5% for 2005 and 2006, respectively. Thus, failure rates were approximately at the national average under the old curriculum and less than half the national average under the new curriculum.

In our anonymous end-of-year-one survey, we lost the ability to consider aptitude–treatment interactions. Although the qualitative analysis of survey comments gave us some insight into the effect of various features of the new curriculum, we were unable to link survey and USMLE results. Although devising new nonanonymous measures that would allow us to examine the interactions of various student behaviors and curricular components through structural equation modeling might be helpful, we believe that a longitudinal qualitative study of students' learning behaviors and attitudes related to various curricular components may provide a clearer understanding of the practical ways in which the features of the HB&D curriculum and learner behaviors interact to enhance learning. Results of such a study should bring us back full circle to an examination of the basic theoretical principles on which the new curriculum was designed.

Although we cannot yet identify particular curricular features that benefited students at the lowest MCAT levels for Verbal and Physical Sciences scores, we have hypothesized that the use of weekly self-assessment quizzes encouraged students to adopt a study-overtime approach and helped faculty members to identify and assist students at risk early. It is also possible that the requirement to research and write a learning issue report each week for PBL provided ongoing practice that strengthened verbal reasoning skills. Certainly, the results support the continued use at UCLA of a more holistic admissions approach that takes into account values such as demonstrated commitment to serve the underserved or the diversity of experience brought by disadvantaged students rather than simply focusing on objective measures such as the MCAT and GPA. This study indicates that a lower MCAT score may be ameloriated by curricular interventions.

Although the current study suffers from some of the limitations of other large-scale curricular intervention studies, it suggests two features that may be of value: the use of historical controls within the same institution that complete the same evaluation tools (e.g., plan ahead), and the consideration of subgroup effects. Limitations include conduct of the study at a single institution, failure to collect identifier data that would have allowed us to link educational experience with outcomes, and use of a single performance measure.

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