An Insight from a Developmental Mathematics Workshop

Eddie Fuller, Marcela Mera Trujillo, Xiangming Wu, Marjorie Darrah and Jessica Deshler
West Virginia University

Abstract: In this report, we present data from 404 students in a developmental mathematics course at a large research university and try to better understand academic and non-academic factors that predict their success. This work is the first step in a larger project to understand when science, technology, engineering, and mathematics (STEM) intending students who begin in developmental mathematics courses are successful and continue to be successful in higher-level mathematics courses. To gain some preliminary insight, we analyze SAT and ACT mathematics scores for STEM and non-STEM majors who succeeded in our developmental mathematics course and also look at personality traits and anxiety levels in these students. Specifically, we sought to answer the following questions for STEM intending students: (i) what SAT and ACT mathematics scores correlate with success in developmental mathematics? and (ii) what other non-academic factors predict success in developmental mathematics?

Key words: Developmental Mathematics, STEM majors, Success.

Introduction and Theoretical Background

Many first-year college students are underprepared in the mathematics needed for their chosen majors and are in need of remedial education courses (Chambers, Ferlazzo, Ho, Pearson, & Radford, 2012). In addition, more than one third of all science, technology, engineering and mathematics (STEM) intending students in the U.S. enroll in mathematics remediation (Radford, Pearson, Ho, Chambers, Ferlazzo, 2012). In this study, we begin to analyze data collected from and about students planning to pursue a STEM degree who enter our university unprepared for college level mathematics. Our ultimate goal is to predict and model academic success patterns in order to intervene and support student success and promote opportunities for underprepared STEM students.

The psychology of learners in developmental mathematics classrooms is complex (Eden, Heine & Jacobs, 2013; Hembree, 1990). This research seeks to identify student characteristics, as indicated by demographic profiles, information collected through personality inventories (John, Naumann & Soto, 2008) and anxiety surveys (Alexander & Martray, 1989), that lead to success and persistence in STEM majors.

Methodology

The course that is the setting for this project is a mastery-based course requiring students to complete online modules at their own pace with specific levels of competency required before students can progress to the next chapter. Students are considered to have completed the course if they earn a 80% or better in each of seven in class exams and 70% on the final exam. Data were collected from 404 (almost 50% of total enrollment) developmental mathematics students who agreed to be part of this study. Surveys were administered to collect personality trait characteristics and to measure levels of exam anxiety (EA), course anxiety (CA), and numerical task anxiety (NA) at the beginning of the term and student progress was recorded at several

points during the semester. The preliminary success data has been correlated to the personality traits and anxiety measures.

Data

Student performance data at various weeks during the semester are shown in Table 1 and SAT and ACT mathematics average scores for STEM and non-STEM intending populations who completed or did not complete are presented in Table 2.

Table 1
Student progress during weeks five, six, eleven, twelve and seventeen

Week	Number of Study Participants Completing Each of 7 Exams							
	Exam 1	Exam 2	Exam 3	Exam 4	Exam 5	Exam 6	Exam 7	Final
5	250	89	57	24	7	1	1	0
6	288	140	89	36	12	12	2	0
11	343	316	292	149	59	59	21	10
12	346	330	325	265	160	160	68	23
17	358	334	326	284	245	245	158	62

Table 2
ACT & SAT comparison between STEM and Non-STEM intending students

	Developmental Course	Average SAT Math	Average ACT Math
Non STEM (n = 320)	Completed	471.48	18.94
	Not Completed	455.14	17.94
STEM (n =84)	Completed	484.02	19.97
	Not Completed	466.9	18.95

Results

ACT mathematics score correlates significantly with stalling – defined as having passed only one exam by a given week - for almost all weeks ($p = .001$ to $p = .012$), but its low variance makes it difficult to use as a predictor. Two personality traits, extraversion and neuroticism, show signs during some weeks of having strong impact on student performance (week 6, $p = .059$ and week 11, $p = .051$, respectively) but these traits are not consistent across all weeks. All three anxiety measures taken at the beginning of the semester were deemed to be significant indicators for a student stalling by week twelve ($p = .002$ for EA, $p = .039$ for CA, $p = .003$ for NA), with exam anxiety statistically significantly correlated to not completing the first exam by week eleven.

Conclusion

These developmental mathematics students will be tracked through subsequent mathematics courses and once more complete information about student performance is collected the data will be combined to determine factors that may affect performance and persistence. The ultimate goal is to develop a profile for a student that will be successful in mathematics courses and be able to persist in a STEM major. This will also allow identification of students who will struggle so that

interventions can be developed and applied early in a student's academic career. The more we can understand who the students are and what makes them succeed or fail the closer we will be to devising programs and courses that will assist all students in achieving their desired goals.

References

Alexander, L., & Martray, C. (1989). The Development of an Abbreviated Version of the Mathematics Anxiety Rating Scale. *Measurement And Evaluation In Counseling And Development*, 22(3), 143-50.

Chambers, E., Ferlazzo, D., Ho, P., Pearson, J., & Radford, A.W. (2012). Remedial coursework in postsecondary education: the students, their outcomes, and strategies for improvement. *MPR Associates, Inc*. 1-28.

Eden, C., Heine, A. and Jacobs, A.M., (2013). Mathematics Anxiety and Its Development in the Course of Formal Schooling—A Review, Psychology 2013. Vol.4, No.6A2, 27-35

Hembree, R. (1990). The nature, effects and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, 21(1), 33-46.

John, O. P., Caspi, A., Robins, R. W., Moffitt, T. E., & Stouthamer-Loeber, M. (1994). The "little five": Exploring the nomological network of the five-factor model of personality in adolescent boys. *Child Development*, 65(1), 160–178.

John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm Shift to the Integrative Big-Five Trait Taxonomy: History, Measurement, and Conceptual Issues. In John, O. P., Robins, R. W. & Pervin, L. A.(Eds.), Handbook of personality: Theory and research (pp. 114-158). New York, NY: Guilford Press.

Radford, A.W., Pearson, J., Ho, P., Chambers, E. and Ferlazzo, D. (2012). Remedial Coursework in Postsecondary Education: The Students, Their Outcomes, and Strategies for Improvement. Jefferson City, MO: Missouri Department of Higher Education