

Pre-Calculus Summer Boot Camp – Lessons Learned

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Abstract - New Jersey Institute of Technology (NJIT) administers a mathematics placement test to all incoming first year students. The only exceptions are students who have advanced placement credits or college level credits for calculus. A poor performance in the placement test will result in students being placed into one of the two pre-calculus (remedial) courses. Students who place in a pre-calculus course must catch up in their curriculum. In summer 2015, NJIT ran a pilot pre-calculus summer boot camp to provide students with an opportunity to catch up before their first semester (fall) at NJIT. The 2015 pilot of the pre-calculus summer boot camp produced very encouraging results with 77% of the students moving onto the next course in the math sequence. In addition to taking a pre-calculus math course, students also received supplemental instruction, breakfast, lunch, a chance to interact with faculty, staff, and academic advisors. The boot camp produced several positives and a few things that need to be worked on going forward. NJIT has decided that the program should continue and all efforts should be made to attract higher student participation for 2016. This paper covers information on details of the boot camp outcome and lessons learned from the 2015 pilot run. Several adjustments have been made to the program this year to increase the impact on the rate of student participation and success.

Index Terms – Summer boot camp, pre-calculus courses, supplemental instruction, tutoring and peer mentoring.

INTRODUCTION

Many universities offer boot camps during summer to help students to hone their skills or to catch up before they officially begin their studies. While offering coursework in mathematics, English or other subjects, boot camps also offer activities and programming to get students adjusted to the college environment and the academic support that is available to them. In addition, students need help with time management, learning style, self-advocacy among other things. Smith [1] and Wissemore [2] in their published work talk about ‘Bridge to Success’ programs and their importance in preparing students for rigors of college. A wide variety of colleges and universities including Columbia University, Rutgers University, New Mexico

College, and Harrisburg Area Community College have successfully implemented summer boot camps [1-3]. A number of studies [4-9] have shown that summer bridge programs have positive effects in student retention and persistence to the second and third years.

A high number of students in Newark College of Engineering (NCE) at NJIT are placed into pre-calculus courses based on their performance in mathematics placement test. Figure 1 illustrates the extra steps they have to take before they are able to reach the recommended starting point for all NCE students. In particular, students that are placed in pre-calculus I (MATH108) may take up to a year or even more before they can take real engineering course. This is very detrimental to students’ motivation to pursue engineering if nothing is done to have them catch up with the rest of the class.

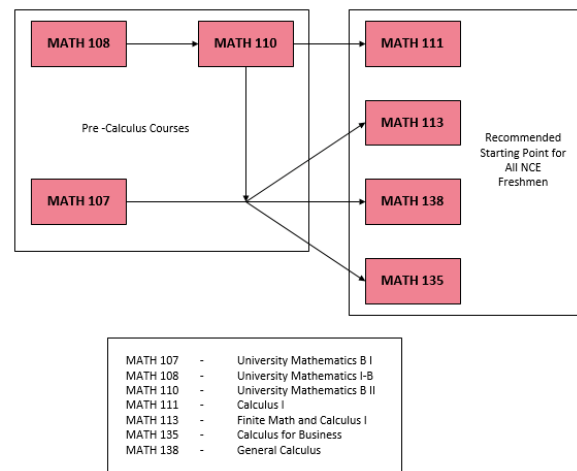


FIGURE 1
PRE-CALCULUS COURSE SEQUENCE

A “work in progress” paper presented at 7th FYEE conference gave an overview of the importance of boot camps and information about NJIT’s approach that was implemented in Summer 2015 [10]. This paper summarizes the outcomes of the pilot pre-calculus summer boot camp NJIT offered in the summer of 2015. The pre-calculus summer boot camp produced very encouraging results with 77% of the students moving onto the next course in the math sequence. In addition to taking a pre-calculus math course, students also received supplemental instruction,

breakfast, lunch, a chance to interact with faculty, staff, and academic advisors. The boot camp produced several positives and a few things that need to be worked on going forward. NJIT has decided that the program should continue and all efforts should be made to attract higher student participation for 2016.

SUMMER BOOT CAMP OUTCOMES

In the summer of 2015 the Pre-Calculus Summer Boot Camp completed its first program cycle. An assessment plan was designed and students were tagged in order to carefully assess whether and to what extent the boot camp was successful in helping students. Students were also given a mid-semester and end-of-semester questionnaire to fill out in order to gauge their views on the usefulness of the boot camp. Please refer to appendix I and II for the exact questions that the students were asked to answer.

In the 2015 program, 48 students enrolled in one of the pre-calculus courses with 4 of those students later withdrawing from the program. In total there were 24 students originally enrolled in what NJIT calls Math 108 and another 24 in Math 110. Of the Math 108 population, approximately 76% of students passed the course with a C grade or higher. Of the Math 110 population, approximately 91% of students passed the course with a C grade or higher. A summary of the course outcomes is outlined below in Figures 2 and 3.

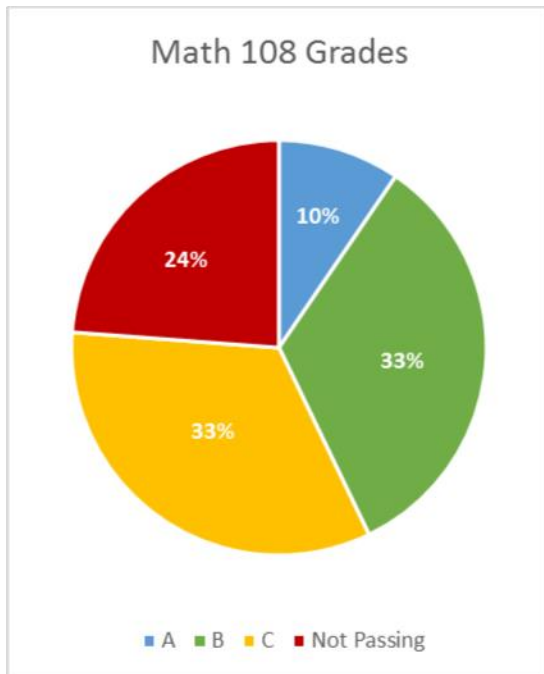


FIGURE 2
SUMMER BOOT CAMP MATH 108 GRADES

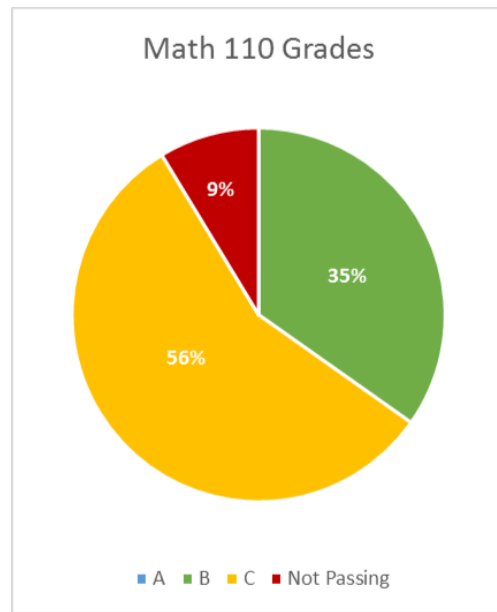


FIGURE 3
SUMMER BOOT CAMP MATH 110 GRADES

Students who passed the Math 108 course during the summer in the boot camp moved on to the Math 110 in their fall semester. When compared against the averages of 5 groups of 20 randomly selected First-Time Full-Time Freshmen who took Math 110 in the fall 2015 term, the boot camp students out performed their peers. About 65% of the Boot Camp students passed Math 110 in the fall term compared to 38% passing from the non-Boot Camp students.

We then compared the students' overall performance in the boot camp to the performance of first-time full-time freshmen who took Math 108 or Math 110 during the fall term. Both students within the Newark College of Engineering and the overall NJIT population were considered. From the comparisons shown in Figure 4, students who enrolled in the Pre-Calculus Summer Boot Camp consistently outperformed their peers who started in the fall term in their respective math courses.

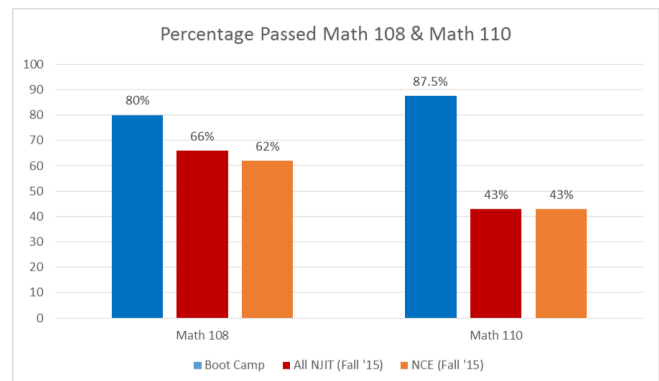


FIGURE 4
COMPARISON OUTCOMES FOR MATH 108 & MATH 110

Additionally, Figure 5 compares the percentage of students who passed for each population in the fall 2015 term for Math 111. It is clear from these charts that the Pre-Calculus Summer Boot Camp has a positive impact on student performance in Math 108 and Math 110. While the Pre-Calculus Summer Boot Camp has a positive impact there is an apparent disconnect once students move on to Math 111. More research is needed to discern the changes in performance for a student who moved from the Pre-Calculus Summer Boot Camp into Math 111 as their passing percentage is lower than either the NCE students who took Math 111 or those who previously took Math 110 at NJIT. One possible explanation of this dichotomy would be the lack of supplementary peer instruction when students moved to Math 111.

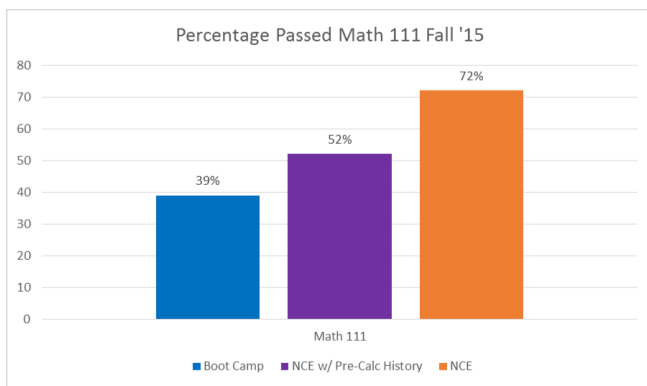


FIGURE 5
COMPARISON OUTCOMES FOR MATH 111

Finally, to assess the perceived impact and overall student satisfaction a “midterm” and “final” assessment was conducted within each cohort of the boot camp program. The goal of the aforementioned assessments was to gauge how the program met student needs and expectations and to later compare them to student academic outcomes. These assessment questionnaires can be viewed in Appendix I and II. It is important to note that for the summer 2015 program the midterm and final assessments were primarily qualitative in nature.

Table I and II below summarize students’ response to these questionnaire/surveys.

TABLE I
NCE MATH SUMMER BOOT CAMP ASSESSMENT: MATH 108

Question	Midterm Assessment Response	Final Assessment Response
Finding the mandatory tutoring useful (scale of 1 to 10)	Average response - 7.5 67% gave rating of 8 or above	Average response - 8.2 77% gave rating of 8 or above

Get most of work done during tutoring hours (Yes or No)	71% replied in favor	83% replied in favor
Continue utilizing the math tutoring service next semester (Yes or No)	84% marked Yes	83% marked Yes
Program helped in better management of time with studies	53% agreed	82% agreed
Program helped building relations with peer (Yes or No)	84% marked Yes	N/A
Staying in on-campus housing as part of boot camp (Yes or No)	25% showed interest	N/A

TABLE II
NCE MATH SUMMER BOOT CAMP ASSESSMENT: MATH 110

Question	Midterm Assessment Response	Final Assessment Response
Finding the mandatory tutoring useful (scale of 1 to 10)	Average response - 7.4 57% gave rating of 8 or above	Average response - 7.8 71% gave rating of 8 or above
Get most of work done during tutoring hours (Yes or No)	92% answered Yes	96% replied in favor
Continue utilizing the math tutoring service next semester (Yes or No)	91% showed interest	96% marked Yes
Program helped in better management of time with studies	82% agreed	67% agreed
Program helped building relations with peer (Yes or No)	95% answered Yes	N/A
Staying in on-campus housing as part of boot camp (Yes or No)	44% showed interest	N/A

Overall feedback from the students, both in the midterm and final assessment were relatively positive. The majority of students felt that the program helped support their academics, adjustment to the university and, with connecting to like-minded peers. Improvements to food provided, the schedule of activities, level of interaction during workshops and detail of information provided before enrolling in the program were areas that could be improved.

IMPLICATIONS AND CONSIDERATIONS

The outcomes thus far from the Pre-Calculus Summer Boot Camp are encouraging however; more analysis and research is needed. Students who participate in the program appear to outperform their peers which lead us to believe that the foundational support and supplemental instruction is helpful in creating an environment where this at risk population can be successful. A point of concern though, is when this population reaches Calculus I (i.e. Math 111) at NJIT there

is a noticeable drop off in rate of success. Going forward our program will aim to continue to aid student success while looking into what the disconnect may be by the time a student reaches Calculus I. Should the program services such as supplemental peer instruction and increased interaction with academic advisors continue? Do the resources provided in the program create a false sense of security? What are the long term outcomes and success or failure rates of students who participate in this program? All of the aforementioned questions are areas in which we look to continue our research and understanding as we refine the Pre-Calculus Summer Boot Camp program

TABLE III
PROPOSED SCHEDULE

Courses	Breakfast	Session 1	Lunch	Session 2	Tutoring
MATH-107 MATH-108 and MATH-110	9:00 AM - 10:00 AM	10:00 AM - 11:30 AM	11:30 AM - 12:30 PM	12:30 PM - 2:00 PM	2:00 PM - 3:00 PM

UPDATED ENGINEERING MATH SUMMER BOOT CAMP MODEL AT NJIT FOR SUMMER 2016

Pre-Calculus Summer Boot Camp at NJIT is designed around pre-calculus sequence. The boot camp is intended for the first year STEM/Engineering students that are placed into either of 4-credit pre-calculus courses. The following two courses will be offered to students under this boot camp:

- MATH-107: University Mathematics B I
- MATH-108: University Mathematics I-B
- MATH-110: University Mathematics B II (Trigonometry and Differential Calculus)

Summer boot camp is a 6-week program offered in summer session II running from 7/5/2016 until 8/17/2016; Monday through Friday from 9:00 AM to 3:00 PM. The final enrollment for the Summer 2016 cycle totaled to 40 students between Math 107, Math 108 and Math 110. Additionally, we secured an outside company, LocoRobo, to work with the Math 110 cohort on computer programing and robotics projects to help connect what they learn in the classroom to real world applications. The LocoRobo projects will help students explore areas of math and engineering that may inspire them about potential majors and career opportunities they otherwise would not have been exposed to at this time.

With LocoRobo students will spend about one day a week for four weeks learning and working on robotics coding exercises, projects and competitions. Students will then spend another two days in the same four week time span working on data analytics as it relates to engineering and the business processes to help students better understand how decisions are made and outcomes derived from datasets. Throughout the activities and projects with LocoRobo students can apply what they learn in the classroom, connect with peers, engage in real world applications, and explore aspects of robotics and engineering. Based on the success and impact of incorporating an outside company to engage the students in the Pre-Calculus Summer Boot Camp program we will consider expanding our collaborative efforts and linking more cohorts of students to projects such as with LocoRobo

PROGRAM BENEFITS

This 6-week educational program is designed to help students get ahead and prepare for their first semester at NJIT. The first year students who enrolled for this will receive a 20% discount on the summer tuition.

The main advantages of our Summer boot camp are:

- Enrollment in a 3 or 4-credit pre-calculus course (Math 107, Math 108 or Math 110)
- Breakfast and lunch served daily
- Built in time for fun activities, networking and college adjustment
- Supplemental peer instruction offered each day to help with any questions, challenges or tough concepts
- Interactive presentations to help students explore mathematics and engineering fields holistically
- Giveaways and prizes

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APPENDIX - I

NCE Summer Boot Camp Program Midterm Assessment

On a scale of 1 to 10 (10 being very useful), how useful are you finding the mandatory tutoring each week. Please explain your response.

Are you able to get most, if not all of your work done during your tutoring hours each week? If not, please explain why.

Will you continue to utilize the math tutoring services offered by NJIT next semester, Fall 2015? If not, why?

How has the NCE Summer Boot Camp program, the mandatory tutoring, and the skills learned in the time-management and study skills workshops, allowed you to

better manage your time each week with regards to homework and studying?

How has the NCE Summer Boot Camp helped you to build relationships with your peers (tutors, classmates, etc.)? If not, please explain why.

What do you think about the educational activities and presentations one day a week instead of tutoring? Has it helped you to better understand the different majors within the Newark College of Engineering? Please explain.

Would you be interested in staying in on- campus housing as part of the NCE Summer Boot camp program? Please explain.

Was enrolling in the NCE Summer Boot camp your decision, your parent's decision, or both? Please explain.

Please provide feedback/suggestions to help us improve the NCE Summer Boot Camp program for future students. Would you recommend that we continue mandatory tutoring four days a week for students? Would you recommend the educational activities, presentations, and workshops? What would you like to see done differently?

APPENDIX - II

NCE Summer Boot Camp Program Final Assessment

1. On a scale of 1 to 10 (10 being very useful), how useful did you find the mandatory tutoring each week. Please explain your response.

2. Were you able to get most, if not all of your work done during your tutoring hours each week? If not, please explain why.

3. Will you continue to utilize the math tutoring services offered by NJIT next semester, Fall 2015? If not, why?

4. Did the mandatory tutoring and the skills learned in the time-management and study skills workshop help you to better manage your time each week with regards to homework and studying?

5. What other types of educational activities would like to have seen offered in the NCE Math Summer Boot Camp? Please explain.

6. What do you anticipate your final grade to be?

7. After completion of this program and your first course at NJIT, what are your expectations for your fall semester? Did this program help you become more prepared for your fall semester?

8. Please provide feedback/suggestions to help us improve the NCE Summer Boot Camp program for future students. Would you recommend that we continue mandatory tutoring four days a week for students? Would you recommend the educational activities, presentations, and workshops? What would you like to see done differently?
