AC 2012-3723: TOYS 'N MORE: STEM STUDENTS INTRODUCED TO ONE OR MORE INTERVENTION STRATEGIES

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Janice M. Margle, Associate Professor of Engineering at Penn State, Abington, received her M.Sc. and B.Sc. degrees in mechanical engineering from the Pennsylvania State University. She is Co-PI and Project Manager of the NSF-Sponsored Toys'n MORE grant and currently teaches introductory thermodynamics and introductory engineering design courses. She is active in promoting activities to increase the number of women and minorities in engineering. She is a licensed Professional Engineer and has worked for IBM, the Navy, NASA, PPL, and private industry.

Dr. Catherine L. Cohan, Pennsylvania State University, University Park

Catherine Cohan has 15 years of experience as a research psychologist. She has expertise in the use of longitudinal designs, various modes of data collection (e.g., questionnaires, personal interviews, observational data), and survey research methods.

Dr. Yu-Chang Hsu, Boise State University

Yu-Chang Hsu is Assistant Professor of educational technology at Boise State University. His research interests include cognitive and metacognitive processes of integrating multiple external representations in STEM fields, learning and instructional innovation through emerging technologies, and information and new media literacy. Before joining Boise State University, he served as the Assessment Coordinator (postdoctoral scholar) for the College of Engineering at Penn State University in the Toys'n MORE project funded by the NSF STEM Talent Expansion Program Grant (DUE # 0756992). He was one of the project leaders, conducting STEM education research with populations including underrepresented students, coordinating assessment efforts across 15 commonwealth campuses, and providing leadership in writing the annual reports.

Hsu is selected as one of the Mobile Learning Scholars of Boise State University for his innovative proposal on integrating mobile learning and applications in his graduate level course Instructional Message Design, where students engage in real-time data collection, design example sharing, and community building. He has taught a new workshop for K-12 teachers and a new course for graduate students on using Google's Android App Inventor to help educators leverage the power of mobile computing and applications for learning and instruction. In a recent project funded by Idaho Digital Learning Academy, he assesses K-12 online students' learning through triangulating survey responses, mining server logs, and analyzing online discussion activities. In addition, he currently serves as one of the PIs of a research project developing an artificial intelligence Decision Support System (DSS) to help online K-12 educators, including STEM teachers, detect at-risk students and provide early pedagogical intervention.

Dr. Jill L. Lane, Clayton State University

Jill Lane has more than 15 years experience working with faculty and teaching assistants on methods to enhance teaching and learning. She has conducted various workshops on teaching methods at universities and at international conferences. While at Penn State, she worked with numerous departments on course restructuring and collaborated with more than 300 faculty members on the design, assessment, and evaluation of their courses. She is currently the Dean of Assessment and Instructional Development at Clayton State University, where she oversees faculty development and accreditation activities. Lane holds a doctorate of education in instructional systems from Penn State, a master's of education in computing in education from Rosemont College, and a bachelor of science in mathematics education from Penn State. Her research centers on the sustainability of innovations in education.

Dr. Amy Freeman, Pennsylvania State University, University Park

Amy L. Freeman is Assistant Dean of Engineering Diversity at the Pennsylvania State University, where she received her Ph.D. in workforce education and her M.S. in architectural engineering. She is Co-PI on the NSF-Sponsored Toys'n MORE grant and currently manages several retention programs targeting more than 2,000 women and underrepresented technical students at all levels of the academic and career development pipeline. She is also an executive member of the National Association of Multicultural Engineering Program Advocates (NAMEPA) organization.

Dr. Javier Gomez-Calderon, Pennsylvania State University

Javier Gomez-Calderon is a professor of mathematics and Mathematics Coordinator at Penn State, New Kensington. He is the author or co-author of 31 articles, four textbooks, four in-house booklets, and the faculty mentor of eight student publications. Gomez-Calderon served as the Head of the Mathematics Division (fourteen campuses) from 2002 to 2006, as the Mathematics Division Coordinator from 2010 to 2011, and obtained his Ph.D. in 1986 from the University of Arizona. Gomez-Calderon was the recipient of the 2007 Milton S. Eisenhower Award for Distinguished Teaching, the 2002 Commonwealth College Outstanding Research Award, the 2001 Valley News Dispatch Coach of the Year, the 1997 New Kensington Excellence in Teaching Award, the 1996 Theresa Cohen Mathematics Service Award, and the 1989 New Kensington Excellence in Teaching Award.

Dr. Dhushy Sathianathan, California State University, Long Beach

Dhushy Sathianathan is the Associate Dean for Academic Programs in the College of Engineering. He has a Ph.D. in mechanical engineering from Penn State University and a B.S. in mechanical engineering from Oklahoma State University. Sathianathan has been actively involved in engineering education initiatives since 1994. He led several NSF funded initiatives to enhance engineering education, especially focused on retention. He is the Co-founder of the Center for Engineering Design and Entrepreneurship. He is a Boeing Welliver Faculty Fellow. He has received the Boeing Outstanding Educator Award and DOW Outstanding Faculty Award for his work in engineering education.

Dr. Renata S. Engel P.E., Pennsylvania State University, University Park

Renata S. Engel is Associate Dean for academic programs in the College of Engineering at Penn State. A member of the Penn State faculty since 1990, she is professor of engineering design and engineering science and mechanics and has served as Executive Director of the Schreyer Institute for Teaching Excellence.

Engel is PI of the NSF-Sponsored Toys'n MORE grant at Penn State. Through various projects and initiatives, she has incorporated elements of design in fundamental engineering courses, and has provided leadership to Penn State's efforts to assess student learning outcomes. For her individual and collaborative contributions to engineering education, she has received several awards including the University's George W. Atherton Award for Excellence in Teaching, the Dow Outstanding Young Faculty Award, and the Outstanding Alumna of the Fayette Campus, and Fellow of the American Society for Engineering Education. An active member in the American Society for Engineering Education, Engel has held leadership positions in the Mechanics Division and Middle Atlantic Section and as the Vice President for Member Affairs. She was ASEE President in 2010-11 and is currently on the Board of Directors.

Toys and Mathematical Options for Retention in Engineering (Toys'n MORE)

STEM Students Introduced to One or More Intervention Strategies

This paper presents preliminary data resulting from the implementation of a project referred to as Toys and Mathematical Options for Retention in Engineering (Toys'n MORE). The Toys'n MORE study is funded through the Technology, Engineering, and Mathematics Talent Expansion Program (STEP grant, DUE # 0756992) of the National Science Foundation and seeks to increase the retention of students pursuing Science, Technology, Engineering, and Mathematics (STEM) degrees. With an emphasis on the proportion of engineering majors, Toys'n MORE seeks to increase the number of students in STEM majors by as much as 10%.

This project is being conducted by the College of Engineering at The Pennsylvania State University. The project involves the College of Engineering and 14 geographically-dispersed campuses in the Penn State system. These campuses serve as both feeder schools for the main campus and also offer baccalaureate and associate degrees in a number of STEM majors. Considering the number and geographic diversity of the campuses involved and the number of different STEM fields served, this effort is significant.

The project is based on three intervention strategies and an assessment strategy. The three intervention strategies include: (a) enhanced tutoring programs for foundational mathematics courses in algebra, trigonometry, and calculus, (b) a freshman toy-based design course (called Toy FUN-damentals) in which dissection and re-design of toys is used to engage students in a positive environment, and (c) a math-intensive summer bridge program offered at three regional campuses to facilitate underrepresented engineering freshmen as they transition from high school to college. The strength of this project lies in the comprehensive scope of the interventions as well as its large sample size.

Applying the Intervention Strategies

Presented in this paper are data based on the project's first four semesters of data collection. Because the intervention portion of the study runs for a total of eight semesters, the reported data are preliminary.

This paper has three goals. First, it updates the information presented in our 2011 ASEE paper by providing the most current information regarding the STEM degrees offered at the 14 regional Penn State campuses. Second, it examines the number of students in the three interventions and their math final exam performance when engaged in one versus two interventions. Reported are numbers of students in the targeted math courses who participated in tutoring, the toy-design courses, and the regional summer bridge programs as well as the number of students engaged in two of the three interventions (e.g., math tutoring and a toy-design course). Third, math course grades for the pre-intervention (baseline or comparison) sample and the intervention sample (to date) at each of the participating campuses are presented.

One Project, 14 Campuses

To understand the breadth of this project, a map of the participating campus locations throughout the state of Pennsylvania is shown in Figure 1, below. The interventions initiated by Toys'n MORE are underway at 14 of these regional campuses. The University Park campus, the main and largest campus in the Penn State system, is the administrative home of the University and the Toys'n MORE project. With close to 6,700 STEM students enrolled full and part-time at these 14 geographically-dispersed locations, the regional campuses are an integral part of the Penn State system.

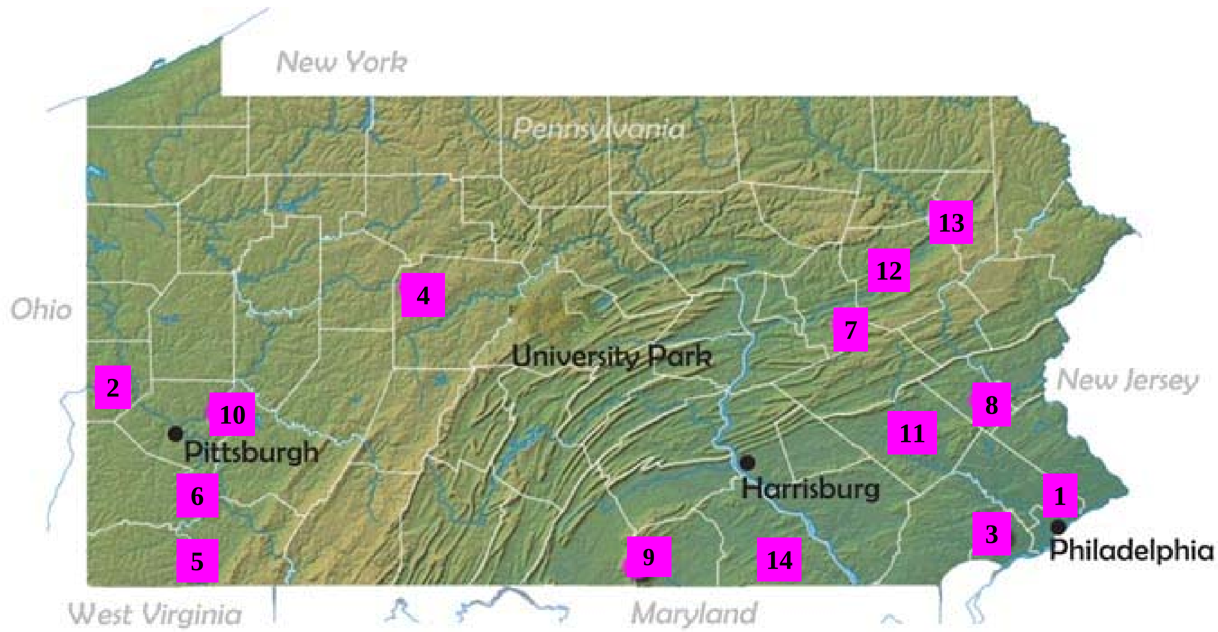

Figure 1: Regional Campuses Participating in the Toys'n MORE Study

Overall, a total of 21 distinct terminal STEM degrees are offered by the 14 participating regional campuses. The degrees range from majors such as biology, earth science, engineering, and engineering technology to information science, mining, as well as science, several of which include options (Tables 1A and 1B, below). There are 11 distinct terminal baccalaureate STEM degrees (Table 1A) and 10 distinct terminal associate STEM degrees (Table 1B) offered by the 14 participating campuses. Not all campuses offer all degrees.

These campuses also offer the first two years of many STEM degrees that require students from the regional campuses to transfer to the main campus (University Park) in order to complete their degree in more than 100 STEM baccalaureate degree programs. The majority of these students are in baccalaureate majors such as engineering and science.

Table 1A: STEM Majors and Enrollments in Terminal Baccalaureate Degrees at 14 Penn State Regional Campuses (Fall 2009 and Fall 2010, total)

Baccalaureate STEM Degree Majors	Enrollment Total	Campuses Where Offered
Biology: Genetics and Developmental Biology Opt. (GENET) Vertebrate Physiology Opt. (VPHOS)	95	[1]Abington
Earth Sciences	19	[4]DuBois
Electrical Engineering Technology (EET)	123	[12]Wilkes Barre
Electro-Mechanical Engineering (EMET)	189	[10]New Kensington [14]York
General Engineering: Alternative Energy & Power Generation (AE&PG) Applied Materials Track (APMLT)	 262 73	 [7]Hazleton [4]DuBois
Information Sciences and Technology (IST)	1026	[1]Abington, [2]Beaver [3]Brandywine, [6]Greater Allegheny, [7]Hazleton [8]Lehigh Valley [9]Mont Alto [10]New Kensington [11]Schuylkill [12]Wilkes Barre [13]Worthington-Scranton [14]York
Science: General Option (GEN) Life Science Option (LIFE)	178	[1]Abington [14]York
Surveying Engineering (SUR E)	81	[12]Wilkes Barre
Overall Baccalaureate STEM Degree Enrollment:	**2046**	
Overall Baccalaureate STEM Degrees Offered:	**11**	

Note: STEM degrees are defined as those in science (including biology, chemistry, physics, and other "classical" sciences), technology, engineering, and mathematics.

Table 1B: STEM Majors and Enrollments in Terminal Associate Degrees at 14 Penn State Regional Campuses (Fall 2009 and Fall 2010, total)

Associate STEM Degree Majors	Enrollment Total	Campuses Where Offered
Biomedical Engineering Technology (2 BET)	50	[10]New Kensington
Building Engineering Technology (2 BLET)	62	[5]Fayette, [13]Worthington-Scranton
Electrical Engineering Technology (2 EET)	91	[5]Fayette, [7]Hazleton, [14]York
Information Sciences and Technology (2 IST)	226	[2]Beaver, [4]DuBois, [5]Fayette, [7]Hazleton, [8]Lehigh Valley, [9]Mont Alto, [10]New Kensington, [11]Schuylkill, [12]Wilkes Barre, [13]Worthington-Scranton, [14]York
Materials Engineering Technology (2 MATE)	12	[4]DuBois
Mechanical Engineering Technology (2MET)	194	[4]DuBois, [7]Hazleton, [10]New Kensington[*], [14]York
Medical Laboratory Technology (2 MLT)	16	[7]Hazleton
Mining Technology (2 MNGT)	90	[5]Fayette
Science (2 SCCC)	16	[4]DuBois, [5]Fayette, [6]Greater Allegheny
Surveying Engineering Technology (2 SRT)	29	[12]Wilkes Barre
Overall Associate STEM Degree Enrollment:	**786**	[*]Effective Spring 2012, this major is no longer available at this campus.
Overall Associate STEM Degrees Offered:	**10**	

Note: STEM degrees are defined as those in science (including biology, chemistry, physics, and other "classical" sciences), technology, engineering, and mathematics.

Table 2, below, shows the number of full and part-time students enrolled in Associate and Baccalaureate non-STEM as well as STEM degrees at the 14 participating campuses. For the 2009-2010 and 2010-2011 academic years, the 14 regional campuses provided instruction to 34,174 full and part-time students in all disciplines during fall 2009 and fall 2010. Of these, 8604 students were enrolled in associate degree programs, and 25,570 students were enrolled in baccalaureate degree programs.

Table 2: STEM Enrollments for Full and Part-time Associate and Baccalaureate Degrees at 14 Penn State Regional Campuses (Fall 2009 and Fall 2010, total)

Campus	Discipline	Degree		Both Degrees
		Associate	Baccalaureate	
1. Abington	0) Non-STEM	173	3842	4015
	1) Science	0	369	369
	2) Technology	0	250	250
	3) Engineering	0	359	359
	Undeclared	0	921	921
	All Disciplines	173	5741	5914
2. Beaver	0) Non-STEM	42	720	762
	1) Science	0	75	75
	2) Technology	11	105	116
	3) Engineering	0	142	142
	Undeclared	0	292	292
	All Disciplines	53	1334	1387
3. Brandywine	0) Non-STEM	71	1718	1789
	1) Science	0	138	138
	2) Technology	0	138	138
	3) Engineering	0	169	169
	4) Math	0	1	1
	Undeclared	0	584	584
	All Disciplines	71	2748	2819

Campus	Discipline	Degree		Both Degrees
		Associate	Baccalaureate	
4. DuBois	0) Non-STEM	428	494	922
	1) Science	105	130	235
	2) Technology	44	18	62
	3) Engineering	77	75	152
	Undeclared	18	142	160
	All Disciplines	672	859	1531
5. Fayette	0) Non-STEM	644	733	1377
	1) Science	0	74	74
	2) Technology	26	4	30
	3) Engineering	82	104	186
	Undeclared	0	141	141
	All Disciplines	752	1056	1808
6. Greater Allegheny	0) Non-STEM	77	603	680
	1) Science	0	106	106
	2) Technology	0	75	75
	3) Engineering	0	172	172
	Undeclared	0	292	292
	All Disciplines	77	1248	1325
7. Hazleton	0) Non-STEM	240	706	946
	1) Science	2	274	276
	2) Technology	15	72	87
	3) Engineering	52	264	316
	Undeclared	0	836	836
	All Disciplines	319	2152	2471

Campus	Discipline	Degree		Both Degrees
		Associate	Baccalaureate	
8. Lehigh Valley	0) Non-STEM	54	746	800
	1) Science	0	137	137
	2) Technology	9	64	73
	3) Engineering	0	185	185
	4) Math	0	1	1
	Undeclared	0	222	222
	All Disciplines	63	1355	1418
9. Mont Alto	0) Non-STEM	683	634	1317
	1) Science	78	200	278
	2) Technology	25	37	62
	3) Engineering	0	170	170
	Undeclared	0	367	367
	All Disciplines	786	1408	2194
10. New Kensington	0) Non-STEM	188	550	738
	1) Science	0	63	63
	2) Technology	25	149	174
	3) Engineering	88	222	310
	Undeclared	0	169	169
	All Disciplines	301	1153	1454
11. Schuylkill	0) Non-STEM	311	905	1216
	1) Science	1	41	42
	2) Technology	10	54	64
	3) Engineering	1	88	89
	Undeclared	0	460	460
	All Disciplines	323	1548	1871

Campus	Discipline	Degree		Both Degrees
		Associate	Baccalaureate	
12. Wilkes Barre	0) Non-STEM	59	542	601
	1) Science	1	100	101
	2) Technology	18	73	91
	3) Engineering	34	207	241
	Undeclared	0	187	187
	All Disciplines	112	1109	1221
13. Worthington-Scranton	0) Non-STEM	492	1035	1527
	1) Science	0	116	116
	2) Technology	14	121	135
	3) Engineering	18	135	153
	Undeclared	1	536	537
	All Disciplines	525	1943	2468
14. York	0) Non-STEM	236	1018	1254
	1) Science	1	151	152
	2) Technology	39	138	177
	3) Engineering	96	246	342
	Undeclared	0	363	363
	All Disciplines	372	1916	2288
All Campuses	0) Non-STEM	7713	14,246	21,959
	1) Science	188	1974	2162
	2) Technology	236	1298	1534
	3) Engineering	448	2538	2986
	4) Math	0	2	2
	Undeclared	19	5512	5531
	All Disciplines	**8604**	**25,570**	**34,174**

Table 2, above, summarizes the number of science, technology, engineering, and mathematics students enrolled at the 14 participating campuses in fall 2009 and fall 2010. During the fall semesters of these two academic years (2009-2010 and 2010-2011), there were 2162 students in science, 1534 in technology, 2986 in engineering, and 2 in mathematics. Overall, there were 6684 full and part-time students enrolled in STEM degree majors at these campuses.

Table 3, below, shows for the 2009-2010 and 2010-2011 academic years, the 14 regional campuses provided mathematics instruction to 2461 students in Math 22 (Algebra II and Analytic Geometry) and 924 in Math 26 (Trigonometry) resulting in a total of 3385 students in pre-Calculus courses and another 925 in Math 140 (Calculus with Analytic Geometry). Overall, for the 2009-2010 and 2010-2011 academic years, the total number of students in introductory mathematics courses was 4310. In addition, the regional campuses provided engineering and engineering technology instruction to 1285 engineering students in courses such as freshman engineering design, freshman engineering seminars, and computer-related engineering courses.

Table 3: Toys'n MORE Math Course Participants Over Four Semesters (Fall 2009-Spring 2010 <u>and</u> Fall 2010-Spring 2011, total)

	Algebra II & Geometry (Math 022)		Trigonometry (Math 026)		Calculus (Math 140)	
	N	**%**	**N**	**%**	**N**	**%**
Total # math course students	2461	100	924	100	925	100
	N	**%**[1]	**N**	**%**	**N**	**%**
Gender:						
Male	1265	63	647	70	673	73
Female	736	37	276	30	246	27
Race:						
White	1151	70	690	75	732	79
Non-White	502	30	235	25	193	21
1st Generation College Student	893	45	405	44	371	40
Intended major = STEM	984	51	741	86	773	84
Participated in a summer bridge program	54	3	21	2	28	3
Received some math tutoring[2]	753	52	372	59	285	44
Enrolled in a freshman engineering design class	127	9	129	20	148	23

Note: [1] Because some students opted not to answer specific questions, the percentages are based on the number of math course students who answered the question, not the total number of students. [2]Questions regarding math tutoring and enrollment in freshman engineering design classes were added in the second semester of data collection (spring 2010).

Sociodemographic Characteristics of the Math Students in the Toys'n MORE Study

In addition to illustrating the scope of the study through the number of available STEM majors from which students might choose (Tables 1A and 1B), the scope is further illustrated through the number of students exposed to any of the three interventions. The math tutoring intervention is offered to students enrolled in a combined algebra-geometry course, a trigonometry course, and a calculus course. Math tutoring interventions vary by campus. Some campuses offer a formal 1-credit tutoring course that requires weekly attendance, and some campuses offer less-formal drop-in tutoring. Table 3, above, shows the number of math students at the participating campuses that had access to and utilized the math tutoring as well as some characteristics of these students. A majority of the math students were white, males and intended to enter a STEM major. A slight majority of algebra-geometry and trigonometry students obtained tutoring. A modest proportion of the math students were also enrolled in a freshman engineering design course. A very small proportion of the math students participated in a summer bridge program.

Table 4: Math Exam Performance as a Function of Enrollment in a Summer Bridge Program (Fall 2009-Spring 2010 and Fall 2010-Spring 2011, total)

	Enrolled in Summer Bridge Program								
	Algebra-Geometry Students			Trigonometry Students			Calculus Students		
	Yes	No	t(1557)	Yes	No	t(695)	Yes	No	t(717)
Sample Size	40	1519		21	676		25	694	
Post-Test Score									
Mean	55%	51%	1.42	43%	48%	-1.31	55%	51%	< 1
(SD)	(15%)	(17%)		(18%)	(18%)		(25%)	(19%)	
Change from Pre- to Post-Test									
Mean	32%	27%	1.09	9%	21%	-1.81	24%	27%	< 1
(SD)	(29%)	(29%)		(31%)	(30%)		(41%)	(33%)	

Math Exam Performance as a Function of Participation in another Intervention Strategy

Next, turning to more substantive analyses, the final exam performance of students in math is examined as a function of participation in either the summer bridge program or the freshman engineering design course. Students in the math courses across the participating campuses were given the same pre-test at the beginning of the semester to test their baseline knowledge. Likewise, these same students were given a common final exam at the end of the semester. Common exams were given to allow exam scores to be combined and compared across the campuses. The expectation was that math students enrolled in another intervention strategy would show better performance in their math courses than math students who were not enrolled in another intervention strategy. As shown in Tables 4 and 5, math students who had also participated in a summer bridge program or who were concurrently enrolled in an engineering design class did not differ from math students who did not participate in the other two interventions on their final exam scores or the percent change from the pre-test to the final exam. There was an exception to that pattern. As shown in Table 5, below, calculus students who were enrolled in a freshman engineering design course performed better on their final exam and exhibited significantly greater increases in knowledge from the pre-test to the final exam compared to the calculus students who were not enrolled in a freshman design course. In general, small sample sizes of students who enrolled in a summer bridge program or an engineering design class limit the statistical power and the ability to detect group differences.

Table 5: Math Exam Performance as a Function of Enrollment in a Freshman Engineering Design Class (Fall 2009-Spring 2010 and Fall 2010-Spring 2011, total)

	Enrolled in a Freshman Engineering Design Class								
	Algebra-Geometry Students			**Trigonometry Students**			**Calculus Students**		
	Yes	**No**	**t(1455)**	**Yes**	**No**	**t(628)**	**Yes**	**No**	**t(640)**
Sample Size	127	1330		129	501		148	494	
Post-Test Score									
Mean	53%	52%	1.13	44%	46%	< 1	56%	49%	3.75***
(SD)	(18%)	(17%)		(18%)	(17%)		(21%)	(18%)	
Change from Pre- to Post-Test									
Mean	31%	28%	1.22	19%	21%	< 1	30%	23%	2.04*
(SD)	(26%)	(28%)		(32%)	(29%)		(35%)	(34%)	

Note: ***$p < 0.001$ and *$p < 0.05$

Math Course Grades for Baseline (Pre-Intervention) and Intervention Samples

Next, the overall math course performance as illustrated by the course grade is presented. This is an intermediate measure of the efficacy of the Toys'n MORE study. A visual inspection of the math grade data by campus is presented for the period of time before the Toys'n MORE interventions were implemented (baseline or comparison sample, fall 2003 through spring 2009) and for the period to date for the intervention (fall 2009 through spring 2011). Tables 6-8 show the math grade data for algebra-geometry, trigonometry, and calculus, respectively. The broad goal is to show an increase in the proportion of A and B grades from the baseline period to the intervention period. Because poor math grades can be a barrier to the successful completion of a

STEM major, better performance in the foundational math courses is expected to increase the likelihood of graduating with a STEM degree. Visual inspection of the tables indicates increases and decreases in the proportion of A's and B's among students in the algebra-geometry and trigonometry courses from the baseline period to the intervention period at the different campuses. Increases in the proportion of A's and B's from the baseline to intervention period are more consistent for the calculus grades. Considering there are various factors, other than the Toys'n MORE interventions that can affect math grades (e.g., changes in standards and/or faculty), we are in the process of trying to understand the variability in the proportions of A's and B's in these math courses over time.

Table 6: Algebra-Geometry Grades (Math 22) by Campus among STEM Majors for the Baseline Period and the Intervention Period (to date)

	Baseline Sample (Fall 2003-Spring 2009)					Intervention Sample (Fall 2009-Spring 2011)				
		Grade of A or B		Grade of C			Grade of A or B		Grade of C	
Campus	**Total # Enrolled**	**N**	**%**	**N**	**%**	**Total # Enrolled**	**N**	**%**	**N**	**%**
Abington	346	131	37.9	71	20.5	122	47	38.5	26	21.3
Beaver	125	56	44.8	34	27.2	37	22	59.5	5	13.5
Brandywine	101	41	40.6	15	14.9	67	14	20.9	14	20.9
DuBois	99	51	51.5	20	20.2	64	28	43.8	12	18.8
Fayette	70	51	72.9	13	18.6	32	22	68.8	4	12.5
Greater Allegheny	129	54	41.9	20	15.5	42	12	28.6	5	11.9
Hazleton	285	109	38.2	61	21.4	123	65	52.8	18	14.6
Lehigh Valley	94	51	54.3	19	20.0	32	26	81.3	4	12.5
New Kensington	111	37	33.3	31	27.9	43	12	27.9	14	32.6
Wilkes-Barre	113	44	38.9	29	25.7	56	23	41.1	14	25.0
Worthington Scranton	123	58	47.2	30	24.4	58	26	44.8	13	22.4
York	82	50	61.0	16	19.5	28	17	60.7	5	17.9
Total	1678	733	43.7	359	21.4	704	314	44.6	134	19.0

Table 7: Trigonometry Grades (Math 26) by Campus among STEM Majors for the Baseline Period and the Intervention Period (to date)

	Baseline Sample (Fall 2003-Spring 2009)					Intervention Sample (Fall 2009-Spring 2011)				
		Grade of A or B		Grade of C			Grade of A or B		Grade of C	
Campus	**Total # Enrolled**	**N**	**%**	**N**	**%**	**Total # Enrolled**	**N**	**%**	**N**	**%**
Abington	197	62	31.5	51	25.9	93	26	28.0	27	29.0
Beaver	56	27	48.2	18	32.1	26	10	38.5	9	34.6
Brandywine	39	19	48.7	7	17.9	48	6	12.5	17	35.4
DuBois	44	29	65.9	3	6.8	24	14	58.3	2	8.3
Fayette	39	24	61.5	5	12.8	22	14	63.6	5	22.7
Greater Allegheny	66	28	42.4	15	22.7	37	11	29.7	5	13.5
Hazleton	160	66	41.3	40	25.0	82	40	48.8	19	23.2
Lehigh Valley	64	35	54.7	23	35.9	26	10	38.5	9	34.6
New Kensington	78	28	35.9	23	29.5	31	6	19.4	8	25.8
Wilkes-Barre	84	32	38.1	17	20.2	38	15	39.5	11	28.9
Worthington Scranton	56	24	42.9	19	33.9	36	19	52.8	9	25.0
York	8	4	50.0	1	12.5	11	7	63.6	2	18.2
Total	891	378	42.4	222	24.9	474	178	37.6	123	25.9

Table 8: Calculus Grades (Math 140) by Campus among STEM Majors for the Baseline Period and the Intervention Period (to date)

	Baseline Sample (Fall 2003-Spring 2009)					Intervention Sample (Fall 2009-Spring 2011)				
		Grade of A or B		Grade of C			Grade of A or B		Grade of C	
Campus	**Total # Enrolled**	**N**	**%**	**N**	**%**	**Total # Enrolled**	**N**	**%**	**N**	**%**
Abington	233	125	53.6	33	14.2	92	44	47.8	12	13.0
Beaver	78	29	37.2	24	30.8	46	13	28.3	14	30.4
Brandywine	10	0	0	2	20.0	38	8	21.1	8	21.1
DuBois	62	28	45.2	16	25.8	38	21	55.3	6	15.8
Fayette	60	34	56.7	10	16.7	34	18	52.9	5	14.7
Greater Allegheny	69	32	46.4	18	26.1	24	13	54.2	3	12.5
Hazleton	178	46	25.8	40	22.5	70	20	28.6	18	25.7
Lehigh Valley	109	55	50.5	30	27.5	46	30	65.2	9	19.6
New Kensington	111	30	27.0	27	24.3	30	14	46.7	3	10.0
Wilkes-Barre	87	24	27.6	17	19.5	24	11	45.8	6	25.0
Worthington Scranton	56	21	37.5	15	26.8	34	22	64.7	4	11.8
York	116	40	34.5	36	31.0	50	16	32.0	17	34.0
Total	1169	464	39.7	268	22.9	526	230	43.7	105	20.0

Conclusions

This paper presents preliminary data at the half-way point of data collection for the Toys'n MORE study. The purpose of the study is to intervene in the freshman and sophomore years to increase the proportion of STEM majors, particularly in engineering, at The Pennsylvania State University. The scope and breadth of the study are strengths and challenges. Because retention data are not available yet, data are presented on two intermediate indicators -math final exam performance and math course grades. Successful math course performance is crucial for the completion of a STEM major. The data look more promising for the calculus students than for the algebra-geometry and trigonometry students. Because of the small number of students who participated in a summer bridge program, low statistical power may account for the lack of findings for the math exam performance data examined. Data collection is continuing for four more semesters. Further research questions include math exam performance as a function of the type of tutoring offered at a regional campus, freshman-year fall-semester grade point average as a function of participation in a summer bridge program, and retention in a STEM major as a function of the three interventions.

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