Examining Medical Students' Domain Performance Using Time-Varying Longitudinal Data

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Abstract

This paper examines medical students’ basic science knowledge in nine domains at six time points over the first 18 months of medical school. Students’ scores showed an increase at the beginning, slowing down in the middle of the time points, and then positive acceleration growth toward the end.

Introduction

In the fall of 2016, our medical school implemented a new curriculum. After an eight weeks of training, students begin working in clinical settings while they master the application of basic science knowledge through guided independent study, small group problem-solving exercises and a weekly large group session based on a “flipped” classroom model. The students’ ability to apply basic science knowledge is assessed at regular intervals through progress testing. We used the National Board of Medical Examiners (NBME) Customized Assessment Services (CAS) to generate progress tests assessing our students’ ability to apply basic science knowledge.

Individual differences in preparation, learning pace, and in growth patterns, make it difficult to support the students and meet their learning needs. Thus, diagnosing students’ growing trajectories on the progress assessment results can help institutions develop interventions that focus on the specific needs of students. The goal of this study was to model our students’ growth in nine basic science domains over the first year and a half in the curriculum as measured by six progress tests.

Program

We assessed 183 medical students’ domain knowledge at six time points during the first 18 months of medical school prior to taking the USMLE Step 1 licensure examination during summer 2018. Each administration of the NBME CAS exam used a slightly different blueprint, but nine domains included enough items on each of the six administrations for the NBME to provide individual domain scores as a percentage of items correct. The nine domains are Anatomy/Embryology, Biochemistry/Genetics, Epidemiology/EBM, Pharmacology/Toxicology, Microbiology/Immunology, Neuroscience, Psychological and Social Science, Histology/Cell Biology/Pathology, and Cardiovascular.

The data structured such that time points are nested within domain, and domains are nested within students. We fit a growth curve model to each domain to examine the linear and/or nonlinear growth of the CAS scores in each domain over time.

Results

There were 183 students × 9 domains × 6 time points or a total of 9,882 data points. There are four patterns of growth over time found from the fitted growth curve models among the nine domains. For the first kind of curve, the results showed significant positive linear effect, negative quadratic effect, and positive cubic effect in the domains Biochemistry/Genetics, Cardiovascular, Epidemiology/EBM, Neuroscience, Psychological/Social Science, and Anatomy. In other words, the scores in these domains have an increase at the beginning, slowing down in the middle of the time points, and then having another acceleration growth toward the end. For the Pharmacology/Toxicology domain, the growth curves showed an increase at the beginning, slowing down the rate of change toward the end, and has not seen a sign of another acceleration yet. For the Histology/Cell Biology/Pathology domain, the fitted model showed a positive slope, indicating
the students have a steady increase over the six time points. For the Microbiology/Immunology domain, the fitted growth curve model showed the scores had a sign of dropping through the end, but when the MCAT was considered in the model, the sign disappeared.

Closure

The use of polynomial approach in growth curve modeling is very common in modeling nonlinear trajectories in social science and education. In this paper, the application of the model helped monitored students’ growing pattern in each of 9 basic science domains during the first 18 months of medical school. The results indicated four kinds of patterns from the nine progress tests among nine domains. The most common pattern: increase first, slow down, and then increase again when the test is approaching. This is aligned with how students prepare for the test in schools. We also identify the domains that are not following this pattern, they may 1) have a steady growth throughout the six assessments, or 2) have an increase at the beginning and then slow down, or 3) have a not statistically significant growth pattern toward the end. Our medical school largely has a problem-based curriculum but the differences in growth patterns may reflect to some extent different content emphasis over the period studied. We hope the results of this study can help understand medical students’ competence level at each domain at varying time point, and at the same time, provide institutions some insight of students learning trajectory in each domain.

Reference List


