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## Chapter

# Perspective Chapter: The Case of Trinity University – An Examination of Vulnerable Students’ Academic Performance in Gateway Courses and Possible Solutions

*John R. Hermann*

## Abstract

The study examines the factors that contribute to deficient grade rates and potential solutions to mitigate the issue at Trinity University. Using 9070 students’ grades in STEM-related gateway courses between the fall 2015 and spring 2020 academic semesters, the findings indicate that first-generation, underrepresented, and PELL eligible students struggle the most. Taking multiple gateway classes in the same semester increases student deficient grade rates as opposed to taking one. The creation of a Quantitative Reasoning Skills Center holds promise in helping students academically succeed and decreasing deficient grade rates in gateway courses, including those who are most vulnerable.

**Keywords:** higher education, pedagogy, student success, gateway courses, STEM-related classes, academic support resources

## 1. Introduction

Gateway courses—lower division, required courses characterized by high enrollment, high failure, and withdrawal rates that serve as a significant barrier to further study, degree completion and, ultimately, the professions [1, 2]—are front and center in preventing students from earning the coveted college degree. Students view gateway courses as a mechanism for weeding them out from some of the most notoriously challenging majors (e.g., Engineering, Physics) and pre-professional programs (e.g., pre-med, Accounting). Gateway courses also affect students differently: First-generation, underrepresented students (FGUS) and PELL eligible students are more profoundly and adversely influenced by their academic performance in gateway courses than their non-FGUS and non-PELL eligible counterparts ([3], p. 54). Finally, students in the United States who take out college loans are faced with the prospect of having secured debt, meaning that student loans are not forgivable in a bankruptcy court.

Faculty, academic support staff, and administrators are also concerned that students are not developing the skill set and knowledge needed to succeed in many of the gateway courses and the most challenging academic pathways of study. For example, these types of courses “represent roadblocks to student persistence and timely graduation ... [and discourages] students from continuing higher education” ([3], p. 54). It is difficult to discern the relative influence of student retention in relation to student persistence when considering student performance in gateway classes. Administrators also lament that it costs more to attract new students than retain the current ones. Cuseo ([4], p. 1) notes that, “retention initiatives designed to manage student enrollment are estimated to be 3–5 times more cost-effective than recruitment efforts, i.e., it takes 3–5 times as much money to recruit a new student than it does to retain an already enrolled student.” It is fair to conclude that improving the rates of students earning a post-secondary degree has been a national priority for over a quarter of a century with little improvement shown (e.g., [5, 6]).

The article is divided into four sections. First, the purpose of the study is explored by addressing the study’s research questions, providing a brief history of Trinity University and its experience with gateway courses, and reviewing the literature on gateway courses that generates testable hypotheses. Second, the study details the research methods (data collection, conceptualization, and operationalization of variables) and the descriptive statistics used. Third, the study discusses the empirical results of Trinity University’s experience with gateway classes. The study also fits the findings into the context of the gateway class literature. Fourth, the study offers a discussion that provides the implications of the findings and avenues for future strategies to reduce deficient grade rates in gateway courses.

## **2. Purpose of the study**

The purpose of this study is to answer three questions. First, Do Trinity University’s FGUS and PELL eligible students have disproportionately higher deficient grade (D/F/W) rates compared with their non-FGUS counterparts in gateway courses? Second, does taking more than one gateway class (as opposed to taking one) at Trinity during the same semester increase deficient grade rates? Third, does the creation of a Quantitative Reasoning Skills Center (QRS) at Trinity reduce the deficient grade rates in gateway courses, particularly among those who are FGUS and PELL eligible? Prior to answering these questions, a short background of Trinity University and its experience with gateway courses are provided.

Trinity University is a small liberal arts university with a few select graduate programs located in the historic Monte Vista district in San Antonio, Texas. Trinity recently celebrated its 150th anniversary and has a total enrollment of approximately 2400 students. While Trinity has Presbyterian roots, it has been a secular university since 1969. For almost 30 years, Trinity has been consistently ranked first in the western region among universities offering undergraduate and master’s degrees.

After the financial crisis in 2008 in the United States, institutional data revealed that Trinity needed to strengthen its approach in helping first-year students succeed. In particular, students struggled in a series of STEM-related courses known as gateway courses. In 2015, Trinity created its first Student Success Center later named The Tiger Learning Commons. It included a director of student success and an academic coach. Trinity also decided to use its Quality Enhancement Plan (QEP) titled *Starting*

*Strong* to try to reduce its deficient grade rates in gateway courses. Since 2003, the Southern Association of College and Schools: Commission on Colleges (SACSCOC) reaffirmation of the accreditation process mandates that higher educational institutions within its region undertake and complete a QEP once every 10 years. SACSCOC’s defines a QEP as a “topic that is creative and vital to the long-term improvement of student learning [that] ... focuses on learning outcomes and/or environment supporting student learning” ([7], p. 49).

Among other strategies, *Starting Strong* created a Quantitative Reasoning Skills Center to use best practices to help mitigate the high deficient grade rates in STEM-related gateway classes. To lead the QRS Center, Trinity hired a Director in January 2019. The Director is tasked with “supporting STEM faculty efforts to assist students facing quantitative reasoning challenges” ([8], p. 35). The QRS Director’s responsibilities include:

1. Overseeing The Quantitative Reasoning Skills Center;
2. Implementing and overseeing software support (i.e., ALEKS);
3. Overseeing Mathematical Placement;
4. Providing meaningful interventions with students struggling in STEM-related courses;
5. Organizing the Summer Bridge STEM course, which includes overseeing peer mentoring;
6. Teaching Pre-Calculus, Calculus, Introduction to Modern Mathematics, and A Mathematics Peer-Educator Course;
7. Expanding Awareness of resources and reducing stigma associated with accessing academic support resources;
8. Coordinating with faculty teaching STEM-related courses; and,
9. Encouraging students struggling in STEM-related courses to engage in a help-seeking behavior by meeting for one hour per week with a trained peer tutor for the remaining part of the semester ([8], pp. 35–36).

The QRS Center is focused on reducing deficient grade rates in STEM-related gateway courses at Trinity. First-year students, who are in the process of learning the norms and expectations of college, also take most of the STEM-related gateway courses. The Tiger Learning Commons and the QRS Center were the main strategies Trinity used to reduce deficient grade rates in STEM-related gateway courses. Active learning, institutionalizing peer tutoring, improving course design, increasing interactive and small-group learning environments, and introducing a STEM-related Summer Bridge class for students less prepared to succeed in STEM courses are all strategies developed by Trinity University to lower deficient grade rates in STEM-related gateway courses.

To contextualize the purpose of the study, an examination of the extant literature is explored, which generates four testable hypotheses.

Gateway courses have generated much scholarly attention (e.g., [9, 10]). Some scholars explore deficient grade rates in gateway courses and their influence on student persistence and retention rates (e.g., [11]). Other scholars explore the root causes of sub-standard performance in gateway classes. For example, it is well chronicled that FGUS and PELL eligible students face daunting challenges in succeeding in and completing gateway classes (e.g., [12, 13]). This leads to the first testable hypothesis in the study:

*H1: FGUS and PELL eligible students are more likely to struggle in gateway courses in comparison to their non-FGUS and non-PELL eligible counterparts.*

Lack of college preparation is another contributing factor to high deficient grade rates in STEM-related gateway courses. As Nunn ([14], p. 3) points out: “A great number of U.S. high schools do not adequately prepare students for the demands of college academics.” From her teaching experience, Nunn notes that she was exasperated by “the performance gap between students in my class who attended excellent high schools and those who did not” ([14], p. 9). While college preparation is certainly an important factor in determining performance in gateway classes, the data are not available to test this hypothesis.

Still, a different set of research examines the possible solutions to high deficient grade rates in gateway classes. For example, there is literature that suggests that the more gateway courses taken in a semester lead to higher deficient grade rates across those types of courses (e.g., [15, 16]). The only thing that is more challenging than taking one gateway class is taking multiple ones in the same semester. This leads to the second hypothesis:

*H2: If a student takes more than one gateway course in a semester, it leads to higher deficient grade rates than taking one gateway class.*

Finally, scholars have shown that there are best practices and strategies to improve student performance in gateway courses. Types of teaching techniques (lecture/chalk talk vs. active learning), improving course design (e.g., early alerts and low stakes assignments), offering bridge and preparatory classes (e.g., Summer Bridge STEM-related course), and improving academic support resources (e.g., academic coaches) are strategies that Trinity employed with the hiring of the QRS Director and the creation of his Center [16]. This leads to our third and fourth hypotheses:

*H3: Deficient grade rates should decrease in gateway courses with the creation of a QRS Center in the Spring 2019 semester.*

*H4: FGUS and PELL eligible students' deficient grade rates in gateway classes should decrease with the creation of a QRS Center.*

To test these four hypotheses, the study's methods of data collection and research methodology are outlined.

### **3. Data collection and research methodology**

The time period under analysis is between the Fall 2015 and Spring 2020 academic semesters. For a course to meet the requirement of a gateway course, Trinity University's

QEP titled *Starting Strong* defined the course as a gateway class during its development phase. After all, one of the central reasons Trinity chose *Starting Strong* is to reduce deficient grade rates in the most notoriously challenging classes. The classes included in the analysis are in the subject areas of Math (Calculus 1 and Calculus 2), Life Sciences (Integrative Biology 1, General Chemistry, Introduction to Chemistry, and Organic Chemistry), the Physical Sciences (Introduction to Mechanics, Introduction of Electricity, Magnetism of Waves) and the Social Sciences (Principles of Microeconomics 1). The total enrollment of students taking STEM-related gateway classes during the Fall 2015 and Spring 2020 semesters is 9070. The data were ascertained from the Office of Trinity University’s Institutional Research and Effectiveness with the permission of the Associate Vice President of Academic Affairs: Student Academic Issues and Retention.

Appendix A conceptualizes and operationalizes the independent and dependent variables. The study uses the following methods. The three independent variables are binary (dummy): First, if the student is first generation or PELL eligible, the independent variable is coded as a 1; otherwise, it is coded as a 0. Second, if the student takes more than one gateway class in the same semester, it is coded as a 1; if the student takes only one gateway class, it is coded as 0. Third, if the QRS Director and the creation of his Center are present (spring 2019–spring 2022), it is coded 1; otherwise, it is coded as 0 (fall 2015–spring 2019). The dependent variable is also dichotomous. If a student earned a deficient grade in or taken a withdrawal from a course (D/F/W), the dependent variable is coded as a 1; otherwise, it is coded as a 0. To discern the influence of the independent variables on the dependent variable, the study will use descriptive statistics.

#### 4. Results

**Table 1** reveals the results for FGUS’ deficient grade rates in Trinity University’s gateway courses during the Fall 2015 and Spring 2020 academic semesters. Overall, the average deficient grade (D/F/W) rate is 19 percent for all students taking gateway classes. However, among FGUS, the deficient grade rate spikes 7 percentage points to 26 percent—over one-quarter of the students. By contrast, if the student is a non-FGUS, the deficient grade rate drops to 18 percent. The study’s findings are consistent with the findings in the literature. FGUS face daunting challenges when tackling the most challenging academic pathways [11, 12]. It may be due to lack of preparation of college-level work. And, FGUS do not always have similar support systems as their non-FGUS counterparts.

Like FGUS, **Table 2** shows that PELL eligible students also face difficulties in gateway classes. While it is not as pronounced as for FGUS, PELL eligible students have an overall deficient grade rate of 23 percent. In comparison, non-PELL eligible students

First-generation student	Deficient grade rate (%)	Frequency
Yes	26	1198
No	18	7162
All Gateway Classes	19	9070

*Missing Cases: 710.*

**Table 1.**  
*The deficient grade rates of students who are first generation.*

PELL-eligible students	Deficient grade rate (%)	Frequency
Yes	23	1550
No	18	7516
All Gateway Classes	19	9070

Missing Cases: 4.

**Table 2.**  
*The deficient grade rates of students who are PELL eligible.*

only have a deficient grade rate of 18 percent—a 5 percentage point difference between being Pell and non-PELL eligible. The study's findings are also consistent with the literature regarding PELL eligible students [12, 13]. The purpose of PELL grants is to equalize the playing field among those who apply to and attend college, creating access and upward mobility for less affluent students. While it is a noble policy, the findings here show that PELL eligible students are less likely to succeed than traditional college students. The reasons for PELL eligible students not succeeding at the same rate as non-PELL eligible ones may be due to the choice of the schools attended. The findings indicate that PELL eligible students are more likely to choose schools with lower retention rates than non-PELL eligible students. However, even in the case of attending universities with higher retention rates, PELL eligible students are more likely to fail out than traditional students, which may also be due to college preparatory issues ([17], p. 1). With higher deficient grade rates in gateway classes, FGUS and PELL eligible students do not graduate at the same rates as traditional college students. In many instances, it means that FGUS and PELL eligible students often must pay back student loans when they have not received the return on investment of those who have graduated from college.

**Table 3** focuses on whether taking multiple gateway courses in the same semester is likely to cause higher deficient grade rates than only taking one gateway class. The logic is that too many gateway classes taken at the same time affects overall performance, because the students may be overwhelmed by the challenging course work—something they were not accustomed to when in high school (e.g., [12]). In the case of Trinity University, taking multiple gateways courses (as opposed to one) in the same semester slightly increases the likelihood of earning a deficient grade. As **Table 3** indicates, Trinity students who took more than one gateway course (21 percent) during the semester were 4 percent more likely to earn a deficient grade than those who only took one gateway class (17 percent). If possible, it is prudent to spread out gateway courses over a longer period of time. At the very least, students should avoid taking multiple gateway classes during their first year of college when they are learning the norms and expectations of college.

Multiple gateway courses	Deficient grade rate (%)	Frequency
Yes	21	4991
No	17	4079
All Gateway Classes	19	9070

**Table 3.**  
*The deficient grade rates of students taking multiple gateway courses in the same semester between Fall 2015 and Spring 2020.*

QRS director	Deficient grade rate (%)	Frequency
Pre-QRS Center (Fall 2015–Fall 2019)	21	7417
Post-QRS Center (Spring 2019–Spring 2020)	10	1653
All Gateway Classes	19	9070

**Table 4.**  
 The deficient grade rates of students before and after the creation of the QRS center in STEM-related gateway classes.

Due to the struggles of students in STEM-related gateway courses, Trinity chose its QEP titled *Starting Strong* to strategically and intentionally help first-year students academically succeed. One of the featured strategies of the QEP was to create a QRS Center with a director who has a background in higher education pedagogy and STEM. Employing best practices, the objective was to decrease deficient grade rates in our STEM-related gateway courses. Our director started the QRS Center in the Fall 2019 academic semester. **Table 3** compares the deficient grade rates before and after the creation of the QRS Center. Prior to creation of the QRS Center, the average deficient grade rate for students in gateway classes was 21 percent between the Fall 2015 and Fall 2019 academic semesters. After the creation of the Center, the deficient grade rate precipitously dropped to 10 percent between the Fall 2019 and Spring 2020 academic semesters. This dramatic drop of 11 percentage points occurred during a global pandemic. COVID-19’s disruption affected all areas of the globe in a myriad of ways, including higher education. Yet, the QRS Center’s strategies helped mitigate one of Trinity’s most challenging academic issues (**Table 4**).

**Table 5** compares the difference in deficient grade rates between FGUS and non-FGUS before and after the creation of the QRS Center. Prior to the creation of the QRS Center between the Fall 2015 and Fall 2019 academic semesters, the deficient grade rates for FGUS were 27 percent. In comparison, for non-FGUS during the same period, the deficient grade rate drops by 7 percentage points to 20 percent. After the hiring of the Director and the creation of a QRS Center between the Spring 2019 and Fall 2020 academic semesters, the deficient grade rate for FGUS decreased by 13 percentage points to 14 percent. And, similarly, for non-FGUS, the deficient grade rate dropped 11 percentage points to 9 percent, the lowest percentage for either group during the time period studied.

QRS director	Deficient grade rate (%)	Frequency
Pre-QRS Center (Fall 2015–2019) for FGUS	27	1015
Pre-QRS Center (Fall 2015–Spring 2019) for Non-FGUS	20	6214
Post-QRS Center (Spring 2019–Spring 2020) for FGUS	14	183
Post-QRS Center (Spring 2019–Spring 2020) for non-FGUS	9	1445
All Gateway Courses	19	8857

Missing Cases: 213.

**Table 5.**  
 The deficient grade rates of FGUS before and after the creation of the QRS center in STEM-related gateway courses.



QRS center	Deficient grade rate (%)	Frequency
Pre-QRS Center (Fall 2015–2019) for FGUS	25	1281
Pre-QRS Center (Fall 2015–Spring 2019) for Non-FGUS	20	6132
Post-QRS Center (Spring 2019–Spring 2020) for FGUS	9	269
Post Hiring of QRS Center (Spring 2019–Spring 2020) for non-FGUS	10	1384
All Gateway Courses	19	9066
<i>Missing Cases: 4.</i>		

**Table 6.**

*The deficient grade rates of PELL eligible students before and after the creation of the QRS Center in STEM-related gateway courses.*

**Table 6** shows a comparison between PELL eligible and non-eligible PELL eligible students prior to and after the creation of a QRS Center and the hiring of the Director. Prior to the creation of a QRS Center between the Fall 2015 and Fall 2019 academic years, the deficient grade was 25 percent for STEM-related courses. For non-PELL eligible students, the deficient grade drops 5 percentage points over the same period. After the hiring of the Director and the creation of a QRS Center between Spring 2019 and Spring 2020 academic semesters, the study finds the most marked decrease among PELL eligible students in their deficient grades by 16 percentage points to 9 percent in STEM-related courses. In fact, the PELL eligible group of students outperformed the non-PELL eligible students (10 percent) by 1 percentage point during the same period.

In an interview, this researcher asked the QRS Director what factors contributed to the improvement in student performance in Trinity's STEM-related gateway courses. He attributed the initial success to three factors. First, while STEM peer tutors are not centralized, departments that have bought into the QRS Center's strategies have helped create a minimum quality standard for the performance of peer tutors. The QRS Director noted that peer tutors are a high-impact educational practice, and that peer tutors need to be properly trained prior to helping struggling students succeed. Second, the QRS director created a peer-tutoring advisory board for STEM-related fields. This makes faculty members stakeholders in peer tutoring and academic student success [18].

Third, the Summer Bridge Math program has also been a valuable strategy in helping students in STEM-related fields with preparatory issues prior to beginning of the student's first semester. Summer Bridge Math is a one-credit hour class that provides a review of the math skills used most often in STEM-related courses. The QRS Director collected data on the 1-week Summer Bridge program for incoming first-year students prior to the beginning of their first semester. He found that those students who accepted the invitation to attend the Summer Bridge Math program did better in STEM-related gateway courses than those who did not attend [18]. Research has reaffirmed the QRS Director's impressions that Summer Bridge programs are an effective strategy in preparing students for the rigors of college [19].

## 5. Conclusion

Consistent with the literature on gateway courses, the study finds that students at Trinity University struggle with gateway courses in STEM-related fields. Academic

performance varied among the student cohorts. FGUS and PELL eligible students faced more daunting challenges in gateway classes compared with non-FGUS and non-PELL eligible students. One of the central findings of the study is that students who took multiple gateway courses struggled with deficient grades more than those who took only one gateway course. Additionally, the creation of a QRS Center helped to mitigate deficient grade rates among all groups in STEM-related gateway classes in its first three semesters. The findings regarding the Director and his QRS Center are still in its preliminary stages. The findings, however, reveal that universities are not powerless to help students succeed in its most challenging academic pathways. It requires financial and personnel resources coupled with a strategic and intentional plan that uses best practices with an understanding of the academic culture of the university.

Even though Trinity has made progress in decreasing the deficient grade rates in its STEM-related gateway courses, there is still notable room for improvement. There are three strategies that may help student performance in gateway courses in the future. First, course redesign with a special focus on student preparatory issues, particularly at the beginning of STEM-related gateway courses, could prove fruitful. Three immediate tweaks to a syllabus may include more low stakes assignments, early alerts, and learning objectives/student-learning outcomes. Second, Supplemental Instruction (SI) has demonstrated to help reduce high deficient grade rates in gateway courses. SI was created by Deanna Martin at University of Missouri, Kansas City, in 1973. It uses peer-assisted study sessions to improve student success and retention within targeted historically challenging courses [20]. As Dawson et. al. ([21], p. 609) point out, “SI is correlated with higher mean grades, lower failure and withdrawal rates, and higher retention and graduation rates.”

Third, co-requisite instruction is another long-term solution, which requires students enrolled in a class “to also attend a 1–3 credit hour co-requisite course that is aligned with, and offered alongside, the appropriate college-level course” [22]. Some students enrolled in gateway courses do not need to take a remedial course before taking a gateway course. Yet, they are still not yet prepared to take the class without a meaningful intervention. Co-requisite instruction appears to resolve this issue. In highly sequential majors, such as Physics at Trinity University, co-requisite instruction seems to be a strategy that holds promise.

Given the exorbitant cost of higher education, it is vital that universities prepare students for the rigors of college once accepted to the institution. It is not only a student-centered approach. It also helps universities retain students and provides upward mobility for students from underrepresented backgrounds.

## **A. Appendix A: definitions and operationalization for gateway classes**

### **A.1 Definitions (Conceptualization)**

*Gateway Classes* are lower-division, required courses characterized by high enrollment, high failure and withdrawal rates that serve as a significant barrier to further study, degree completion, and ultimately, the professions [2].

*Gateway Classes at Trinity:* The time period under analysis is between Fall 2015 and Spring 2020. For a course to meet the requirement of a gateway class, at least 15 percent of the students (on average) had to receive a D/F/W. The classes under analysis are in the areas of Math (Calculus 1 and Calculus 2), Life Sciences (Integrative Biology 1, General Chemistry, Introduction to Chemistry, and Organic Chemistry),

the Physical Sciences (Introduction to Magnetism, Intro to Elec, Magn, and Waves), Computer Sciences (Principles of Computer Science 1), Engineering (Mechanics 1), Business (Fundamentals of Accounting 1), and the Social Sciences (Principles of Microeconomics 1). The total enrollment of students taking these classes during the time period under analysis is 9070.

*Multiple Gateway Classes* are when a student takes more than one gateway course in the same semester.

*First-Generation Student (FG)*: The first student in the family that will graduate from a 4-year college.

*PELL Eligible Student (PE)*: The Federal Pell Grant is usually awarded to undergraduates who have a high degree of unmet financial need. Students whose families have a total income of up to \$50,000 may be *eligible* for the need-based funding, though most Pell grant money goes to students with a total family income below \$20,000.

*Quantitative and Reasoning Skills (QRS) Director*: As a result of Trinity's Quality Enhancement Plan titled *Starting Strong*, the university hired a QRS Director. The Director is tasked with supporting "STEM faculty efforts to assist students facing quantitative reasoning challenges" (*Starting Strong*, 2018, p. 35). Additionally, the QRS Director implements software support, oversees mathematics placement, and tutorial software (i.e., ALEKS), provides meaningful interventions with students struggling in STEM-related courses, assists in offering the Summer Bridge Summer STEM course, teaches Calculus 1 (Math 1311), and oversees peer tutors, among other activities (Ibid, pp 35–36).

## A.2 Operationalization of definitions

*Gateway Classes*: If a student earned a D/F/W in the course, it is coded as a 1; otherwise, 0.

*Multiple Gateway Classes*: If a student took multiple gateway courses in the same semester, it is coded as a 1; otherwise, 0.

*FG Student*: If a student is first generation, it is coded as a 1; otherwise, a 0.

*PELL Eligible Student*: If a student is PELL Eligible, it is coded as a 1; otherwise, a 0.

*QRS Director*: After the hiring of QRS Director (Spring 2019), it is coded as a 1; otherwise, 0.

### Author details

John R. Hermann  
Trinity University, San Antonio, Texas, United States of America

\*Address all correspondence to: [jhermann@trinity.edu](mailto:jhermann@trinity.edu)

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