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Implementing Data-Driven Strategies to Improve Course Performance: A Case Study at the University of Houston

Teri Elkins Longacre[1] and Caroline S. Neary[2]

[1] Senior Vice Provost and Dean for Undergraduate Student Success, University of Houston, [2] Director of Student Success Research and Analysis, University of Houston

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Abstract

In an effort to increase completion rates, the University of Houston (UH) has implemented customized strategies to improve course performance. Course grades impact GPA, and the literature consistently shows a strong positive relationship between GPA and the likelihood of persistence and degree completion. In 2021, UH launched an initiative to improve student performance in gateway courses through faculty professional development and strategic course redesign. Redesign efforts focused on general education courses with high enrollment, high DWIF rates, and gaps in course DWIF rates across student populations. Redesign elements included more time engaging with course material in a meaningful way, new assignments, and amnesty opportunities. This case study highlights three courses which started with DWIF rates of 41% to 49%. After implementing course redesign strategies unique to each course, DWIF rates decreased by 9 to 35 percentage points, and performance gaps were improved. Course redesign strategies were analyzed in the context of Ryan and Deci's (2000) self-determination theory of human motivation. Lessons learned included using disaggregated data to create urgency and accountability, focusing on students' academic and non-academic needs, and remembering there is no one-size-fits-all method for course redesign.

Keywords: higher education, persistence, degree completion, course completion, gpa

Introduction

Making a positive impact on the lives of students is central to the University of Houston's mission. As such, we are committed to student success as a no-excuses priority. A critical component of this commitment is our belief that we have a duty to provide clear and unobstructed pathways to degree completion. From 2014 to 2024, the six-year graduation rate at UH increased 35% (from 48% to 65%). Building on positive momentum, the University is striving to further support students by achieving a completion rate of at least 70%. One approach UH has taken toward reaching this goal is engaging faculty in designing and implementing strategies to improve course performance. Course grades impact GPA, and the literature consistently shows a strong positive relationship between GPA and likelihood of persistence and degree completion (Allen et al., 2008; Chen & DesJardins, 2008; Herzog, 2005; Hu et al., 2012; Ishitani & DesJardins, 2002; Mayhew et al., 2016; Stratton et al., 2008). These findings hold true not only for students overall, but also for students from underserved populations (Baker & Robnett, 2012; Hausmann et al., 2009; Lohfink & Paulsen, 2005; Mayhew et al., 2016; Somers et al., 2004). Literature aligns with internal institutional research demonstrating that having a lower DWIF ratio (defined as the proportion of D, Withdrawn, Incomplete, or F grades earned to all grades earned) is a statistically significant predictor of six-year graduation for students at UH.

In 2021, UH launched an initiative to improve student performance in gateway courses through faculty professional development and course redesign. Initial redesign efforts focused on general education courses with high enrollment, high DWIF rates, and gaps in course DWIF rates across student populations. Redesign elements included early detection of student challenges, more time engaging with course material in a meaningful way, new assignments, and amnesty opportunities. From fall 2021 to fall 2023, DWIF rates decreased by five percentage points or more in 111 undergraduate courses overall. This case study will highlight three courses which started with DWIF rates of 41% to 49%. After implementing course redesign strategies unique to each course, DWIF rates decreased by 9 to 35 percentage points in fall 2023, and performance gaps were improved. Success beyond the course grade was also observed in cumulative GPAs and subsequent enrollment.

Case Description

Institutional Context

As an urban public university enrolling over 38,000 undergraduate students in the fall of 2024, UH serves a diverse student population and is a federally designated Hispanic- and Asian American-serving institution, as well as a Native Pacific Islander-serving institution. Hispanic students (38.0%) make up the largest racial/ethnic group represented, followed by Asian American and Pacific Islander students (23.0%), White students (16.4%), and Black students (12.2%). Over 75% of the first-time in college students who entered in fall 2024 came from the greater Houston area, defined here as from Harris County or an adjacent county. In terms of socioeconomic status, 43.3% of UH students are first-generation, meaning that neither parent nor guardian has completed a bachelor's degree, and 41.1% receive a federal Pell grant for students with financial need.

With a focus on improving outcomes for all of our students, institutional student success efforts are led by the Office of the Provost, working in collaboration with key campus stakeholders. Our initiative to improve course performance was overseen by the Provost, the Senior Vice Provost and Dean for Undergraduate Student Success, and the Associate Provost for Faculty Development and Faculty Affairs. This team worked closely with college leaders, faculty, and staff throughout the initiative.

Faculty Professional Development and Course Redesign Approach

Key aspects of the UH initiative to improve course performance included faculty professional development and course redesign guided by national content experts. To support faculty in identifying and addressing challenges faced by students, 14 faculty members participated in the Gardner Institute's Teaching and Learning Academy, a community of practice designed to improve student learning in gateway courses, with a particular focus on inclusive teaching practices (Gardner Institute, n.d.). Additionally, 97 faculty teaching undergraduate gateway courses participated in Association of College and University Educators (ACUE) training and earned the ACUE Certificate in Effective College Instruction. This certification teaches a framework to improve retention rates and DWIF rates and reduce performance gaps through elements like creating an inclusive learning environment (ACUE, n.d.).

To facilitate course redesign, UH partnered with the Gardner Institute through Gateways to Completion (G2C), a guided three-year process for faculty-led course transformation to boost retention and graduation rates (Gardner Institute, n.d.a.). This process was led by a task force divided into three roles: liaisons, steering committee members, and course-specific committee members. Two liaisons served as overall project leaders in Undergraduate Student Success; their roles were Senior Vice Provost and Dean for Undergraduate Student Success and Director of Student Success Research and Analysis. The course-specific committees were each made up of three to four faculty members who instructed the course or academic advisors who advised the course department. The steering committee was comprised of the liaisons and course-specific committee members, along with several cross-campus colleagues who served in administrative capacities within the Office of the Provost or the academic colleges. The liaisons coordinated the work and messaging, the steering committee guided the action steps, and final decision-making was solely in the hands of the course department itself.

In year one, the steering committee engaged in an institutional self-study analysis covering the six G2C principles: academic policy and practice, faculty instructors, improvement, learning, students, and support. The university's Institutional Research office partnered to provide student-level demographic and academic data directly to the Gardner Institute, where it was aggregated in a data portal designed specifically for the process. Subcommittees reviewed institutional data such as course DWIF rates by demographic characteristics, as well as data from a Student Learning Gains survey administered to students currently in the courses of interest. This survey asked students to report how much factors like class activities, assignments and tests, information and support given, and understanding of class content helped their learning in the course. Ultimately, the committee completed a report with recommendations and an action plan included. In year two, the action plan was implemented, and in year three, the outcomes were monitored and recommendations were refined.

Course Selection

The initial redesign efforts focused on general education courses with high enrollment (500 or more students enrolled per term) and high DWIF rates (the percentage of students earning a D, W, I, or F grade in the course). The most comprehensive redesign among G2C courses occurred in College Algebra (MATH 1314) and Fundamentals of Chemistry (CHEM 1311). Applying what was learned in G2C more broadly, we began examining all undergraduate courses with particularly high DWIF rates, providing data to colleges, and collaborating with college leaders and faculty regarding interventions. One example of this work is Principles of Macroeconomics (ECON 2301), which had one of the highest DWIF rates for first-semester freshmen. As shown in Table 1, these three courses all had a trend of DWIF rates well above 20% over the last four to five years, as well as relatively large enrollments.

TABLE 1. Course DWIF rate trend

Course	**Fall 2017**		**Fall 2018**		**Fall 2019**		**Fall 2020**		**Fall 2021**	
	N	DWIF%	N	DWIF %	N	DWIF %	N	DWIF %	N	DWIF %
CHEM 1311	1,501	34.2%	1,639	49.0%	1,754	42.2%	1,680	27.4%	1,557	49.0%
MATH 1314	1,551	34.6%	1,700	35.6%	1,770	33.9%	1,678	24.4%	1,832	45.1%
ECON 2301	698	18.6%	772	24.4%	802	37.4%	754	37.7%	759	40.8%

Note. In fall 2020, UH was under an interim grade policy in which students could elect to receive a satisfactory/unsatisfactory grade rather than a letter grade.

Course Redesign

Redesign elements in MATH 1314 and CHEM 1311 focused on early detection of student challenges, clear expectations, more time engaging with course material in a meaningful way, and timely and frequent feedback. MATH 1314 added a supplemental workshop, updated the syllabus to include more detailed objectives and real-world applications, wrote new exams and quizzes based on past performance data, and revised homework assignments to make more connections to real-life applications. Faculty teaching CHEM 1311 implemented a new technology platform for graded assignments, enabling them to incorporate textbook publisher-provided algorithmic homework questions that include detailed feedback. They also provided a self-paced practice environment, added homework and quiz assignments for each week, created more non-exam points to the grading scale, and slightly changed the weighting between the midterm and final exams.

Faculty teaching the ECON 2301 course utilized a mastery approach, focusing on providing students with amnesty opportunities, including voluntary make-up midterms and recovery homework for missed deadlines. Additionally, teaching assistants engaged in expanded outreach, including informing students of deadlines, office hours, and livestreams. Faculty noted that students who fell behind early in the course had some commonalities, including full-time employment, lack of family support, and financial strain. The course redesign elements allowed students to recover and earn credit for the course.

Approaches to course redesign in each of these highlighted courses are closely aligned with the G2C principles of Learning and Support. Informed by students' challenges and needs self-reported in the Student Learning Gains survey and garnered by institutional data, as well as faculty experience and interactions with students, redesign elements in CHEM 1311 and MATH 1314 effectively applied the concepts of clear expectations and timely/frequent feedback while ECON 2301 faculty focused on content mastery and timely support. Principles learned through G2C were also embedded in ongoing discussions regarding course redesign more broadly across our curriculum.

Analysis

Self-Determination Theory

Information gathered through the G2C assessment process highlighted a number of challenges faced by students, with motivation and ability to successfully complete course requirements emerging as key concerns. Ryan and Deci's (2000) self-determination theory posits that motivation is enhanced when the psychological needs of autonomy, competence, and relatedness

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are met. In the context of a college classroom, meeting these needs results in greater academic engagement and better academic outcomes (Niemic & Ryan, 2009). Applying self-determination theory to the course redesign initiative at UH provides insight regarding the improved outcomes observed to date.

A student's autonomy refers to their willingness to complete academic tasks of their own volition (Niemic & Ryan, 2009). Strategies for fostering autonomy in the classroom include reducing the pressure of assessments, ensuring students have a choice in their academic tasks, and illustrating why a task is beneficial to the student. The G2C Student Learning Gains survey, administered to students enrolled in CHEM 1311 and MATH 1314, assessed how much different aspects of the class helped their learning on a scale from 1 (no help) to 5 (great help). Students' responses to "Explanation of why the class focused on the topics presented" indicated a potential need for greater autonomy (CHEM mean = 2.5 and MATH mean = 3.6). A number of strategies implemented in these courses aligned with increasing students' autonomy. MATH 1314 added connections to real-world applications in course topics and homework assignments to allow students to make a connection between these course tasks and their personal benefits. CHEM 1311 offered a self-paced practice environment that reduced pressure and allowed a student to choose how quickly they progressed. ECON 2301 faculty addressed autonomy by giving students more control over opportunities to improve their grades through voluntary make-up exams and recovery for missed homework deadlines.

A student's competence refers to a feeling that they can effectively meet academic challenges (Niemic & Ryan, 2009). Strategies for fostering competence in the classroom include providing tasks that are optimally challenging and providing feedback. Suggesting a greater need for feedback, the G2C Student Learning Gains survey item "feedback on my work received after tests or assignments" was the lowest rated aspect of the class for CHEM 1311 (mean=2.1). In MATH 1314, feedback was the second-lowest rated aspect of the class (mean = 3.0). At UH, a number of implemented redesign elements aligned with feedback as a strategy to increase competency. CHEM 1311 introduced new technology that supplied algorithmic homework questions, which were tailored to the student and included detailed feedback. MATH 1314 added a supplemental workshop, which provided additional time outside of the course meeting time for students to challenge themselves with the content and receive feedback.

A student's relatedness refers to their perception of connectedness and belonging in the classroom (Niemic & Ryan, 2009). Strategies for fostering relatedness in the classroom include increasing a student's perception that their instructor respects and values them. Connecting with students through real-world examples and providing opportunities for feedback have also been recommended (Escandell & Chu, 2023). The G2C Student Learning Gains survey item "willingness to seek help from others, including teacher/TA" suggests a need to improve relatedness (CHEM mean=2.9 and MATH mean =3.1). Feedback enhancements were implemented in both courses, along with real-life applications in Math 1314 and additional outreach to students in ECON 2301.

Outcomes

In fall 2021, DWIF rates for the highlighted courses were well above our institutional threshold of concern, with MATH 1314 at 45.1%, CHEM 1311 at 49.0%, and ECON 1301 at 40.8%. From fall 2021 to fall 2023, DWIF rates improved overall and within historically underrepresented groups in these courses. As seen in Table 2, the overall DWIF rate decreased 8.6 percentage points in MATH 1314, 22.0 percentage points in CHEM 1311, and 24.7 percentage points in ECON 2301.

TABLE 2. Course DWIF rates fall 2021 vs. fall 2023

Course	Fall 2021	Fall 2023
MATH 1314	45.1%	36.5%
CHEM 1311	49.0%	27.0%
ECON 2301	40.8%	16.1%

These decreases in DWIF rates also represent improvements in performance gaps. Most notably, the gap between Pell-eligible students and non-Pell-eligible students decreased from 10.7 percentage points to zero in ECON 2301 and from 15.2 percentage points to 9.8 percentage points in MATH 1314. The gap between first-generation students and non-first-generation students decreased from 17.2 to 9.2 percentage points in CHEM 1311, from 1.9 percentage points to zero in ECON 2301, and from 10.6 to 7.4 percentage points in MATH 1314. The gap between Black students and White students decreased from 18.6 to 15.5 percentage points in MATH 1314 and from 11.0 to 6.5 percentage points in ECON 2301, while the gap between Hispanic students and White students decreased from 12.0 to 6.2 percentage points in MATH 1314.

Subsequent success beyond the course grade was also observed (see Tables 3-5). Compared to fall 2022, students who took CHEM 1311 or ECON 2301 in fall 2023 had a higher cumulative GPA that fall, had a higher enrollment rate the following spring, and enrolled in more hours the following spring. Notably, the spring retention rate of first-generation students and Hispanic students increased by five percentage points for those who took CHEM 1311 and by ten percentage points for those who took ECON 2301 from 2023 to 2024.

TABLE 3. Students enrolled in CHEM 1311 in fall 2022 vs. fall 2023

Student Group	Average Fall Cum. GPA		Following Spring Enrollment Rate		Following Spring Average Hours Taken	
	Fall 2022	Fall 2023	Fall 2022	Fall 2023	Fall 2022	Fall 2023
Pell Eligible Students	2.839	2.996	92%	95%	13.9	14.0
First Generation Students	2.836	2.991	89%	94%	13.7	13.8
Black Students	2.734	2.828	91%	92%	14.1	14.2
Hispanic Students	2.702	2.934	89%	94%	13.4	13.6
All Students	2.931	3.113	92%	95%	14.0	14.1

TABLE 4. Students enrolled in ECON 2301 in fall 2022 vs. fall 2023

Student Group	Average Fall Cum. GPA		Following Spring Enrollment Rate		Following Spring Average Hours Taken	
	Fall 2022	Fall 2023	Fall 2022	Fall 2023	Fall 2022	Fall 2023
Pell Eligible Students	2.648	2.951	85%	93%	12.9	13.4
First Generation Students	2.517	2.886	80%	90%	12.6	13.2
Black Students	2.651	2.660	89%	88%	13.5	13.0
Hispanic Students	2.475	2.885	79%	89%	12.7	13.0
All Students	2.639	2.937	84%	90%	12.9	13.3

TABLE 5. Students enrolled in MATH 1314 in fall 2022 vs. fall 2023

Student Group	Average Fall Cum. GPA		Following Spring Enrollment Rate		Following Spring Average Hours Taken	
	Fall 2022	Fall 2023	Fall 2022	Fall 2023	Fall 2022	Fall 2023
Pell Eligible Students	2.637	2.724	87%	89%	13.2	13.6
First Generation Students	2.645	2.702	86%	88%	13.1	13.4
Black Students	2.570	2.595	88%	88%	13.3	13.8
Hispanic Students	2.706	2.758	87%	90%	13.1	13.4
All Students	2.733	2.831	88%	90%	13.2	13.7

Discussion

As UH works to implement strategies to increase degree completion, course redesign aligned with theory and best practice has yielded initial promising results in terms of course performance improvements. Overall DWIF rates improved from 8.6 percentage points up to 24.7 percentage points. These decreases in DWIF rates resulted in improvements in performance gaps, such as those for first-generation and Pell-eligible students, and higher enrollment rates in subsequent terms. We have learned a great deal throughout the redesign process to guide expanded efforts and taken steps to ensure the sustainability of a culture that supports continued course performance improvements.

Lessons Learned

During each phase of the initiative to improve course performance at UH, we gained key insights that may be helpful to others who engage in this work. As depicted in Table 6, we have identified ten lessons learned which focus on the use of data, personalized collaboration, and shared philosophy.

TABLE 6. Lessons learned

Use of Data	Personalized Collaboration	Shared Philosophy
Urgency in data	Faculty champions	Not one size fits all
Accountability in data	Student needs	Compassion matters
Disaggregation of data	Non-academic challenges	Change takes time
	No gatekeeping	

The use of data throughout the redesign process is critical, beginning with identifying courses of interest, then sharing course performance data with colleges and departments, which created a sense of urgency. Some stakeholders were not aware of stark data points that ultimately led to action, including the examination of students' needs. Monitoring data also helps to create accountability for stakeholders to drive continuous assessment and improvement. Finally, it is critical to disaggregate data, not just by student characteristics, but also by faculty and course characteristics. For example, we identified a course with a very high DWIF rate overall; disaggregating data by instructor revealed that one instructor had an extremely high DWIF rate while rates in other instructors' sections were low. As a result, it was determined that course redesign was not the appropriate intervention in this case.

Personalized collaboration involves drawing on institutional and national experts to guide tailored redesign based on best practices. Finding internal faculty champions to collaborate with was essential to help others get on board and lead successful, large-scale departmental or college-wide efforts. National experts provided a process for conducting a self-assessment and developing redesign strategies. Through this process, it became clear that the needs of students should drive the redesign elements with a thorough assessment of the challenges faced by students in the course. This lesson was critical, as it ties back to Niemic and Ryan's (2009) self-determination theory. Acknowledging students' challenges informed the course redesign efforts that helped meet students' needs for competence, autonomy, and relatedness. Challenges are not always academic, and a wide variety of strategies should be considered to support student success. While academic supports, such as supplemental workshops and self-paced practice environments, were identified as needs in Math and Chemistry courses, Economics instructors found that many students who benefited from the course redesign were also employed full-time and/or caretakers, and needed flexibility. Finally, gatekeeping is not a strategy for success. While some initial reactions to DWIF data were to place students who face challenges in different courses, the goal of redesign is for all students to have the ability to be successful in the course.

We learned that having a shared philosophy to guide the redesign process is key to managing expectations and maintaining meaningful engagement. This philosophy is comprised of three overarching tenets. First, it is important to recognize that there is no one-size-fits-all solution. Course redesign needs will differ based on challenges faced by students, which will vary in each course. Successful redesign involves drawing on the expertise of faculty to thoroughly examine factors impacting performance and tailor strategies accordingly. Second, compassion matters when considering ways to support students in the classroom. Challenges impeding course performance come in many forms, including academic, personal, and financial. Course redesign that provides flexibility along with academic resources can be particularly effective. Third, change takes time. Meaningful course redesign cannot be planned or implemented overnight. An intentional process, including data-driven assessment and strategic redesign, is needed to make a meaningful impact.

Sustainability

We have taken several steps to sustain our efforts toward improving student performance in courses with high DWIF rates across the curriculum. This includes incorporating a review of DWIF rates in key strategic initiatives, providing colleges and departments with easy access to data, and introducing new faculty training and incentives.

To ensure that colleges and departments regularly monitor DWIF rates and address courses of concern, rates are now included as metrics in two key institutional student success and enrollment planning efforts. The first is a recently initiated review of our general education curriculum, in which colleges assess DWIF rates, in addition to many other factors, for each course. We have also launched a data-informed student success and strategic enrollment planning process, which includes an assessment of all undergraduate course DWIF rates. Both initiatives involve the submission of college/department plans to address higher-than-acceptable DWIF rates, with 20% as the threshold for examination.

To help colleges and departments more closely monitor DWIF rates each semester and over time, our Institutional Research team has developed a dashboard that includes course grade performance, with the ability to view data at the individual course level as well as by other factors, such as instruction mode, faculty rank, and course level. To equip faculty with the knowledge and incentives to engage in effective course redesign, we are also developing training modules featuring the courses examined in this case study, as well as others with notable course performance improvements.

Conclusion

This case study demonstrates how faculty-led strategic course redesign in three courses at the University of Houston resulted in improved course performance. Course redesign strategies included early detection of student challenges, more time for engaging with material in a meaningful way, timely support and feedback, and a content mastery approach. We found that these strategies aligned with self-determination theory (Ryan & Deci, 2000), and self-determination theory-informed practices were proposed by Niemic and Ryan (2009). In the first year following redesign implementation, DWIF rates in CHEM 1311, MATH 1314, and ECON 2301 decreased for all students. Importantly, as a result, performance gaps were reduced between Pell-eligible students and non-Pell-eligible students, first-generation students and non-first-generation students, Black students and White students, and Hispanic students and White students. Most notably, in ECON 2301, the performance gaps for Pell-eligible students and first-generation students were eliminated. While outcomes are promising, not all performance gaps improved across the three courses. There is more to learn regarding barriers faced by students as we continue our work to implement additional strategies in support of student completion.

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