Math-Related Predictors of Academic Success for Future Educators

San Diego State University
College of Education

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BACKGROUND

California has a predicted deficit of 2 million degrees by 2025.
In California, there is a predicted deficit by 2025 of more than 2 million workers with degrees or credentials. Millions of Californian lack the required credential or degree to benefit from California's projected economic growth (California Competes, 2015).

CSU prioritizes student success with Graduation Initiative 2025.
The California State University (CSU) publically committed to improved graduation rates and zero achievement gaps by 2025 for its undergraduate student population.

Low grades impede progress, damage confidence and add to student debt.
Low grades are known to negatively impact student retention and graduation rates by impeding student progression (Bahr, 2009; Yue & Fu, 2017), to damage academic confidence (Fowler & Boylan, 2010; Lotkowski, Robbins & Noeth, 2004), increase the cost of college, and add to student debt (Britt, Ammerman, Barrett & Jones, 2017).

Liberal studies advisors recommended exploring relationships between math course grades and student progress through the major.
This is an issue of equity. We want to encourage students to see themselves as confident problem solvers who can make valuable mathematical contribution, and to be confident and enthusiastic when teaching math to young minds (Aguirre, Mayfeld Ingram, & Martin, 2013; Ching, 2018; Flores, 2007).

RESEARCH QUESTIONS

Phase 1: Data Exploration
- What courses show higher rates of low grades for liberal studies majors?
- Are there differences in graduation rates for liberal studies students with low grades?
- Is there evidence of disproportionate impact for traditionally underrepresented liberal studies students?

Phase 2: Transcript Analysis
- What patterns can be observed in liberal studies student academic profiles, with respect to mathematics preparation, courses and assessments?

Phase 3: Regression Analysis
- What factors related to math success are statistically significant predictors of on-time graduation?

METHODS

Phase 1: Data Exploration
Interactive summary charts were prepared for low grades earned by major cohort. Factors included graduation rates, time to degree, transferring institution and student demographics. Two courses were selected for transcript analysis: MATH 210 and MATH 211.
Data Source:
SDSU SIMS/R, queried by Sandra Kahn using PLSQL in Oracle Application Express (10/15/2018)

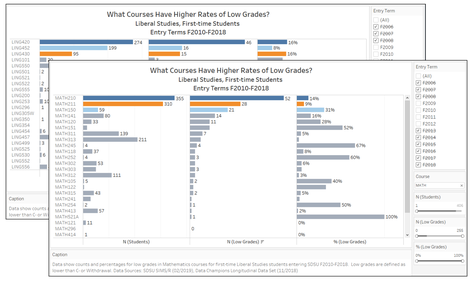
Phase 2: Transcript Analysis
Purposeful random sampling was used to select students from cohorts Fall 2012, Fall 2014 and Fall 2016 for transcript review. Academic profiles were prepared with student transcripts, test scores and background information.
Data Sources:
Data Champions Longitudinal Data Set, w/course outcomes for MATH 210 and MATH 211 (03/20/2019)
Test Scores for Liberal Studies Math Placement Assessments, queried from SDSU Test Center (03/10/2019)

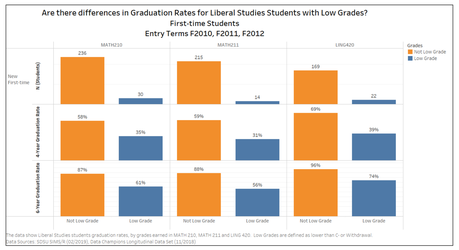
The Data Champions Team, along with college and program leadership, met twice for a total of 5 hours to review academic profiles, using the approach used by The Education Trust and described in Diploma Matters: A Field Guide for College and Career Readiness (Murray, 2011).

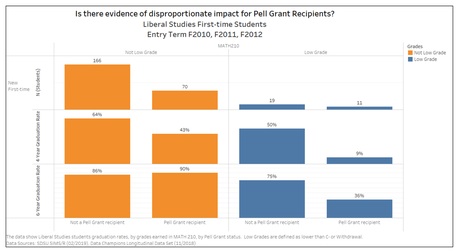
Phase 3: Logistic Regression
Logistic regression was used to explore whether qualitatively observed factors related to math success were statistically significant predictors of on-time graduation.
Data Sources:
Data Champions Longitudinal Data Set, w/course outcomes for MATH 210 and MATH 211 (03/20/2019)
Test Scores for Liberal Studies Math Placement Assessments, queried from SDSU Test Center (03/10/2019)

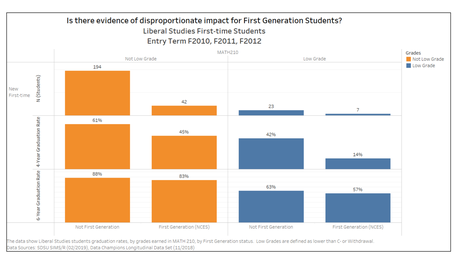
FINDINGS

Phase 1: Data Exploration









Phase 3: Logistic Regression Analysis

What factors related to math success are statistically significant predictors of on-time graduation for liberal studies students?

Cohort	First Time Students	Transfer Students	Total
Fall 2011	69	55	124
Fall 2012	88	101	189
Fall 2013	61	97	158
Fall 2014	91	99	190
Total	**309**	**352**	**661**

Variables List	
Groups	Entry Term (Cohort), Enrollment Status, Full-time Status
Student Background	Age, Gender, Hispanic, URM, 1st Gen, Military, Service Area, EOP, Pell
Academic Preparation /Assessment	PreMajor Status, Math Proficiency, Eligibility Index, Incoming GPA, Incoming Units, SAT Math, ACT Math, ELM, LS-MPA
Graduation Outcomes	Graduated, Graduated 2/4 Years, Graduated 4/6 Years, Graduated Liberal Studies

Regression Analysis Findings
The following variables were significant predictors of graduation outcomes. Additional analysis is needed.

	First Time Students	Transfer Students
Graduate	Incoming GPA (.957, 2.605)	Incoming GPA (1.486, 4.417)
Graduate 4/2 Years	Pell (.952, 2.591)	Hispanic (.657, 1.929) Incoming Units (.041, 1.042) T2 PreMajor Status (2.546, 17.759)
Graduate 6/4 Years	[none]	Incoming GPA (1.754,5.780) T2 PreMajor Status (1.313,3.715)

Correlation to On-time Graduation		
	First Time Students	Transfer Students
Hispanic	-.093	**-.114 ***
URM	**-.142 ***	-.095
1st Gen	**-.131 ***	**-.116 ***
Pell	**-.187 ***	.011
Military	.068	**.106 ***
Service Area	**-.166 ***	**.148 ***
HS Math Proficiency	**.122 ***	
SAT Math	**.145 ***	
ACT Math	**.208 ***	
Incoming GPA	**.184 ***	**.263 ***
Incoming Units	.051	**.222 ***
Term 1 PreMajor Status		**-.302 ***
Term 2 PreMajor Status		**-.539 ***
Graduate Liberal Studies	**.562 ***	**.429 ***

*$p<.05$

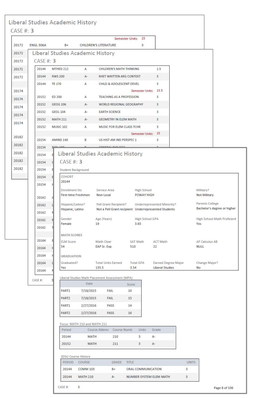
Phase 2: Transcript Analysis

What patterns can be observed in liberal studies student academic profiles, with respect to mathematics (preparation, courses and assessments) and its relationship to degree completion?

Theme A: Liberal Studies Math Placement Assessment (LS-MPA)
- LS-MPA does not appear to delay graduation. Supporting interventions such as tutoring, advising and re-takes appear to be working.
- LS-MPA failing scores are mostly near misses.
- LS-MPA failures appear related to math preparation indicators.

Theme B: Low Grades
- Low grades in MATH 210 and/or MATH 211 do not appear to delay graduation.
- Low grades in MATH 210 and/or MATH 211 do not appear to affect upper division courses.

Theme C: Math Confidence
- Students face negative experiences that may impact learning and teaching math.



Example of Academic Profile

CONCLUSIONS & FUTURE DIRECTIONS

Phase 1: Data Exploration
- Higher rates of low for two required math courses, MATH 210 and MATH 211.
- Lower rates of on-time graduation for students with low grades in MATH 210 and MATH 211.
- Evidence of disproportionate impact for low income and first generation students.

Phase 2: Transcript Analysis
- Frequent near-miss failures were observed for the math placement assessment.
- Graduation and upper division classes appear unaffected by low grades.
- Existing interventions appear successful for graduation outcomes, however the team observed patterns of negative experiences that may affect future educators' confidence and math-identity.

Phase 3: Regression Analysis
Regression inconclusive, however correlation analysis produced signification results:
- Positive relationships between on-time graduation and math skills
- Negative relationships between on-time graduation and traditionally underserved students
- Negative relationship between on-time graduation and delays advancing into the major
- Negative relationships between math skill and traditionally underserved students.

Recommended actions:
- Request funding for a Liberal Studies Math Bridge Program.
- Advocate for procedural changes to the Liberal Studies Math Placement Assessment.
- Incorporate math preparation and student background data into advising.
- Seek student input.
- Conduct follow-up studies, focusing on transfer students and on pre-major status.

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