AC 2011-1340: TOYS'N MORE -INITIAL IMPLEMENTATION OF INTERVENTION STRATEGIES

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Dr. 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.

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Jill Lane has more than fifteen 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 over 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.

Dr. 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.

Amy Freeman, Pennsylvania State University, University Park

Introductory Biography for Amy Freeman

Amy L. Freeman is the Assistant Dean of Engineering Diversity at The Pennsylvania State University serving as an advocate for racially underrepresented students and women in Engineering. She received her Bachelor of Science degree in Construction Management from Washington State University and completed a Master of Science degree in Architectural Engineering at Penn State. In 2009, she will complete a Ph.D. in Workforce Education at Penn State with a dissertation focusing on underrepresented graduates in technical fields.

Along the way, Amy Freeman has served the interests of underrepresented students and the field of Engineering in many capacities. As an educator, she served the Pennsylvania State System of Higher Education for 10 years directing retention programs for Bloomsburg University, and as Director of Human and Cultural Diversity for Lock Haven University. She has developed and taught art workshops for children, literacy programs for the elderly, and has provided direction for youths in the juvenile justice system. She

has also assisted in job training for incarcerated women completing apprenticeships in the construction trades.

At Penn State, she continues to provide recruitment and retention enhancement through the long standing Multicultural Engineering Program, the Women in Engineering Program and through cultivation of partnerships with corporations, alumni, university constituents and organizational alliances. She has written, published and presented research findings at national conferences and is a member of several organizations including the GEM Consortium, The National Association of Women in Engineering Advocates Network, Society of Women Engineering, The National Society of Black Engineers, The Society of Hispanic Professional Engineers and the American Indian Society of Engineering and Science. She is currently serving as the President of the National Association of Multicultural Engineering Program Advocates.

She has spoken at schools, churches and correctional institutions, and received a commendation from the Pennsylvania Historical and Museum Commission for her contribution to African Americans in the city of Williamsport and Lycoming County.

Ms. Freeman has traveled internationally including Europe, Canada, Mexico, The People's Republic of China, Jamaica, Morocco and the Republic of Korea. As a speaker and an educator, she emphasizes the need to learn as much as possible about others and the world around us.

Javier Gomez-Calderon, Penn State University

Dr. Javier Gomez-Calderon is a Professor of Mathematics and Mathematics Coordinator at Penn State New Kensington. He is the author or co-author of thirty articles, four textbooks, four in-house booklets, and the advisor of eight student publications. Dr. Gomez-Calderon served as the Head of the Mathematics Division (fourteen campuses) from 2002 to 2006 and obtained his Ph.D. in 1986 from The University of Arizona. Dr. Gomez-Calderon was the recipient of the 2007 Penn State 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.

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Dr. Sathianathan is the Associate Dean for Academic Programs in the College of Engineering at California State University, Long Beach (CSULB). He has a Ph.D. in Mechanical Engineering from Penn State University, and BS in Mechanical Engineering from Oklahoma State University. Prior to joining CSULB, he was the head of the School of Engineering Design, Technology, and Professional Programs at Penn State. Dr. Sathianathan has been actively involved in engineering education initiatives since 1994. He led several NSF funded initiative to enhance engineering education, especially focused on retention. He is the co-founder of the Engineering Entrepreneurship Program and the Center for Engineering Design and Entrepreneurship at Penn State. He has received the Boeing Outstanding Educator Award and Boeing Welliver Faculty Fellow Award, and the ASEE - DOW Outstanding Faculty Award for his work in engineering education. Dr. Sathianathan currently serves on the ASEE Projects Board.

Renata S. Engel, Pennsylvania State University, University Park

Renata S. Engel is Associate Dean for Academic Programs and Professor of Engineering Design and Engineering Science & Mechanics. A member of the Penn State faculty since 1990, she served from 2000-2006 as the Executive Director of the Schreyer Institute for Teaching Excellence. Through various collaborative efforts, she has affected changes in the engineering curriculum at Penn State, primarily to incorporate elements of design in fundamental engineering courses. Engel earned a BS in engineering science at Penn State and PhD in engineering mechanics at the University of South Florida. She can be contacted at rse1@psu.edu.

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

Initial Implementation of the Four Intervention Strategies

This paper presents preliminary data from the initial implementation of a project referred to as Toys and Mathematical Options for Retention in Engineering (Toys'n MORE). The goal of the project is to increase the retention of Science, Technology, Engineering, and Mathematics (STEM) students by 10% at the 15 Penn State regional coalition campuses.

This project is being conducted by the College of Engineering at The Pennsylvania State University through an NSF-funded Science, Technology, Engineering, and Mathematics Talent Expansion Program grant (STEP grant, DUE # 0756992). The project involves the College of Engineering and 15 geographically-dispersed campuses in the Penn State system. These regional campuses offer a number of associate and bachelor STEM degree majors. Although some STEM students receive their degree at one of these regional campuses, many start at a regional campus and then transfer to the largest campus at University Park to complete their degree.

Toys'n MORE is based on four intervention strategies underway at these 15 regional campuses. These strategies include (a) tutoring programs that serve four mathematics courses (three pre-calculus and one 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, (c) a new summer bridge program administered at three regional campuses and designed to assist underrepresented students, who have expressed an interest in engineering, to transition from high school to college, and (d) the assessment and evaluation of the three aforementioned intervention strategies. The strength of this project lies in the comprehensive scope of the interventions as well as its large sample size.

To illustrate the breadth of this project, the first semester of the intervention occurred on 15 of the Penn State campuses. It involved seven STEM courses: four as part of the math tutoring strategy (algebra-analytic geometry, trigonometry, a combination of algebra-trig-analytic geometry, and calculus) and three as part of the toy design strategy (freshman engineering design, freshman engineering seminars, and computer-related engineering courses). After the first two semesters of implementation, more than 7300 students were enrolled in the mathematics courses, the toy-based engineering courses, and the summer bridge programs. Covering these courses were fifty math faculty and twenty engineering faculty.

This paper presents the descriptive characteristics and preliminary retention information based on Toys'n MORE data from participants enrolled in the first two semesters of the intervention (Fall 2009 and Spring 2010). Analysis of participant data is underway to examine the student perceptions of course interventions as well as major preferences of participants after one year.

1. One Project, 15 Campuses

To understand the breadth of this project, a map of coalition campus locations throughout the state of Pennsylvania is shown in Figure 1, below. The interventions initiated by Toys'n MORE are being administered at 15 of these regional campuses. The University Park campus is the largest campus and the administrative home of the University and the Toys'n MORE project. With close to 18,000 STEM students enrolled full and part-time at these geographically-dispersed locations, the regional coalition campuses are an integral part of the Penn State system.

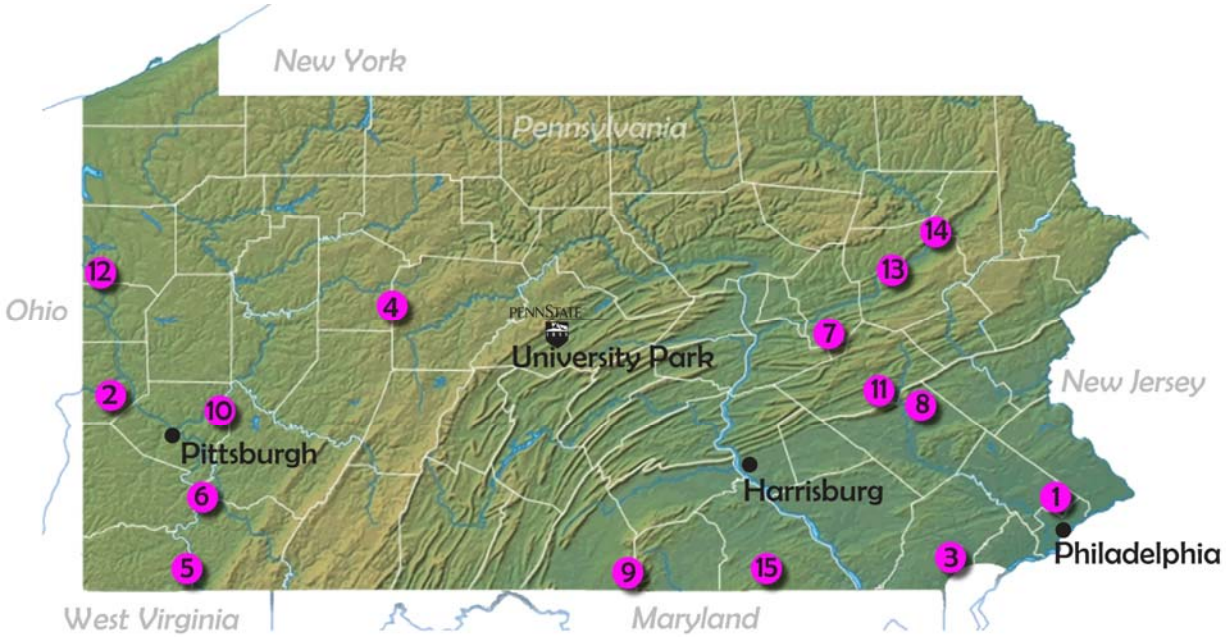

Figure 1: Regional Coalition Campus Locations across Pennsylvania.

Collectively, the participating regional coalition campuses offer 32 associate degrees and 26 baccalaureate STEM degrees in majors such as biology, earth science, engineering and engineering technology, information science, mining technology, and science (Table 1, below). Many students from the regional campuses transfer to the largest campus at University Park to complete their degree in more than 100 STEM baccalaureate degree programs.

Table 1: STEM Degrees Offered.

Associate and Baccalaureate STEM[a] Degrees Offered at the 15 Regional Penn State Coalition Campuses (Fall 2009-Spring 2010)			
Campus	Degrees		Enrollment
	Associate	Baccalaureate	Total[b] Campus
1. Abington	(none)	1. Biology with Genetics and Developmental Biology Option	

		2. Biology with Vertebrate Physiology Option 3. Information Sciences and Technology 4. Science with Life Science Option 5. Science with General Science Option	
Total		**5 BS degrees**	**3377**
2. Beaver	1. Information Sciences and Technology (2IST) 2. Science (2SC)	1. Information Sciences and Technology	
Total	**2 Assoc degrees**	**1 BS degree**	**774**
3. Brandywine	(none)	1. Information Sciences and Technology	
Total		**1 BS degree**	**1593**
4. DuBois	1. Information Sciences and Technology (2IST) 2. Materials Engineering Technology (2MATE) 3. Mechanical Engineering Technology (2MET)	1. Earth Sciences 2. General Engineering –Applied Materials Track 3. Information Sciences and Technology	
Total	**3 Assoc degrees**	**3 BS degrees**	**954**
5. Fayette	1. Building Engineering Technology (2AET) 2. Building Engineering Technology (BEST) 3. Electrical Engineering Technology (2EET) 4. Information Sciences	(none)	

	and Technology (2IST) 5. Mining Technology (2MNGT) 6. Science (2SC)		
Total	**6 Assoc degrees**		**1050**
6. Greater Allegheny	1. Science (2SC)	1. Information Sciences and Technology	
Total	**1 Assoc degree**	**1 BS degree**	**756**
7. Hazleton	1. Electrical Engineering Technology (2EET) 2. Information Sciences and Technology (2IST) 3. Mechanical Engineering Technology (2MET) 4. Medical Laboratory Technology (2MLT)	1. General Engineering – Alternative Energy & Power Generation Track 2. Information Sciences and Technology	
Total	**4 Assoc degrees**	**2 BS degrees**	**1301**
8. Lehigh Valley	1. Information Sciences and Technology (2IST)	1. Information Sciences and Technology	
Total	**1 Assoc degree**	**1 BS degree**	**785**
9. Mont Alto	1. Information Sciences and Technology (2IST)	1. Information Sciences and Technology	
Total	**1 Assoc degree**	**1 BS degree**	**1206**
10. New Kensington	1. Biomedical Engineering Technology (2BET) 2. Information Sciences and Technology (2IST) 3. Mechanical Engineering Technology 4. Science (2SC)	1. Electro-Mechanical Engineering 2. Information Sciences and Technology	

Total	**4 Assoc degrees**	**2 BS degrees**	**827**
11. Schuylkill	1. Information Sciences and Technology (2IST)	1. Information Sciences and Technology	
Total	**1 Assoc degree**	**1 BS degree**	**1001**
12. Shenango	1. Information Sciences and Technology (2IST) 2. Science (2SC)	1. Information Sciences and Technology	
Total	**2 Assoc degrees**	**1 BS degree**	**812**
13. Wilkes Barre	1. Information Sciences and Technology (2IST) 2. Surveying Engineering Technology (2SUR)	1. Electrical Engineering Technology 2. Information Sciences and Technology 3. Surveying Engineering	
Total	**2 Assoc degrees**	**3 BS degrees**	**669**
14. Worthington Scranton	1. Building Engineering Technology (2BLET) 2. Information Sciences and Technology (2IST)	1. Information Sciences and Technology	
Total	**2 Assoc degrees**	**1 BS degree**	**1429**
15. York	1. Electrical Engineering Technology (2EET), 2. Information Sciences and Technology (2IST) 3. Mechanical Engineering Technology (2MET)	1. Electro-Mechanical Engineering 2. Information Sciences and Technology 3. Science	
Total	**3 Assoc degrees**	**3 BS degrees**	**1336**
Overall Totals	**32 Assoc degrees**	**26 BS degrees**	**17,870**

[a]STEM degrees are defined as those in science (including biology, chemistry, physics, and other "classical" sciences), technology, engineering, and mathematics.
[b]Total Campus Enrollment (Fall 2009- Spring 2010) is defined as annualized head count with no

double-counting. (For example, if a student changes from one STEM major to another during the period Fall 2009 through Spring 2010, they are counted only one time.)

Overall, for the 2009-2010 academic year, the 15 regional campuses provided instruction to 17,870 full and part-time students in all disciplines. Of these, 3212 students were enrolled in associate degree programs, and 14,658 students were enrolled in baccalaureate degree programs (Table 3, below).

Table 2: STEM Enrollments.

Associate and Baccalaureate STEM[a] Enrollments
Full and Part-time Students
at the 15 Regional Penn State Coalition Campuses
(Fall 2009-Spring 2010)

		Degree		Both Degrees
		Associate	Baccalaureate	
Campus	Discipline			
1. Abington	0) Non –STEM	124	1958	2082
	1) Science	0	424	424
	2) Technology	3	146	149
	3) Engineering	0	219	219
	Undeclared	0	503	503
	All Disciplines	127	3250	3377
2. Beaver	Discipline			
	0) Non-STEM	27	286	313
	1) Science	1	123	124
	2) Technology	6	63	69
	3) Engineering	0	101	101
	Undeclared	0	167	167
	All Disciplines	34	740	774

Associate and Baccalaureate STEM[a] Enrollments
Full and Part-time Students
at the 15 Regional Penn State Coalition Campuses
(Fall 2009-Spring 2010)

		Degree		Both Degrees
		Associate	Baccalaureate	
3. Brandywine	Discipline			
	0) Non-STEM	48	985	1033
	1) Science	0	91	91
	2) Technology	0	72	72
	3) Engineering	0	100	100
	4) Math	0	1	1
	Undeclared	0	296	296
	All Disciplines	48	1545	1593
4. DuBois	Discipline			
	0) Non-STEM	267	314	581
	1) Science	61	70	131
	2) Technology	26	12	38
	3) Engineering	43	62	105
	4) Math	0	1	1
	Undeclared	12	86	98
	All Disciplines	409	545	954
5. Fayette	Discipline			
	0) Non-STEM	319	414	733
	1) Science	5	36	41
	2) Technology	14	2	16
	3) Engineering	123	69	192
	Undeclared	0	68	68
	All Disciplines	461	589	1050

Associate and Baccalaureate STEM[a] Enrollments
Full and Part-time Students
at the 15 Regional Penn State Coalition Campuses
(Fall 2009-Spring 2010)

		Degree		Both Degrees
		Associate	Baccalaureate	
6. Greater Allegheny	Discipline			
	0) Non-STEM	55	298	353
	1) Science	4	103	107
	2) Technology	0	46	46
	3) Engineering	1	105	106
	Undeclared	0	144	144
	All Disciplines	60	696	756
7. Hazleton	Discipline			
	0) Non-STEM	142	487	629
	1) Science	17	143	160
	2) Technology	11	42	53
	3) Engineering	42	136	178
	Undeclared	0	281	281
	All Disciplines	212	1089	1301
8. Lehigh Valley	Discipline			
	0) Non-STEM	27	385	412
	1) Science	0	115	115
	2) Technology	4	35	39
	3) Engineering	1	103	104
	4) Math	0	1	1
	Undeclared	0	114	114
	All Disciplines	32	753	785

Associate and Baccalaureate STEM[a] Enrollments
Full and Part-time Students
at the 15 Regional Penn State Coalition Campuses
(Fall 2009-Spring 2010)

		Degree		Both Degrees
		Associate	Baccalaureate	
9. Mont Alto	Discipline			
	0) Non-STEM	374	367	741
	1) Science	45	105	150
	2) Technology	14	20	34
	3) Engineering	4	91	95
	Undeclared	0	186	186
	All Disciplines	437	769	1206
10. New Kensington	Discipline			
	0) Non-STEM	121	282	403
	1) Science	4	72	76
	2) Technology	11	82	93
	3) Engineering	56	121	177
	4) Math	0	1	1
	Undeclared	0	77	77
	All Disciplines	192	635	827
11. Schuylkill	Discipline			
	0) Non-STEM	167	391	558
	1) Science	2	120	122
	2) Technology	4	29	33
	3) Engineering	2	53	55
	Undeclared	0	233	233
	All Disciplines	175	826	1001

Associate and Baccalaureate STEM[a] Enrollments
Full and Part-time Students
at the 15 Regional Penn State Coalition Campuses
(Fall 2009-Spring 2010)

		Degree		Both Degrees
		Associate	Baccalaureate	
12. Shenango	Discipline			
	0) Non-STEM	343	323	666
	1) Science	8	25	33
	2) Technology	22	8	30
	3) Engineering	12	15	27
	Undeclared	0	56	56
	All Disciplines	385	427	812
13. Wilkes Barre	Discipline			
	0) Non-STEM	45	267	312
	1) Science	2	55	57
	2) Technology	9	37	46
	3) Engineering	21	140	161
	Undeclared	0	93	93
	All Disciplines	77	592	669
14. Worthington Scranton	Discipline			
	0) Non-STEM	285	621	906
	1) Science	0	66	66
	2) Technology	6	69	75
	3) Engineering	11	83	94
	Undeclared	0	288	288
	All Disciplines	302	1127	1429

Associate and Baccalaureate STEM[a] Enrollments
Full and Part-time Students
at the 15 Regional Penn State Coalition Campuses
(Fall 2009-Spring 2010)

		Degree		Both Degrees
		Associate	Baccalaureate	
15. York	Discipline			
	0) Non-STEM	166	537	703
	1) Science	1	101	102
	2) Technology	29	74	103
	3) Engineering	65	156	221
	Undeclared	0	207	207
	All Disciplines	261	1075	1336
All Campuses	Discipline			
	0) Non-STEM	2510	7915	10425
	1) Science	150	1649	1799
	2) Technology	159	737	896
	3) Engineering	381	1554	1935
	4) Math	0	4	4
	Undeclared	12	2799	2811
	All Disciplines	**3212**	**14,658**	**17,870**

For the 2009-2010 academic year, the 15 regional campuses provided mathematics instruction to 3028 students in Math 22 (Algebra II and Analytic Geometry), 1177 in Math 26 (Trigonometry), and 85 in Math 40 (Algebra, Trig, and Analytic Geometry) resulting in a total of 4290 students in pre-Calculus courses, and another 1791 in Math 140 (Calculus with Analytic Geometry). Overall, for the 2009-2010 academic year, the total number of students in introductory mathematics courses was 6081. In addition, the regional campuses provided engineering and engineering technology instruction to 1285 engineering students (Table 3, below) in courses such as freshman engineering design, freshman engineering seminars, and computer-related engineering courses.

Table 3: Math and Engineering Enrollments.

Math and Engineering Enrollments[a]
Full and Part-time Students
at the 15 Regional Penn State Coalition Campuses
(Fall 2009-Spring 2010)

	Pre-Calculus			Calculus I	Engineering & Engineering Technology
	Math 22[b]	Math 26[b]	Math 40[b]	Math 140[c]	
Campus	Algebra II and Analytic Geometry	Trigonometry	Algebra, Trig, and Analytic Geometry	Calculus with Analytic Geometry	
Abington	671	288		335	113
Beaver	131	51		119	59
Brandywine	282	84		114	137
DuBois	117	36		82	92
Fayette	109	58		75	117
Greater Allegheny	140	78		100	59
Hazleton	274	152		156	126
Lehigh Valley	149	51		109	45
Mont Alto	216	75		138	111
New Kensington	90	39	27	70	134
Schuylkill	202	62		80	20
Shenango	76	27		26	12

Wilkes-Barre	117	46		108	74
Worthington-Scranton	279	89		105	43
York	175	41	50	171	143
Overall Totals	**3028**	**1177**	**85**	**1791**	**1285**

[a]The course enrollment numbers are based on student transcripts.
[b]Pre-Calculus courses (Math 22, 26, and 40) include algebra, trigonometry, and geometry.
[c]Calculus I (Math 140) is the first in the sequence of calculus courses.

2. Applying the Intervention Strategies

Through the auspices of the National Science Foundation, Toys'n MORE (STEP grant, DUE # 0756992) seeks to increase the retention of students pursuing STEM degree programs, particularly in engineering. Considering the number of campuses involved (Figure 1), the number of different STEM fields served (Tables 1 and 2), and the number of STEM related courses (Table 3), this effort is significant. Four strategies are called into play. Each allows students the opportunity to apply several learning styles. At the same time, each campus is able to evaluate ways in which to enhance the curricular approach and educational resources for STEM field majors.

The four strategies are:

1) supplementary tutoring for students in introductory mathematics courses,
2) hands-on design of functional toys to engage first-year STEM students in actual applications of science and mathematics,
3) math-intensive summer bridge programming, including academic, social, and cultural activities for underrepresented students (e.g., minorities, women, first-generation college students), and
4) continuous assessment of strategies 1) through 3).

3. Math Tutoring Strategy

By Fall 2009, the Math Tutoring Program strategy was underway at all 15 participating regional coalition campuses (Table 4, below). The program, although implemented slightly different at each campus, involved tutoring services for introductory algebra, trigonometry, and calculus.

Table 4: Math Tutoring, Toy FUN-damentals, and Campus College Connection Start Dates at the 15 Coalition Campuses.

	Coalition Campuses	Math Tutoring Program	Toy FUN-damentals Program	Campus College

		Started		Started			Connection-Bridge Programs Started
		Spring 2009	*Fall 2009*	*Fall 2009*	*Spring 2010*	*Fall 2010*	*Summer 2010*
1	Abington		√	√			
2	Beaver	√		√			
3	Brandywine	√		√			√
4	DuBois	√		√			
5	Fayette	√		√			
6	Greater Allegheny	√		√			√
7	Hazleton	√		√			
8	Lehigh Valley		√	√			
9	Mont Alto	√				√	
10	New Kensington	√				√	√
11	Schuylkill	√			√		
12	Shenango	√				(a)	
13	Wilkes-Barre	√		√			
14	Worthington Scranton	√			√		
15	York	√				(b)	

(a) Unable to secure additional state funding.
(b) Elected not to participate.

4. Toy FUN-damentals Strategy

The Toy FUN-damentals Program strategy was first launched in the fall of 2009 (Table 4, above). As of fall 2010, the toy program was underway at 13 of the 15 campuses. (Note: One campus elected not to participate and another was unable to secure additional state funding which was critical to recruiting students into the proposed campus project.)

The Toy FUN-damentals program, which is delivered through a 1-credit, first-year seminar (FYS) or as part of an existing 3-credit engineering design or computer-related course, focuses on enhancing retention through the deconstruction, creative design, and use of toys. With the focus on toys, students' anxiety appears reduced and the misconception that other majors are more fun appears quelled.

The Toy FUN-damentals curriculum combines the fundamental concepts of engineering design (e.g., durability, functionality, and material selection), creativity, practical experience, innovation, and problem solving by means of hands-on design projects. It allows students to exercise their curiosity and discover how something as simple as a toy is put together and how it

functions. At campuses where prototyping is introduced, Toy FUN-damentals provides an opportunity for students to take a concept from a blank sheet of paper to a low-level functioning model. At other campuses, students are afforded the excitement of interacting with end-users (e.g., children). At still other campuses, students are introduced to the concept of value-added products. Overall, the goal is to retain these freshmen engineering students by piquing their interests and promoting creativity through diverse methods in a freshmen-level engineering design class focused on toys.

5. Campus College Connection Strategy

The third strategy, the Campus College Connection, is geared towards retention of under-served students (e.g., ethnic minorities, women, first-generation college students) through a math-intensive summer bridge program administered at three regional campuses. Incoming freshman are also able to prepare for their first fall semester through this summer program.

At the University Park campus, there are two successful existing residential summer bridge programs. One is designed to serve students who will attend University Park in the fall, and one is designed to serve students who will attend the regional coalition campuses. Presently, 140 to 160 incoming engineering first-year students are African American, Native American, or Hispanic. Over half begin their engineering degrees at one of the 15 regional campuses. The math-intensive summer bridge program administered by the College of Engineering at the University Park campus has been successful at improving retention rates of underrepresented students. Although students from various regional campuses who attend the University Park summer bridge program build good relationships, the advantage of offering a summer bridge at a local campus allows students to form a larger cohort group and a larger learning community at their local campus.

The Toys'n MORE project adapted the summer bridge strategy from the College of Engineering at University Park and administered it at 3 of the 15 regional campuses. Implementation of this strategy, called the Campus College Connection, began during the summer of 2010 (Table 4, above).

6. Assessment

The fourth strategy, Assessment, examines the impact of the three aforementioned intervention strategies: Math Tutoring, Toy FUN-damentals, and Campus College Connection. For the Math Tutoring Program, the assessment involves a demographic survey, a common diagnostic test, and a common final exam across participating campuses for each of the targeted introductory mathematics courses. The diagnostic tests are used to establish a baseline with respect to students' prerequisite ability for pre-calculus and calculus courses. The final exams are used to examine whether significant learning gains result from the intervention of the tutoring programs. In addition, the pattern of students' passing rates (i.e. grades of C, or better) is being tracked in introductory mathematics courses. For the 2009 cohort of students, there is initial success compared to the 2004-2008 student cohorts in pre-calculus courses such as Math 22 and Math 26. However, the passing rate for the introductory calculus course, i.e. Math 140 (Table 5, below), reveals challenges. The Toys'n MORE project will continue to work with the

participating regional coalition campuses to improve and examine the effectiveness of the tutoring intervention.

For the Toy FUN-damentals Program, the assessment includes a demographic survey, a pre-survey and a post-survey on students' engineering self-efficacy and career interests in engineering disciplines. Findings of the surveys for Toy FUN-damentals program participants will provide valuable information regarding attitude change due to the intervention.

For the Campus College Connection, the assessment involves a post-program survey with rating scales and open-ended questions to solicit students' feedback about future improvement of the program. The purpose of this survey is to learn about students' learning and participation experiences, which will form continuous improvement of the mathematics-intensive summer bridge program.

It is important to note that even though the coalition campuses are all Penn State campuses, each campus is administratively independent. The budget for each campus is directly driven by enrollments and state allocation. Hence, administratively, there are varying degrees of resources available to each of the 15 regional coalition campuses to address challenges associated with student retention. To reduce this disparity and examine the effect of intervention strategies relative to the project scope and goals, the retention and academic pathways of STEM degree students at these campuses are being tracked as part of the Toys'n MORE project.

7. Preliminary Results after Two Semesters of Implementation

A. Demographic Characteristics

Based on the first two semesters of implementation, demographic characteristics for the participants reflect the overall enrollment patterns in STEM disciplines across institutions of higher learning. Similar to traditional first-year students, the average age was 18. The targeted Mathematics courses had a 67% to 33% male to female ratio, with 71% White, 9% African American, 9% Asian, 6% Hispanic, and 5% Other. In the Toy FUN-damentals classes, the male to female ratio was 90% to 10%, and the racial breakdown was 78% White, 7% African American, 7% Asian, 5% Hispanic, and 3% Other. In the Campus College Connection program, the male to female ratio was 71% to 29%, and the racial breakdown was 54% White, 21% African American, 18% Asian, and 7% Hispanic.

B. STEM Retention

The one-year retention rate of STEM majors at participating campuses was examined. For the first-year STEM students enrolled in the first semester of the Toys'n MORE intervention (Fall 2009), there was a 79.7% one-year retention rate in STEM majors by the sophomore year (Fall 2010). That rate looks promising compared to a 66.6% one-year retention rate (6-year average) for first-year STEM majors who enrolled prior to the intervention (Fall 2003-Fall 2008). However, the differences have yet to be statistically tested.

C. Strategy I: Passing Rates in Math Courses (% A, B, and C Grades)

The central goal of the math tutoring strategy is to maximize success in math courses so students do not repeat math courses and stay on track for the completion of a STEM major. An indicator of success in math courses is passing rates (% of A, B, and C grades). Table 5, shown below, gives passing rates in the target math classes for students in the intervention and the pre-intervention period. Please note that differences between the passing rates of the students in the intervention cohort and the comparison cohort have yet to be formally tested.

Table 5: Passing Rates in Math Courses (% A, B, C Grades).

Cohort	Algebra	Trigonometry	Calculus
Intervention (Fall 2009-Spring 2010)	68.0%	70.8%	74.6%
Pre-intervention (2002-2007)*	60.2%	62.1%	60.4%

*Source: Distribution of Grades in Algebra, Trigonometry, and Calculus at Selected Campuses, Office of the Vice President for Commonwealth Campuses.

D. Strategy II: Toy FUN-damentals Student Efficacy (Fall 2009-Spring 2010)

At the beginning and end of the semester, the students in the first-year engineering design "toy" courses complete an engineering efficacy survey (Table 6, below). The subscales have adequate internal consistency (***α)***, which means the items tap a similar construct. When comparing the pre- and post-survey results, students reported statistically significant increases in (a) communication skills, (b) confidence in completing engineering major prerequisites, (c) feeling tied to their peers, (d) working on a team, and (e) confidence in conceptualizing and executing a design. The efficacy measure will be used to explain retention rates and not as an outcome measure.

Table 6: Engineering Toy FUN-damentals Student Efficacy (Fall 2009-Spring 2010).

	Pre-Survey			Post-Survey			
Engineering Efficacy Scale	***α***	***M***	***SD***	**α**	***M***	***SD***	***t(138)***
Communication Self-Efficacy[1]	.86	7.62	1.49	.83	8.02	1.25	-3.24**
Coping Self-Efficacy[2]	.76	4.83	.78	.71	4.89	.70	-1.14
Engineering Career Success Expectations[2]	.85	5.06	.67	.88	5.13	.67	-1.50
Engineering Self-Efficacy I[2]	.87	4.87	.88	.85	4.88	.88	< 1
Engineering Self-Efficacy II[2]	.84	4.84	.82	.87	4.98	.77	-2.31*
Feeling of Inclusion[2]	.83	4.42	.93	.85	4.71	.86	-4.12***
Math Outcome Expectations[2]	.82	5.06	.80	.78	5.08	.91	< 1
Teaming Self-Efficacy[1]	.80	7.35	1.46	.82	7.61	1.50	-2.12*

Technology Self-Efficacy[1]	.86	7.55	1.70	.84	7.95	1.50	-2.77**

Note: * $p < .05$, ** $p < .01$, *** $p < .001$, [1]Lucas engineering self-efficacy subscales (maximum score = 10), [2]Longitudinal Assessment of Engineering Self-Efficacy (LAESE) subscales (maximum score = 6), Pre-Survey N = 318, Post-Survey N = 139 (44% of Pre-Survey respondents).

E. Strategy III: First Semester GPA for Campus College Connection Students

After the new Campus College Connection programs were run in Summer 2010, the first semester Fall 2010 average GPA for the participants from the Greater Allegheny, New Kensington, and Brandywine campuses was 3.02. By comparison, the average Fall 2010 GPA for similar non-participating underrepresented students at the same three campuses was 2.72. This difference was not statistically significant [t (85) = 1.59, *ns*]; however, the direction of the difference is encouraging and indicates differences of practical significance. In practice, differences in GPA as small as 0.2 can have significant real-world consequences for students' academic success (e.g., retaining scholarships or financial aid, qualifying for an internship, likelihood of graduation). Although GPA is not the central outcome measure for this study, it is an intermediate indicator of the likelihood of retention.

8. Synthesis: Progress towards Goals

Looking back, the first step taken by Toys'n MORE was to establish a baseline against which to examine changes in STEM retention. To start, the average STEM retention rates from freshman year to sophomore year for the 6 years prior to the start of the Toys'n MORE project was computed. After the first year of Toys'n MORE, there was a 13% increase in the retention of STEM majors from the freshmen to sophomore year, which is consistent with the goal of a 10% increase in STEM retention. Although this difference has yet to be statistically tested, the raw numbers are encouraging and suggest that curricular changes and tutoring support are having an impact on student retention. This first Toys'n MORE cohort, and subsequent cohorts, will continue to be tracked longitudinally. Second, there were positive changes in pass rates for pre-calculus math courses. Compared to pre-intervention cohorts, the pass rates in algebra and trigonometry classes increased by 8% and 9%, respectively, for students enrolled in the first two semesters of the project. These changes have not been tested statistically yet, but they suggest that the increased tutoring at the campuses is improving students' mastery of pre-calculus material and reducing the need for students to repeat these courses. Third, baseline retention rates of underrepresented students (African American, Hispanic, Native American) between their first and third semesters have been collected. However, due to changes in reporting categories as part of the Integrated Postsecondary Education Data System (IPEDS), the numbers for those students who are part of the first cohort have yet to be made available to Toys'n MORE project.

The Toys'n MORE project has been fully implemented since Fall 2010. Strategies are on track to meet the overall broad impact goal of increasing the retention of Science, Technology, Engineering, and Mathematics (STEM) students at 15 regional Penn State coalition campuses by 10%.