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# Embedded Mini Boot Camps: A Path to Success

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**Abstract**

The failure rate in the Calculus sequence is alarming. Generally speaking, this is attributed to poor preparation in that the students are weak in pre-requisites skills. As educators, we then must stop and think how best to reach the students. Several techniques are in use such as recitation sections, embedded tutors, and Learning Commons for peer-to-peer review, but institutional data shows that the needle has not shifted significantly as the prognosis for success remains at around 50%. The goal here is to develop and bring meaningful support to the math-challenged students within a semester, so that they can achieve mastery of skills and knowledge to pass the course. The target course is Calculus I. This is foundational and predictive course for later STEM success. With the pedagogy developed and discussed in this paper, the Embedded Mini Boot Camps, the success rate (as defined by grades A, B and C) was above 80%. This is noteworthy for our institution, as the DFW rates in this course was upwards of 50%, pre-pandemic. Further the challenges of COVID-19 have also taken a toll in K-12 education, Mathematics education has taken a particular hit. We expect to see an increased number of math challenged students this year and moving forward. We want to get ahead of the curve and put mechanisms in place such as the proposed Embedded Mini Boot Camps to cope with the crisis that is practically at our doorsteps. In this paper I present a new pedagogy which builds on some elements of several existing methodology to develop a new model of Embedded Mini Boot Camps for our Calculus sequence. I have run this model successfully in Calculus I and I discuss the encouraging results obtained.

*Calculus is a challenging course, and the concepts can get confusing or difficult but thankfully,*
*Professor Dutta Gupta is there to help and provide opportunities for one to be able to improve their performance on exams and their grades. Professor Dutta Gupta introduced the class to Boot Camps after the first exam which opened up a wonderful opportunity. The Boot Camps required extra work, more studying, and a retake of the exam that was taken before (the questions were different but had the same concept). Along with the extra work/effort that had to be put in, you had to attend lectures so that the Professor could help and keep track of deadlines for the work. The idea of Boot Camps sounds like a lot of work and effort, but it is all worth it so that you can improve your performance and understand the lessons thoroughly if you were not able to the first time*

*--Student testimonial in Embedded Boot Camps Calculus Course.*

**Introduction:** As more colleges look for avenues to tackle lack of math competency, a literature search reveals that there are different approaches of offering support to students. One angle is to tackle the problem at its core that is at the developmental stages (Boatman et al., 2018; Chen et al.,2016; Ganga et al., 2018; Jaggars et al., 2013 & 2018). However, given that this maybe a deterrent for students because of huge investments in times and money (Bahr, 2012; Belfield et al., 2016; Boatman, 2021; Gardenhire et al., 2016), other approaches are to think of remediation as a co-requisite task that goes hand in hand with the actual course work (Atwell et al., 2016; Ganga et al., 2018; Logue et al., 2019). Embedded tutors, peer tutors (Webb et al. 2006), learning centers and boot camps prior to the start of a course (Hodara, 2013), (FAU, NJIT) are some such models. Extensive literature in boot camp literature points to lack of significant success (Barnett et al., 2012).

Descriptive studies, many of which report institutional research (Gleason et al.,2010; Hodara et al., 2012; Kallison & Stader, 2012; Reisel, Jablonski, Hosseini, & Munson, 2012; Sherer & Grunow, 2010) also point to lack of far-reaching influence. In each of these models the boot camps (or it's longer duration counterpart: the bridges) were held prior to the start of a course as a remediation for deficient knowledge in pre-requisite materials. A comprehensive study of boot camps and universities that have used such strategies are presented in (Borgaonkar, 2015). Other boot camp models are discussed in (Cerna, 2019). Bootcamp software packages (CENGAGE, WEBASSIGN) have made attempts at self-guided boot camps as well.

Sadly, over the years we have noticed that the performance of our STEM majors is slipping in the Calculus sequence. It has become a major hurdle for our STEM majors, students have switched majors due to high failure rates in these courses. The reason for the high failure rate is attributed to gaps in knowledge of pre-requisite materials. In this paper I shall layout a new bootcamp model that I developed which has addressed the issue by bringing timely help to the students leading to increased student success. The question addressed here is what are the root causes of difficulty which prevents a student to be successful in calculus. I take a journey with each student during the course, remediate as soon as I see failure after each major assessment through the embedded boot camps customized to the student's deficiencies. At end of each strategically placed intensive week of targeted remediation through the embedded boot camp, the student is given another chance to retake the assessment that they had previously failed. The re-assessment score erases the failed assessment score and is recorded in its place. Normally speaking, because this is a labor-intensive process, one would suspect this is a process from which a student would shy away, rather leaving passing the course to chance. However, linking the labor of this intensive, timely, customized embedded boot camp for remediation directly to grades has enticed the student to try this process. The re-examination will completely erase the failed high-stakes in class exam score. This has also been enough of a reward that students who are not failing but want to improve their scores have also availed of this opportunity. As an added benefit, it has reduced math anxiety amongst students, because they know they always have an embedded customized boot camp to help them achieve their potential, if they were to slip at their first attempt taking an exam.

**Literature search:** Boot camps and bridges are often used to refer to a similar idea of remediation. A point of distinction maybe that boot camps are of shorter durations than bridges. The evidence on lack of significant success from bridges and boot camps are found in (Barnett et al., 2012) and a set of descriptive studies, many of which report institutional research (Gleason et al.,2010; Hodara et al., 2012; Kallison & Stader, 2012; Reisel, Jablonski, Hosseini, & Munson, 2012; Sherer & Grunow, 2010). Overall, these studies do not yield strong findings in favor of bridges or boot camps. Barnett et al. (2012) conducted a randomized experiment of developmental summer bridge programs offered to recent high school graduates at two open-admissions four-year colleges and six community college, across the state of Texas. Kallison and Stader (2012) also conducted a study on the Texas developmental summer bridge programs, but their study was descriptive and has limited internal validity. They examined gains in placement test scores among summer bridge participants who took a pretest and posttest. Only four institutions collected math test score data, and at these colleges there was no statistical difference in the math placement exam performance of students before and after participating in the summer bridge program.

Two descriptive studies (Gleason et al., 2010; Reisel et al., 2012) report on the outcomes of students in bridge programs at University of Alabama and University of Wisconsin-Milwaukee targeted to incoming STEM majors who placed below calculus; both universities identified an initial placement below calculus as a key predictor of STEM attrition. The bridge programs provided accelerated instruction in pre-calculus mathematical content, including college algebra and trigonometry, so that students did not delay enrollment in the calculus sequence. Both programs had similar features: they were residential (although in the first two years the University of Wisconsin program also allowed students to complete the program online from home); they lasted about one month; and students spent the mornings learning math content and the afternoons applying their math skills in real-world problem-solving activities. The University of Alabama program was voluntary for students who scored in a certain range below the cutoff for placement into calculus, while the University of Wisconsin program was mandatory for students whose math ACT, high school grades, and class rank matched the profile of engineering students with the lowest graduation rates.

Gleason et al. (2010) found that although the Alabama students who took part in the summer bridge program, from 2005 to 2007, significantly increased their math placement scores upon completion of the program, not all students were able to place into calculus in the fall.

The Reisel et al. (2012) study of the University of Wisconsin program did not employ a comparison group, and its purpose was primarily to track the relationship between features of the program and gains in students' math placement test scores upon completion of the program. The remaining findings on boot camps are all descriptive reports based on colleges' internal research. Boot camps at EPCC in Texas, LaGuardia Community College in New York, Montgomery County Community College in Maryland, and Pasadena City College in California all report that a proportion of participants improved their placement exam performance and placed into a higher developmental math level or college-level math (Sherer & Grunow, 2010). However, without a comparison group, it is unknown what the outcomes of these students would be in the absence of the treatment—for example, if the students had simply retested without participating in the boot camp.

Institutional research from a North Carolina college also finds a positive association between test preparation and improvements in placement (Hodara et al., 2012). The North Carolina college created an online course for their reading, writing, and math placement exams, which students can access and complete from any computer at their convenience. The college found that from fall 2010 to spring 2011, among all students who took the review course before re-testing, 35 percent of students tested at least one level higher in the developmental math sequence and had similar or higher pass rates in the courses they retested into, compared with their counterparts who placed directly into the course. Currently, the state is working with a new placement test vendor to create similar, online courses that will be offered to incoming community college students statewide. These point to boot camps just prior to an assessment which is targeted to deficiencies are fruitful.

An interesting couple of question raised in (Hodara 2013) is what academic and non-academic features of boot camps are most important in supporting students' college persistence and degree attainment? What is the optimal length of time for boot camp programs in order to yield cost-effective, long-term impacts? In this paper I outline a method: a special concept in boot camps called the Embedded Mini Boot Camps placed strategically for a short duration of times to remediate, enhance, and stabilize performance maximizing each student's potential.

**Embedded Mini Boot Camp Design**

**Model Concept:** I have created embedded, asynchronous mini boot camps for students taking MAT 131 (Calculus 1) to set them up for academic success. This one-week program of added rigorous instruction customized to each student's deficiencies was offered three times throughout the semester for those showing weakness in class after key exams.

The goal here is to bring meaningful support to the math-challenged students within a semester, so that they can achieve mastery of skills and knowledge to pass the course. The target course was MAT 131 (Calculus 1). This is foundational and predictive course for later STEM success, the Embedded Mini Boot Camps are designed so that high success rate (target: 80+%) could be achieved. Another goal of the embedded boot camp is to ensure that the timely intervention helps promote understanding in a big way and jumpstarts the Math health of the student. We track this by noting the pass rate of exams when first administered in class. The expectation of improvement of the math health of the student is reflected by noticing the pass rate rising significantly. That is, if a student goes through embedded boot camp 1, after failing the first major assessment (exam 1) in class, the student recuperates, the math health is now sound, and the student has a much better footing going into the next major assessment (exam 2). This is validated by increasing pass rates of successive exams in the class prior to its corresponding boot camp.

**Problem to be Addressed:** The DFW (D and F are grades, W stands for Withdrawal from the course) rate for Calculus I, MAT 131, (data for Pace University, New York Campus) from Fall 2015-Fall 2019, pre-pandemic) was upwards of 50%. Success in Calculus I is often predictive of a student pursuing a STEM career. Therefore, this rather large failure rate is of concern to our university and has to be addressed.

Also, the challenges of COVID-19 have also taken a toll in K-12 education, Mathematics education has taken a particular hit (NY Times 2021; WSJ 2021). We expect to see an increased number of math challenged students this year and moving forward. We want to get ahead of the curve and put mechanisms in place such as the Embedded Mini Boot Camps proposed here to cope with the crisis that is practically at our doorsteps.

In this institutional research, the data was collected from Pace University, New York Campus which holds the major enrollment (roughly 70% of the multi campus enrollments) as it is the flagship campus. The DFW (D and F are grades, W stands for Withdrawal from the course) rate for Calculus I, MAT 131, data for Pace University, New York Campus from Fall 2015-Fall 2019, pre-pandemic) was upwards of 50%. The reason that data considered was only from pre-pandemic years was due to the stability of methods of data collection (mainly in-person exams rather than online exams) which could guarantee that the results of student performance were not skewed due to academic dishonesty. As the pandemic hit, and Pace University scrambled to pivot to online teaching, just like all institutions around United States and the world in general. Faculty were trying to figure out sound methods to assess students which would not be skewed by potential academic dishonesty as the platform changed to online overnight. Whereas several methods of proctoring through lock down browsers are available, these methods best apply to exams that are computerized. Our examination methods are descriptive, most value is placed on correct mathematical steps and explanations, rather than the answer itself. Given the difficulties of typing math symbols, we kept our traditional methods of students using pen and paper, then scanning and uploading their work. The exam itself was zoom proctored with cameras on. This as we recognize was not as nearly a fool proof method for proctoring as the in-person exams. The grades obtained by students during the pandemic years were also higher, though the knowledge base in class coming into the next level of math course as observed by instructors is lower. Hence, we have left out the data from the pandemic years.

**The Plan:** The Mathematics Department at Pace University, New York campus has standardized it's in class exams (Exam 1,2 and a final exam) in all its multi-section courses. This has helped us maintain the pacing and rigor of delivery and offer approximately the same educational experience in all our sections. The Department offers exam 1 and 2 roughly in the $5^{th}$ and $10^{th}$ week of the semester, and the final exam is in the $14^{th}$ week. Therefore, the Embedded Mini Boot Camps which are three asynchronous one-week programs of added rigorous instruction customized to each student's deficiencies would be offered in the $6^{th}$, $11^{th}$ and $13^{th}$ week. Failure in the in-class exam administered by the department roughly in the $5^{th}$ and $10^{th}$ week identifies the at-risk student. It is now mandatory for the student who has failed an exam to join the boot camp that takes place the following week. The boot camps run synchronous to the semester. So, students must put in twice as much effort during this week. They are continuing in their regular curriculum and working to catch up deficiencies in the boot camp. Therefore, to make sure that the students can attend these boot camps, they are asynchronous. Video modules of various concepts and short assignments are loaded into these asynchronous boot camps. They are customized to the needs of each student. A boot camp program director is in touch with the students daily, directing them, answering their questions, and moving them through the week helping them to catch up with their deficiencies. Deficiencies are not just limited to the calculus course but are often in the pre-requisite materials. The week of remediation, begins with a reflection on the failed exam, fixing deficiencies that surfaces and it ends with a re-assessment of an equivalent exam. The re-assessment of the Embedded Mini Boot Camp exam is not offered if all the requirements of the Embedded Mini Boot Camp are not completed in a timely manner. Further once the reassessment is taken, its score replaces the exam score irrespective of which is higher. The replacement of re-assessment score for the original without penalties, coupled with if you take the reassessment, it's score is now the score that remains makes the student take the Embedded Mini Boot Camp seriously. Once in the boot camp, they are totally invested in it because they do not want to risk lowering their exam scores.

**Timeline and criteria for <u>mandatory</u> enrollment in the three, embedded one-week mini boot camps:**

<u>First one-week Embedded Mini Boot Camp enrollees (administered in the $6^{th}$ week of the semester):</u>

> If a student fails the in-class exam 1 in week 5, the instructor directs them to enroll in the first one-week mini boot camp held in week 6. The week begins with a reflection of the failed exam 1 and ends with reassessment for Exam 1 at the end of the week. The entire week is a customized intensive asynchronous boot camp where under the guidance on a program director the student works on fixing their deficiencies. Material is provided through video lectures, and short assignments are given to check understanding. The progress of the enrollees is monitored on a regular basis.

Second one-week Embedded Mini Boot Camp enrollees (administered in the 11th week of the semester):

If a student fails the in-class exam 2 in week 10, the instructor directs them to enroll in the second one-week Embedded Mini Boot Camp held in week 11, with reassessment for Exam 2 at the end of the week. The steps taken here is a repeat of first boot camp. It is important to note that the enrollment into the first two Embedded Mini Boot Camps is independent of each other. It entirely depends on the performance of the corresponding exams.

Third one-week Embedded Mini Boot Camp enrollees (administered in 13th week of the semester, one week before the final exam):

There would be mandatory enrollment for anyone who participated in first and/or second Embedded Mini Boot Camp. The third embedded mini bootcamp is to strengthen skills alongside the main curriculum, look for areas of repeated errors and try to fix them. A mock final exam is given at the end of this third Embedded Mini Boot Camp. The purpose here is to gauge readiness and alleviate some math anxiety as students have a chance of looking at a mock exam and strengthen their skills by working through any errors remaining.

Students who are not at risk but willing to work for a higher grade are welcome for join any of the three Embedded Mini Boot Camps. All students were apprised of this opportunity several times throughout the semester. In fact, there is robust enrollment in these embedded mini bootcamps from students who are in the BC range. They are looking to improve their grade performance.

**Embedded Mini Boot Camp Features:**

1. An intensive one-week asynchronous program, closely monitored by a Program Director, who provides materials such as topic videos and checkpoints online to assess and address areas of weakness for the students.
2. Strict calendar setup where students are guided by the Program Director to review the material. Their weaknesses and progress are assessed through checkpoints. Daily check-ins (monitored online) are mandatory through the week.
3. At the end of the week, a makeup exam (re-assessment) is offered to students who have been in attendance for the first two mini boot camps. The makeup exam score (that is the re-assessment) replaces the failed exam score by the participating Instructors of the course. The re-assessment exam score is binding. Therefore, a previous low exam score can be erased. Also, because the re-assessment score is binding, students are doubly serious about their progress through the Embedded Mini Boot Camp because they cannot afford to perform at knowledge base status quo. This would make them vulnerable to decreasing their score.
4. A mock final exam is offered in the third mini boot camp in preparation for the final exam.

**Distinguishing Characteristics:** National trend for the status of support outside of class meetings to facilitate student learning in Mathematics courses is somewhat similar. The usual go to are Faculty office hours, perhaps peer tutoring available at a Math Resource Center or perhaps recitation classes. But the reality is that many of the math courses are run by our adjunct faculty, who are contractually not obligated to give office hours at most institutions. Whereas faculty members may encourage their students to take advantage of outside the classroom help like in Math Resource Center, where students can have another format of learning through peer tutors, it is really left up to the students to seek out this help. Most often the extra time to be invested around the fixed hours and physical locations of the Math Resource Centers has often acted as a deterrent. Math Resource centers does provide help to students who attend on a regular basis. Peer tutors are helpful in many ways. However, bottom-line it is not obligatory for students to attend. Recitation sections and/or embedded tutors are subject to availability of funding. Nationwide trend of budget cuts over the past few years have resulted in services such as embedded tutors not at a level where they need to be to support all the students who need it. As an aside, anecdotally, the recitation sections are often not well attended, and attendance declines over the semester. Students feel that the extra class meeting, which they don't see as linked to their grades is more of a chore, given the multitude of things they are juggling. They are not mandatory.

However, the idea of Embedded Mini Boot Camp offered built on three important pillars: asynchronous in modality, program director always at hand to guide and help navigate the student through the week-long program, re-assessment that entirely wipes out previous low scores makes it unique and successful.

The first pillar is the asynchronous modality. The asynchronous modality for the embedded mini boot camps is used to counter the demands of time, and physical locations for this customized help. Normally speaking, student has a lot of their plate as is. Now if we are adding on a weeklong Embedded Mini Boot Camp for remediation while the student is going through all the other requirements of the semester in progress, we cannot expect them all to have a common time to meet in a physical location. Therefore, the tools for help should be present on demand at their fingertips, so they can spend any extra time during the day to complete the elements of the Embedded Mini Boot Camp. For it to be effective for an individual, it cannot be arranged for a group, but instead it must be customized to the individual. Therefore, the asynchronous mode with videos populating the module to combat the demands on time, physical location and help with customization was preferred. The second pillar is the program director. As we know key to a student's success is discussions and guidance provided by instructors knowledgeable in the field. Therefore, a program director who provides the human touch of guiding them through the modules, checking in with them to gauge progress is key to the success of the Embedded Mini Boot Camp. The work of the program director starts with each student's reflection of their failed exam. Then the program director runs a flipped model of the classroom customized for each student's need guided by their reflections. The personal check ins help the program director to gauge success and direct the students. Short assessments graded and returned promptly gives valuable feedback with which a student progress through the Embedded Mini Boot Camp. Successful remediation is at the heart of this joint venture between student and program director.

The third pillar is a second chance given via an equivalent re-assessment at the end of the Embedded Mini Boot Camp. The score of the re-assessment replaces the original exam score. Here there is a two-pronged objective. The first is that a hardworking student who imbibes the true spirit of the boot camp is always successful, the sheer remediation drives the score up several folds. Next, it also helps the student to make whole-hearted effort as early in the boot camp it becomes clear through short assessment feedbacks, that if you continue with status quo knowledge you stand a risk of lowering your original score. The students who are repetitive in committing their errors get an early taste at their scores; it does not rise at all unless they fix their errors. So, making the Embedded Mini Boot Camps linked to their grades by giving them a second chance through an equivalent re-assessment makes this truly motivating and hence successful.

This is a fresh look which combines the strengths of different methods discussed above. It is significantly different in the approach that includes customization through video modules provided in asynchronous setting; a Program Director who helps each student with their reflections, gives support and feedback; and a second chance for the students to be reevaluated as soon as their deficiencies are identified by the instructor. The success of the pilot (conducted in one section) in reducing the DWF rates by 1/3 in Spring 2021 speaks for itself (21 ABC, 4 DFW). Emboldened by this success in Calculus 1, we are now offering Embedded Mini Boot Camp to our Calculus 2 students. This part of the project is supported by Bridge Funds, Office of Research of Pace University. The results are similarly encouraging.

**Results, Calculus 1, Fall 2021, Pilot data:** Here is the data collected from when I ran the Embedded Mini Boot Camps in Fall 2021. Since the ability of students were being re-visited and re-assessed, this being the semester back in-person after the semesters of online instruction during the pandemic, it was a difficult question as to how to analyze the data. Therefore, to standardize, discussions we choose our Exam 1 results to indicate the baseline knowledge of this group of entering students. Exam1 material is more-or-less a review of the concepts from Pre-Calculus as we launch into Calculus I.

**Table 1: Pass Rates as percentages**

| Grade Group | Exam 1 | Boot Camp 1 | Exam 2 | Boot Camp 2 | Final Exam |
|---|---|---|---|---|---|
| ABC | 25% | 64% | 52% | 68% | 84% |
| DFW | 75% | 36% | 48% | 32% | 16% |

ABC are the grades A, B, C. DFW are grades D and F and W stands for students that withdrew.

**Table 2: Raw data of exam results (all exams were in person):**

| Raw Score | Equivalent Grade | Exam 1 | Boot Camp 1 | Exam 2 | Boot Camp 2 | Final Exam |
|---|---|---|---|---|---|---|
| <60 | F | 13 | 2 | 8 | 4 | 1 |
| 60-70 | D | 5 | 7 | 4 | 3 | 2 |
| >70-80 | C | 1 | 4 | 2 | 3 | 7 |
| >80-90 | B | 4 | 8 | 7 | 9 | 6 |
| >90-100 | A | 2 | 4 | 4 | 5 | 8 |
| Missed Exam/Withdrew | | 3 | 3 W | | 1 W | |
| Total | | 28 | 25 | 25 | 24 | 24 |

Notable points:

- Exam 1, ABC rate 25%
- After Embedded Boot Camp 1 and opportunity to retest, ABC rate 64%
- Exam 2, ABC rate 52%
- After Embedded Boot Camp 2 and opportunity to retest, ABC rate 68%
- Embedded Boot Camp 3 was prior to final Exam, no tests, just rigorous review, and problem solving through all concepts, and mock exam given.
- Final Exam, ABC rate 84%.

**Analysis:** The 25% pass rate (pass rate is synonymous with ABC grades) in Exam 1 gives an indication of the hand that I was dealt. Exam 1 is based on material which is approximately a quick review of pre-requisite to the course and a start of new ideas of Calculus I. Typically the students are either placed in the Calculus 1 class because of results of a placement test or have a minimum score of 4 in AP Calculus BC or if they have a C or better grade in pre-calculus. Most fall in the latter category. Therefore, the incoming group into Calculus I is one of the most math challenged that I have ever worked with inspite of having a C or better earned in the pre-requisite course Pre-Calculus mainly during the pandemic semesters. 64% of the students performing were in the DF range, 11% did not take the exam.

In my first Embedded Mini Boot Camp I took on the daunting task of working with a class, 75% of who were a DF grade student, or no-shows. The hard work of the week managing each individual student's deficiencies was grueling. At this stage, students did not see light at the end of the tunnel and so were non-believers of the concept of Embedded Mini Boot Camp. Most wanted the easy way out, instead to acknowledging their deficiencies, they tended to believe they made silly mistakes, and they were convinced that if I were to just give them the re-assessment like a make-up exam they would do just fine. I gave them a series of mini assessments for them to understand their errors were repetitive, hence not silly mistakes. Students were then convinced of their deficiencies and so turned to the hard work of the Embedded Mini Boot Camp 1. I pre-loaded their Embedded Mini Boot Camp 1 with video modules that they were required to go through, the boot camp was asynchronous to meet the demand of time and was customized: students were given measurable guidelines developed from prior assessments, reflections as to what skills each one needed to strengthen. At the end of the week the boot camp exam 1 was given. After reassessment we were up to a 64% ABC grade performance. Notable here was that at the end of Embedded Mini Boot Camp 1 the 64% of the DF students came down to a 32% of DF students. The three students who were a no-show were never invested in the course and dropped at this stage.

The most rewarding experience for me from Embedded Mini Boot Camp 1 was when I saw the needle shift after administering Exam 2. The class performance had gone up to 52% ABC rate. Therefore, the first Embedded Mini Boot Camp provided remediation that was long lasting. Another 27% of the students when compared to the start of the semester, (exam 1 pass rate was 25%) moved up and steadied their performance at ABC level, the remediation from the Embedded Mini Boot Camp 1 had worked, the students did not slide back to square one.

The second Embedded Mini Boot Camp was upbeat. There was a sense of impending achievement round the corner. The Embedded Mini Boot Camp enrollees were hard at work from the start, and sure enough the re-assessment for Exam 2 gave another shot in the arm, 68% of the class was now successful.

Success is contagious; you could feel the excitement as the whole class willingly enrolled themselves into the third Embedded Mini Boot Camp before the final exam. The performance was on an upward trend. Therefore, in addition to the regular class curriculum, we set up a parallel boot camp to strengthen typical errors. The video modules were preloaded and could be assessed asynchronously. Students were guided to remediate their deficiencies, there were several class assessments and pop-quizzes that helped me create a profile for each student and guide them. We did not get bogged down by the physical office hours; I could create zoom office hours almost at any time of the day to help students. Emails were the best way to connect. I encouraged them to take a picture of their work in which they had difficulty and email it to me. I often responded with a video in which I worked through their difficulty step by step. At the end of the third Embedded Mini Boot Camp, the students worked on a mock exam, which we graded together. This gave them confidence that the cumulative final exam for this course was doable. It worked as a wonderful review, we reflected on errors which gave them a stronger foundation to apply the methods. This increased preparedness for the final exam.

The final exam saw an 84% success rate. This is a long way to come with the help of the three Embedded Mini Boot Camps. Starting with success rate, defined as tracking the ABC grades, in Exam 1 of 25%, the semester results culminated in a success rate of 84%.

Also noteworthy is that the Embedded Mini Boot camp really got to the heart of the remediation. Note how the success rate in Exam 2 doubled from Exam 1, that is Embedded Mini Boot Camp 1 helped remediate and kept the performance up for exam 2. Finally, Embedded Mini Boot Camps 2 and 3 pushed all students (who stuck with it and did not withdraw) over to success. Lessons learnt: the hardest part was to get the students invested in the idea. I had not expected that level of resistance for Embedded Mini Boot Camp 1. I had to regroup offer a series of 5–10-minute formal/ informal assessments to bring to light that there are weaknesses that needs to be worked on, and that the deficiencies would not disappear on its own. A strict timeline must be maintained for the Embedded Mini Boot Camp, and members notified if they are not keeping up. The re-assessment is only given to the students if all the customized criteria set for a student is met. By simply stating that it is mandatory, the criteria are not met. It is the constant involvement of the program director of the Embedded Mini Boot Camp, in this case me, was very important to help each student to keep up with the timeline. The success rate at the end of the Embedded Mini Boot Camp 1 was sufficient to motivate students for the Embedded Mini Boot Camps 2 and 3. Also offering the Embedded Mini Boot Camps to anybody who wanted to improve their scores destigmatized the effort. Though it was targeted and mandatory for the DF students, plenty of BC students participated to get a better grade. All students willingly participated in the final Embedded Mini Boot Camp before the final exam.

**Discussion and Conclusion:** The Embedded Mini Boot Camps is a method of helping high risk students as soon as we identify them. It helps students achieve mastery of skills and knowledge to pass the course by offering targeted assessment of each student's individual weakness to help them work on it. By providing asynchronous online modality of presenting video materials which gives the student flexibility of time, the Embedded Mini Boot Camps become accessible for anyone who chooses to participate in it. By offering support from the Embedded Mini Boot Camp Program Director overseeing this program, who guides the students up to three intensive one-week camps and helps them attain their goals of passing the class and remaining in their intended major is at the heart of this project. It directly impacts their grades by giving the students a second chance at reassessment right after remediation and therefore alleviates anxiety. One can really get the student's attention because the Embedded Mini Boot Camps are so closely intertwined with their grades. To get the Embedded Mini Boot Camp project off the ground, I faced significant resistance because the student perception is that their mistakes are silly mistakes, and that they could overcome it by another chance without having to put in any significant work. They often do not see how deep-rooted their errors maybe and that they really need to work on the remediation first, by understanding the concepts, to make any further progress. The success of the first Embedded Mini Boot Camp really paved the path for the next two Embedded Mini Boot Camps, the voluntary enrolling to the Embedded Mini Boot Camps increased, and for the final Embedded Mini Boot Camp, the whole class participated willingly.

Embedded Mini Boot Camps, in a larger scale, requires coordination between faculty and program directors running the boot camp, and therefore institutional support. It is an immensely a labor-intensive method for the instructors; if the instructors are in addition the boot camp directors, it is like teaching an intersession course within a course. The video modules are time consuming to create, it takes approximately more than 200 hours to make a good basic set of video modules, which can then be tweaked as needed. The tweaking process is fairly time consuming as well. So, a stipend by the way of incentive for the instructors to run these fruitful programs is desired.

Creation, maintenance, and upkeep of these modules are key to success. Therefore, additional budgets for equipment and soft-wares and studio spaces for creating them is needed.

Successful boot camp student participants could also likewise be given a token reward, though the biggest reward for students is scaling up to an honor grade. Students do often have to give up other activities in the short term to focus on these intensive boot camps. Often the students are working several hours in addition to furthering their education. So, a monetary incentive at the completion of a labor-intensive embedded boot camp may be appropriate. I presented the pedagogy of Embedded Mini Boot Camps as a solution to help math-challenged students at the MAA section meeting. This pedagogy was well received and colleagues from other universities have reached out to investigate implementing it in their courses.

**References:**


1. Attewell, P., Lavin, D., Domina, T., & Levey, T. (2006). New evidence on college remediation. *The Journal of Higher Education*, 77(5), 886–924. https://doi.org/10.1353/jhe.2006.0037 [Taylor & Francis Online], [Web of Science®], [Google Scholar]
2. Bahr, P. R. (2012). Deconstructing remediation in the community college: Exploring associations between course-taking patterns, course outcomes, and attrition from the remedial math and remedial writing sequences. *Research in Higher Education*, 53(6), 661–693. https://doi.org/10.1007/s11162-011-9243-2 [Crossref], [Web of Science®], [Google Scholar]
3. Barnett, E. A., Bork, R. H., Mayer, A. K., Pretlow, J., Wathington, H. D., Weiss, M. J., Zeidenberg, M. (2012). Bridging the gap: An impact study of eight developmental summer bridge programs in Texas. *New York, NY: National Center for Postsecondary Research.*
4. Belfield, C., Jenkins, D., & Lahr, H. (2016). *Is corequisite remediation cost-effective? Early findings from Tennessee* (CCRC Research Brief No. 62). Community College Research Center. https://ccrc.tc.columbia.edu/publications/corequisite-remediation-cost-effective-tennessee.html [Google Scholar]
5. Boatman, Angela (2021). Accelerating College Remediation: Examining the Effects of Math Course Redesign on Student Academic Success *The Journal of Higher Education*, Volume 92(6), Pages 927-960. https://doi.org/10.1080/00221546.2021.1888675 [Crossref], [Web of Science®], [Google Scholar]
6. Boatman, A., & Long, B. T. (2018). Does remediation work for all students?: How the effects of postsecondary remedial and developmental courses vary by level of academic preparation. *Educational Evaluation and Policy Analysis*, 40(1), 29–58. https://doi.org/10.3102/0162373717715708 [Crossref], [Web of Science ®], [Google Scholar]
7. Borgaonkar, K. & Vandermark, H (2015) Engineering Math Summer Boot Camp to help Students Succeed in Remedial Courses FYEE ASEE conference http://fyee.asee.org/FYEE2015/papers/5015.pdf
8. CENGAGE (2020) Boot Camp Software packages https://corporate.cengage.com/news/press-releases/2020/cengage-offers-free-college-math-readiness-boot-camps/
9. Center for Community College Student Engagement (CCCSE). (2016). *Expectations meet reality: The underprepared student and community colleges*. The University of Texas at Austin. https://www.ccsse.org/docs/Underprepared_Student.pdf [Google Scholar]
10. Cerna, O. (2019). Building Basic Math Skills Boot Camp at Tarrant County College MDRC https://www.mdrc.org/publication/building-basic-math-skills-boot-camp-tarrant-county-college https://files.eric.ed.gov/fulltext/ED601131.pdf [Google Scholar]
11. Chan, M., & O'Connor, T., & O'Connor, P. (2016). Using Khan Academy in Community College Developmental Math Courses: Results and Lessons Learned from Developmental Math Demonstration Project New England Board of Higher Education. https://files.eric.ed.gov/fulltext/ED590821.pdf
12. Chen, X., & Simone, S. (2016). *Remedial coursetaking at U.S. Public 2- and 4-year institutions: Scope, experiences, and outcomes: Statistical analysis report*. National Center for Education Statistics. U.S. Department of Education. http://nces.ed.gov/pubs2016/2016405.pdf [Google Scholar]
13. FAU Florida Atlantic University Boot camp as a supplemental unit outside of the course https://www.fau.edu/ugstudies/Math_Boot_Camp.php

14. Ganga, E., & Mazzariello, A. (2018). *Math pathways: Expanding options for success in college math. Education commission of the states*. Education Commission of the States. https://postsecondaryreadiness.org/wp-content/uploads/2018/10/math-pathways-expanding-options-success.pdf [Google Scholar]
15. Gardenhire, A., Diamond, J., Headlam, C., & Weiss, M. (2016). *At their own pace: Interim findings from an evaluation of a computer-assisted, modular approach to developmental math. Executive summary*. MDRC. https://www.mdrc.org/sites/default/files/ModMath%20Report%202016_Executive%20Summary.pdf [Google Scholar]
16. Gleason, J., Boykin, K., Johnson, P., Bowen, L., Whitaker, K., Micu, C., Slappey, C. (2010). Integrated engineering math-based summer bridge program for student retention. *Advances in Engineering Education*, 2(2), 1–17.
17. Hodara, M. (2013). Improving Students' College Math Readiness: A Review of the Evidence on Postsecondary Interventions and Reforms Community College Research Center Teachers College, Columbia University https://ccrc.tc.columbia.edu/media/k2/attachments/improving-students-college-math-readiness-capsee.pdf[Crossref], [Web of Science ®], [Google Scholar]
18. Hodara, M., & Jaggars, S. S. (2014). An examination of the impact of accelerating community college students' progression through developmental education. *The Journal of Higher Education*, 85(2), 246–276. https://doi.org/10.1080/00221546.2014.11777326 [Taylor & Francis Online], [Web of Science ®], [Google Scholar]
19. Hodara, M., Jaggars, S. S., & Karp, M. M. (2012). Improving developmental education assessment and placement: Lessons from community colleges across the country *(CCRC Working Paper No. 51). New York, NY: Columbia University, Teachers College, Community College Research Center*
20. Jaggars, S., & Hodara, M. (2013). The opposing forces that shape developmental education. *Community College Journal of Research and Practice*, 37(7), 575–579. https://doi.org/10.1080/10668926.2012.716754 [Taylor & Francis Online], [Google Scholar]
21. Jaggars, S. S., & Bickerstaff, S. (2018). Developmental education: The evolution of research and reform. In M. Paulsen (Ed.), *Higher education: Handbook of theory and research* (Vol. 33, pp. 469–503). Springer. [Crossref], [Google Scholar]
22. Kallison, J. M., & Stader, D. L. (2012). Effectiveness of summer bridge programs in enhancing college readiness. *Community College Journal of Research and Practice*, 36(5), 340–357.
23. Logue, A. W., Douglas, D., & Watanabe-Rose, M. (2019). Corequisite mathematics remediation: Results over time and in different contexts. *Educational Evaluation and Policy Analysis*, 41(3), 294–315. https://doi.org/10.3102/0162373719848777 [Crossref], [Web of Science ®], [Google Scholar]
24. NJIT New Jersey Institute of Technology Boot camp as a supplemental unit outside of the course https://engineering.njit.edu/pre-calculus-summer-bootcamp
25. [NY Times] *The Pandemic Hurt These Students the Most* https://www.nytimes.com/2021/07/28/us/covid-schools-at-home-learning-study.html
26. Reisel, J. R., Jablonski, M., Hosseini, H., & Munson, E. (2012). Assessment of factors impacting success for incoming college engineering students in a summer bridge program. *International Journal of Mathematical Education in Science and Technology*, 43(4), 421–433.
27. Sepanik, S. (2012, June). Getting ready for success: Bridging the gap between high school and college in Tacoma, Washington. *Paper presented at the 2012 National Center for Postsecondary Research Conference, New York, NY.*
28. Sherer, J. Z., & Grunow, A. (2010). 90-Day cycle: Exploration of math intensives as a strategy to move more community colleges students out of developmental math courses. Stanford, CA: *The Carnegie Foundation for the Advancement of Teaching.*
29. WEBASSIGN Boot Camp Software Packages
30. https://webassign.com/math-readiness-bootcamps/
31. [Webb, N.M. & Nemer, K.M. &Ing, M.] *Small-group reflections: Parallels between teacher discourse and student-behavior in peer-directed groups.* Journal of the Learning Sciences, 15(1), 63–119 (2006) http://dx.doi.org/10.1207/s15327809jls1501_8
32. [WSJ] *Student Test Scores Drop in Math Since Covid-19 Pandemic* https://www.wsj.com/articles/student-test-scores-drop-in-math-since-covid-19-pandemic-11605974400