Analyzing qualitative and quantitative data to predict and increase student success within a critical STEM sub-population

By:
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Introduction

School of Math and Science, Chaffey College

Nicole Gores – Administrative Assistant
Jacob Biggs – Research/Administrative Assistant
Ted Younglove – Dean
Karen Olsen – Administrative Assistant
Linda Lamp – Educational Program Assistant
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Background

- It is a requirement of the State of California community college system that a student who has not successfully passed a course twice must petition in order to repeat it a third (and last time).
- This applies to W’s, D’s, and F’s.
- Students may be able to take a course a 4th time if they can document extenuating circumstances leading to failing to pass the third attempt. Examples include:
  - Hospitalization
  - Loss of housing or employment
  - Death in the family
  - ???
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Background

Petition Process to Repeat a Course for Third Time at Chaffey College:

- The School of Math and Science at Chaffey College has created a process for petitioning to repeat a class for the third time to help boost the success rates for these students as follows:
  - Complete the Petition form
  - Attach a copy of their unofficial transcript
  - For Math or Biology courses, student must complete workshops at the Success Center.
  - Prepare a written statement which briefly explains why the student was not successful in previous attempts, and what steps he or she plans to take to be successful in the course.
  - Once these steps are completed, submit the completed paperwork to the Dean of Math and Science for review and approval.
  - Once approved, student will pick up the signed petition paperwork and take to Admissions on their registration day (Admissions must override the system to allow the student to register for this third attempt).
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Background

Petition Procedure for Math & Science Course Repetition

1. Complete the Substandard Grade Petition Form
   - Available on your My Chaffey View page (under Registration Documentation) or the Admissions office

2. Attach a copy of your Unofficial Transcript
   - Available on your My Chaffey View page (under Academic Profile)

3. For MATH or BIOLOGY courses, you are required to complete workshops and/or learning groups at the Success Center(s). Please see the reverse side for workshop/learning group information. For ANY OTHER course, you are not required to complete workshops and/or learning groups. Skip to step 4.

4. Prepare a Written Statement
   - Explain why you were not successful in your previous attempts and what steps you plan to take to be successful in the course.

After you have completed all steps for your petition, bring your paperwork to the Dean’s Office in ZH-116. Petitions are accepted by the Dean’s Office on a walk-in basis – we do not make appointments for petitions. After you drop off your paperwork, the Dean will review the petition for possible approval (this usually takes less than 48 hours). If your petition is approved, you will have to pick up the signed paperwork from the Dean’s Office and take it with you on (or after) your registration date to register for the course in person at Admissions.
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Background

Math and Biology Workshop Information (read other side first)

Math Petitions
Complete 4 specific* Math Workshops or Activities at any of the Success Centers below:
- Math Success Center in Math-121
- Chino Success Center in CHMB-145/147
- Fontana Success Center in FNFC-122
  - Workshop schedules available online at http://libguides.chaffey.edu/successcenters
  - Reservations available in person or online at https://chaffey.mywconline.com

Important note: If you feel that you would benefit from a math review course, you might consider registering for Math 610 or Math 625 prior to retaking your math class for the third and final time. If you complete Math 610 or Math 625, you do not need to complete the math workshops, as the review course would take the place of the workshops. It is still highly recommended to take the workshops even if you do complete a review course.

Biology Petitions
Complete 3 specific* Workshops or Activities at any of the Success Centers below:
- Multidisciplinary Success Center in Lib-7E
- Chino Success Center in CHMB-145/147
- Fontana Success Center in FNFC-122
  - Workshop schedule available online at http://libguides.chaffey.edu/successcenters
  - Reservations available in person or online at https://chaffey.mywconline.com

* The Success Centers will give you more information about which specific workshops are required.
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Background
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Background

Repeat Petition

I have attended Chaffey College since Fall 2008. In that time I have always gone to school part-time (some semesters full-time) and I have worked part time. In my years at Chaffey I have taken many different classes, learned an incredible amount, and have progressed as a student as well as a person. I have come to a point where I have met nearly all the requirements to transfer to a University. In Spring 2010 and Fall 2010 I attempted to take Math-25, College Algebra but unfortunately each time I dropped the class beyond the deadline, and received a W. In retrospect I see now that I was too focused on other classes and my work to have taken those classes at those times. College Algebra is the final class I need to be able to complete a University transfer and I intend to make the appropriate adjustments to my schedule and life to fulfill this requirement.

Strategies for Success:

• My workload will be lightened so that I have the appropriate time outside of the classroom to dedicate to my studies.
• I will be receiving one-on-one tutoring to help my understanding of Math-based concepts that I have struggled with in the past.
• I plan on attending Math workshops in the success center.

I see now more than ever that completing my education is paramount to having a bright and successful future. If I am given the opportunity to repeat Math-25, I will not squander the chance to set myself up for the success and progression that I so deeply desire. Thank you.
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**Background**

Why is this petition process important in Math and Science?

- Math and Science courses are very high demand courses for various reasons, such as GE requirements, the strong demand for STEM courses, Chaffey College’s nursing program, etc.
- Math and Science courses can be difficult classes for many students.
- Math and Science courses have a much greater volume of petitions submitted than the other schools in the college
- Many of these classes are part of a sequence, and it is important to help the students succeed so they can progress toward their goals.
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Background

Additional Petition Requirement for Math and Biology:

• A majority of the petitions submitted to the Math and Science Dean’s Office are from Math and Biology
• In order to repeat a Math or Biology course for the third time students are required to complete workshops at the Success Center(s).
  • The Math workshops have been a requirement since 2011
  • The Biology workshop requirement has been required since 2015
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**Background**

**Additional Petition Requirement for Math and Biology:**

**Math:** Student is required to complete four specific math workshops:

1. Directed Learning Activity
2. Growth Mindset workshop
3. Choice of Study Skills Workshop or Test Taking Workshop
4. In addition, the Success Center will give suggestions for one math-related workshop that would be at appropriate level for that student.

As an option, there is a more intensive four-week math review course (Math-610 or Math-625) that can be taken in lieu of the four workshops.
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**Background**

**Additional Petition Requirement for Math and Biology:**

**Biology:** Student is required to complete three specific workshops or activities:

1. Growth Mindset workshop
2. Choice of Study Skills Workshop or Test Taking Workshop
3. In addition, the Success Center will give suggestions for one biology-related workshop or activity that would be at appropriate level for that student.
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**Background**

**Workshops Offered for Petition Process:**

**Growth Mindset:**
- Focuses on giving students information about the psychological concept of “Growth Mindset.”
- Examples from the literature are used to illustrate the consequences of having a Growth Mindset versus a Fixed Mindset.
- Students are also exposed to the biological concept of “Neuroplasticity” and how that relates to their learning process.

**Study Skills:**
- Students taking this workshop will focus on how to shift their learning practices from using lower-order thinking skills to incorporating higher-order thinking skills.
- Students learn about Bloom’s Taxonomy, and how to use that framework to rethink how they engage with their courses.
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**Background**

**Workshops Offered for Petition Process:**

**Test-Taking Strategies:**
- Provides a framework to allow students to develop a plan for successful test-taking.
- All time periods are included for the planning process, including before the test, during the test, and after the test.
- Emphasis is placed on how to choose planning elements that reduce anxiety throughout the process.

**Directed Learning Activity**
- This written activity allows students to reflect on their past experiences with mathematics and how they plan to think about their future courses in mathematics.
- Tutors then meet with the students to discuss their concerns as well as their plan for future engagement.
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Background

Dean Approval Process

• Ad Hoc based on some research, some experience, some ‘intangible student factors’

• General Guidelines:
  • Time since 2\textsuperscript{nd} attempt
  • Grade history
  • Student persistence
  • Past success in subject area
  • Student intangibles
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Data Collection

Data Sources

- Request form
- Written petition
- Workshop checklist
- Transcript
- Campus MIS data
Gathering the Data

• Pulled all hard copies from office files
• Set aside those petitions for the timeframe we wanted
• Decided what data we wanted from a complete petition packet
• Developed an online survey to use as a guide in digitizing the key data from our physical copies
Gathering the Data

• Manually input desired data from individual petitions
• Export collected data to excel for cleanup and analysis
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Growth Mindset

- Workshops in the Success Centers introduce students to the concept of growth mindset
- Student Learning Outcomes:
  - Intelligence is not simply “you have it or you don’t”
  - Intelligence is malleable and can be developed through hard work
  - Students should focus on doing better and strategies for success
- Mindset greatly affects ability to learn
  - Students displaying a growth mindset will do better than students who don’t
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**Growth Mindset**

- If we can gauge a student’s mindset, we can possibly predict how successful they will be in repeating a course

- Petition Statements provide insight into student mindset
  - Why weren’t students successful in past attempts?
  - What will they do differently to succeed?
    - Indication of growth mindset
      - Motivated to succeed
      - Willing to work hard and dedicate time
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Measuring Growth Mindset

• Used a mindset rubric adapted from Mindset Works
  • Online company
    • Provides resources, tools, and programs that help teach growth mindset principles
  • Developed using current research on growth mindset
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Effective Effort Rubric

Adapted from Mindset Works® Educator Kit
http://www.mindsetworks.com/free-resources/

- Submitting the petition indicates taking on a challenge
- Learns from Mistakes:
  - Only one class
  - Less hours at work
  - Manage time better
- Asks ?’s/Accepts Feedback & Criticism
  - Visit Math Success Center
  - Supplemental instruction
  - Ask questions during class
- Practices/Learns & Applies Strategies
  - Study more
  - Practice everyday
  - Work hard on HW
- Perseveres
  - They WILL pass the course
  - DETERMINED to pass
  - WILL NOT FAIL
I am petitioning to be able to repeat my math 25 course, College Algebra. Last semester I was hoping to graduate and transfer, stacking up six classes with fifteen and a half credits while keeping a part time job. I realized that it was too much for me to handle but felt that I could be able to push on and graduate with good grades. Unfortunately, the math course was the exception and I took a D grade in College Algebra for Spring 2014. I feel that this time around I will be able to focus more on the course and material since this will be my only class this semester. It also frees up my week from other classes so I can use that time to study math everyday and become an active participant in the class with homework questions and class discussions. More sleep and healthier eating will help to keep myself study ready and I look forward to acing this class once and for all! I will carry these study habits with me to the university I plan to transfer to, and any job I hold in the future. Thank you for your time and support.

Statement 1

Asks ?s
Accepts Feedback
Learns from Mistakes
Practices/ Applies Strategies
Perseveres
this will be my only class this semester
math success center or even hire a private tutor
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**Statement 2**

I have failed to complete Math 425 the past two attempts because I didn’t have initiative, I didn’t take my education serious, as I should have. I did not take my education. Now I have plans to complete my education. Now I have plans to complete my education and start the next chapter in my life. Having to take my final courses at Chaffey College would greatly be appreciated so I can continue my education and perhaps transfer so I can get my degree in Landscape Architecture.

MINDSET SCORE = 0
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Growth Mindset Scores Distribution

- Mindset Score: 12, Number of Students: 112
- Mindset Score: 9, Number of Students: 157
- Mindset Score: 6, Number of Students: 163
- Mindset Score: 3, Number of Students: 109
- Mindset Score: 0, Number of Students: 43

Number of Students
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Data Analysis

Chaffey College Gender Distribution

- Male: 56.7%
- Female: 41.1%
- Unknown: 2.8%

Repeat Study Gender Distribution

- Male: 30%
- Female: 66%
- Unknown: 4%
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Data Analysis

Chaffey College Age Range

Repeat Study Age Range
Pass Rates

- Overall pass rates for petitioned classes sit above 60%
- However, petitions for classes like astronomy are rare and can give us results like we see below
Pass Rates

- Math 410 and 425 are the most taken classes
Pass Rates

- Biology 20 and 22 are the most taken classes
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Data Analysis

Predictive Modeling

Build a statistical model to:

• Identify significant predictor variables
• Predict Pass/Fail of 3rd time repeat students
• Estimate changes in pass probability based on changes in behavior
• Provide a framework for data based decision making
Background

Discriminant Analysis

- Similar to a simple regression, but you predict groups instead of values.
Background

Stepwise Discriminant Analysis

Example: Gender predicted with Height and Weight
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Data Analysis

Predictive Modeling

Variables:

• Demographic Data
• Assessment Data
• Petition Derived Data
• Academic History Data
• Course Repeat History Data
• Repeat Term Data
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Data Analysis

Predictive Modeling

Model Building

- SPSS Stepwise Discriminant Analysis
- 747 Valid cases
- 16 Variables
  - 4 Continuous
  - 12 Discrete
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Data Analysis

Predictive Modeling

Model Building

• Stepwise procedure, 6 Forward steps, 0 Backwards elimination steps

• Final model included 6 Variables

• Wilks Lambda 0.934 with Chi-square 50.746

• p < 0.001, reject null hypothesis of no discriminating ability
Phase I Model Building

3rd Repeat Success Model

Final Model Success is predicted with:

\[ \text{DsecondAttempt} = \text{Indicator variable for student receiving a grade of ‘D-’, ‘D’, or ‘D+’ on second attempt of the course} \]

\[ \text{OverallGPA} = \text{Students Grade Point Average at time of 3rd attempt} \]

\[ \text{NumberLines} = \text{Total number of lines in the students written petition to the dean} \]

\[ \text{FastTrack} = \text{Indicator variable for 3rd attempt course taken was an 8 week Fast Track course} \]

\[ \text{AddUnitsAtt} = \text{Number of additional units taken by the student while taking the 3rd attempt course} \]

\[ \text{RecencyOver12mo} = \text{More than 12 months between 2nd and 3rd attempts} \]
Model Building

3rd Repeat Success Model

Final Model: Success

<table>
<thead>
<tr>
<th>Predicted</th>
<th>Not Pass</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Pass</td>
<td>62.4%</td>
<td>37.6%</td>
</tr>
<tr>
<td>Pass</td>
<td>40.4%</td>
<td>59.4%</td>
</tr>
</tbody>
</table>
Conclusions

• Variables were found that have predictive ability for success in 3rd attempts of STEM courses
• The model is significant, but does not have strong predictive ability for either Pass or Not Pass groups
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Next Steps

• Finish collection of qualitative data for all cases
• Incorporate workshops data
• Add additional data from new terms
• Develop and implement one page survey for students requesting future 3rd attempt petitions
  • Expected hours worked during 3rd attempt
  • Dependent care responsibility
  • Food insecurity (yes/no)
  • Housing insecurity (yes/no)
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Implementation

Repeat Process Modifications

Steps to Implement Model Results

• Recommend students take 3\textsuperscript{rd} attempt Fast Track
• Recommend students with low GPA take and pass additional courses prior to 3\textsuperscript{rd} attempt
• Recommend students with short petitions take 600 series course or some additional step to demonstrate they are willing to work harder on this attempt
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Questions?