MATH PREPARATION OF ENTERING BUSINESS STUDENTS

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ABSTRACT

Many business faculty members lament the decline in students' academic preparation. Yet a cursory review of available data suggests that high school graduates on average take more college-preparatory courses and score slightly higher on college entrance exams than in previous years. This paper addresses this seeming inconsistency specifically in terms of mathematical preparation: How can it be that entering college students are better prepared for college-level mathematics, but business faculty perceive them as increasingly poorly prepared? This paper reviews several national studies of high school student preparation, notes some intergenerational concerns, suggests possible explanations for the apparent contradiction, and explores classroom implications.

INTRODUCTION

Recent comparisons of the mathematical knowledge of US K-12 students to students from other countries have not painted an optimistic picture of the future competitiveness of our nation's workforce. In response, various authors and organizations have suggested increasing the rigor of middle school and high school math and science curricula as well as requiring what has been called the college-prep high school curricula of all college-bound students regardless of intended major. It is relevant to ask what changes have taken place in the mathematical preparation of incoming business students and to take appropriate action as necessary to prepare business grads for successful careers. Since many colleges of business require course-work at the lower-division in economics, statistics and calculus, adequate high school preparation in mathematics is essential to success for business students.

STATE OF SECONDARY MATHEMATICS EDUCATION IN THE U.S.

The *Trends in International Mathematics and Science Study (TIMSS)* [4] provides comparisons of the performance of U.S. fourth and eighth grade students to students from around the world. In the most recent study, students from the United States ranked 12th for fourth graders and 14th for eighth graders. The relatively poor competitive performance of U.S. students has been on the national education radar for some time, and many efforts including the landmark, *No Child Left Behind* legislation of 2002 [5], have been designed to address this shortfall. Performance for U.S. fourth graders is exactly the same as in 1995, both in relative ranking and in absolute test performance, while the performance for eighth graders has improved modestly, from a score of 492 in 1995 to a score of 504 in 2003.

College aptitude tests, including ACT and SAT tests, are partial measures of the mathematical preparation of college-bound students in the U.S. The ACT and SAT averages in math from 1967 to 2005 suggest modest increases in math performance of college-bound students on college entrance exams. A recent report provided by ACT [2] suggests a minimum of four years of high school math including Algebra I, Geometry, Algebra II and at least one additional advanced math class. The data from ACT indicate a slight increase in the percentage of students taking at least four high school math

courses, including at least one advanced math course in high school. In summary, it may be said there is a demonstrable gap in mathematical competency between students in the U.S. and students in other nations as measured by the TIMSS assessment, but there is no clear pattern of deterioration of the average mathematical preparation of U.S. college-bound students.

STUDENTS ATTENDING COLLEGE

It may also be important to consider the math preparedness of students who actual enroll in college; the students taking college entrance exams and the students enrolling in college are not necessarily the same populations. According to National Center for Education Statistics [1], almost three times as many students enrolled in college immediately after high school in 2004 as compared to 1960. Since the standard deviation in math ACT scores has been nearly constant since 1997 (earlier data for s.d. are not available) the growth in the percentage of students attending college immediately after high school does suggest that more students attending college would not meet a fixed ACT performance level. While the math ACT or SAT score distribution data for students enrolling in college is not available directly, some characteristics of the distribution can be inferred from other data (see full paper for analyses). The implications are that if a greater fraction of graduating high school students are enrolling in college, then a greater number of college-bound students would have scores below any particular ACT level. While it isn't possible with the information available to estimate the number of students enrolling in college who don't meet the ACT-recommended score of 22, it is possible to estimate the increase in the number of students who do not meet this score. The analyses suggest that an additional 17%, or about 300,000 students, do not meet the ACT math readiness score of 22. These analyses do lend support to the notion that many more students seem less prepared than in past years. Compared to 30-40 years ago, average ACT and SAT scores are very similar, but many more students from lower quartiles of ACT/SAT performance with less than desirable preparation are enrolling in college.

INTERGENERATIONAL ISSUES

Many authors have provided suggestions for understanding the unique learning style of the Millennial generation (Millennials, born between 1981 and 2000, are estimated to include 81 million members). Considering information processing characteristics of the Millennials [3] is useful for effective pedagogy with today's students. In the July/August 2003 issue of *Educause Review* [6] Oblinger provided insights regarding understanding and teaching the millennial generation. Today's students associate problem solving and knowledge/skill acquisition with rapid, random group experiences rather than with devoted, determined personal study and practice. Readily and instantly accessible resources are a given, as is instant and unlimited information processing power. "Googling" is the ultimate learning skill. Oblinger suggests, "The aging infrastructure and the lecture tradition of colleges and universities may not meet the expectations of students raised on the internet and interactive games."

The basic principles of process control or systems analysis suggest that success in any effort depends on knowing the characteristics of all input variables. Not all students will come to the classroom with the same learning paradigm, or the same educational background. Oblinger offers a few considerations for instructors: Are instant resource access and communication assets to be exploited in the classroom? Are linear models of reading, delivery, and learning inferior to multi-dimensional, geometric, or non-linear approaches? Is the Millennials' preference for group learning a pedagogy that is more effective and should be embraced?

DISCUSSION AND CONCLUSIONS

If on a national basis unprepared students are likely to be entering college, it becomes relevant to ask: Are my students prepared, and if not, what should I do about it? Since in any particular institution the math preparation of entering students may or may not follow national averages, a comparison to national averages becomes relevant. This section will consider the math preparation of the students taught by the current authors at their home institution. To determine student math preparedness, the authors surveyed incoming freshmen to ascertain high school math courses taken. Following the results of the survey, SAT math scores for the survey respondents were compared to national averages to validate the average math preparedness. These data suggest that two thirds of entering students in this sample completed at least algebra 1, algebra 2, geometry, and either trigonometry or another advanced math course. These percentages compare favorably with the equivalent national data; however, it is unfortunate that approximately one third of these students entered the university without adequate math preparation. For the same group of students, university admissions data indicated an SAT math average of 541 which compares favorably with national SAT Math scores of 520.

The evidence provided in this review suggests that some entering students do not have the mathematical skills necessary to directly begin the set of courses including accounting, economics, statistics and calculus. At the institution surveyed in this study, it appears that a majority of the incoming students are prepared for immediate enrollment in college level algebra followed by statistics, economics and calculus. About one third of the students will require mathematical remediation prior to entering college algebra. The assertion and evidence that a portion of entering business students is unprepared for college-level coursework does not entirely explain the ongoing frustration that faculty at the home institution express regarding student success. Given this knowledge, instructors at the home institution may want to focus their efforts on pedagogical approaches that help then to cross the generational divide between themselves and the Millennial generation. Efforts in this regard include a one-credit required junior level course on professional business expectations, what some affectionately called, "charm school." Colleges of business across the nation and at the home institution will increase student success both in the classroom and in the work place if they formally address the disconnect between the instantly accessed, wired world of the Millennial generation with professional business expectations.

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