Implementation of an Introductory Engineering Course and its Impact on Students' Academic Success and Retention

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Abstract

This Complete Research paper will describe the implementation of an introductory course (ENGR194) for first semester engineering students. The course is meant to improve retention and academic success of engineering first-year students in the College of Engineering at the University of Illinois at Chicago. The implementation of this course is part of an ongoing National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Math (S-STEM) project. This paper reports on the impact of combinatorial enrollment in ENGR194 and a previously described two-week Summer Bridge Program (SBP) offered only for entering S-STEM scholars before their first semester.

To measure the impact of this course on student retention and academic success, various evaluation metrics are compared for three separate Comparison Groups (C-Groups) of students. The results show that the ENGR194 course had a significant positive impact on the first-year retention rate. The results also revealed that students who participated in both ENGR194 and SBP (C-Group 1) made changes to their declared majors earlier than students who had only taken ENGR 123 or neither of the courses (C-Groups 2 and 3 respectively). Furthermore, students in C-Group 1 received better grades in math and science than their peers, and students in C-Groups 1 and 2 had significantly higher GPAs than their peers in C-Group 3.

Introduction and Related Works

A report from the President's Council of Advisors on Science and Technology suggests that the United States needs to produce approximately one million STEM college graduates during the next decade to retain its preeminence in science and technology [1]. The authors assert that, *"Increasing the **retention** of STEM majors from 40% to 50% would, alone, generate three quarters of the targeted one million additional STEM degrees over the next decade."* To reach this goal, universities and higher education institutions have made significant efforts to design and implement effective methods for improving student academic performance, increasing retention, and increasing graduation rates. Regarding these goals, the University of Illinois at Chicago was granted a National Science Foundation Scholarship in Science, Technology, Engineering, and Math (S-STEM) to implement a support system integrating intervention techniques for academically talented, low-income engineering students (Scholars). The implementation of an introductory course (ENGR194) is part of this support system.

Various approaches have been employed to design intervention methods. Snyder et al conducted a systematic review and meta-analysis to determine the efficiency of the interventions for students from groups with low retention and graduation rates [2]. Their analysis of over 53 studies revealed that interventions are moderately effective in improving achievements and psychosocial outcomes. They also showed that the effectiveness of the interventions varied by student classification. Harackiewicz and Priniski reviewed three types of interventions [3]. These interventions focused on students' value perception in academic tasks (task value interventions), students' personal values (personal values interventions), and changing the way students frame challenges (framing interventions). Various other studies showed that specific educational problems can also be addressed by targeted interventions. For instance, helping first-year students with the college transition [4] [5], closing achievement gaps for racial/ethnic minority students [6] [7], motivating students to pursue science careers [8] [9], enhancing student learning outcomes [10] [11], promoting STEM career among women [12], and psychological processes relevant to the problem [13] [14] are all examples of targeted interventions.

On the other hand, an engaging first-year engineering experience can circumvent the need for interventions and has been shown to play a critical role in encouraging excitement, retention, and satisfaction in engineering [15] [16]. This is attributable to the importance of the first year and its frequent coincidence with failed classes and dropouts [17]. In addition, completion of the first-year (i.e., first-year retention) is predictive of eventual graduation rates [17]. Therefore, significant efforts have been invested by universities to support first-year engineering students, such as developing and implementing introductory engineering courses [18]. One of the most common interventions for student retention and satisfaction in engineering programs is project-based courses and other active learning-based strategies [19]–[21].

This paper presents the implementation of an introductory course (ENGR194) for first semester engineering students with the purpose of improving retention and academic success in the College of Engineering at the University of Illinois at Chicago. ENGR194, as a part of Freshman Engineering Success Program (FESP), was offered for the first time in the Fall of 2018. Its topics include math and science discussion groups, entrepreneurship challenge, four-year graduation plan development, time and stress management, undergraduate research projects and internships, discussions on how to select a major, engineering identity, math applications in engineering, and course evaluations. Combinatorial enrollment in ENGR194 and a previously described program only for S-STEM scholars (the Summer Bridge Program – SBP) [4] was used to define three comparison-groups (C-Groups) of students for comparative assessment. Various metrics such as the percentage of students who dropped out the university, the math and science grades in Fall 2018 and Spring 2019, the average cumulative GPA, and the average number of semesters until students change their major inside the College of Engineering or to a non-engineering major are compared between C-Groups.

The remaining sections of this paper are as follows: Section 2 describes the ENGR194 architecture and its main objectives. Section 3 will contain the different modules of the ENGR194. Evaluations and results will be presented in Section 4. The conclusion and future work will be discussed in Section 5. The appendix section provides the relevant details of the collected data.

Introductory Engineering Course (ENGR194) Architecture

At the University of Illinois at Chicago, FESP is a coordinated effort by six engineering departments to support students throughout their first fall semester. General sessions are led by instructors from each department and they organize break-out sessions and mini-projects in their respective disciplines. In addition, FESP provides interactions with engineering societies and junior/senior level teaching assistance to enhance early experiences and to encourage students to be self-directed in their educational planning process and overall academic success.

The ENGR194 course was designed as a complementary 1-credit course to FESP and was offered in the Fall of 2018 for the first time. Enrollment in this class was allowed for all students in the College of Engineering. The students who took this course had the opportunity to interact with professionals of different disciplines and cultural backgrounds and attend seminars and symposia on subjects including engineering identity, undergraduate research, time and stress management, and careers in STEM. Instructors for the course gave presentations on their specific disciplines and its relation to mathematics – loosely following other successful models to relate engineering concepts to mathematics. This course was also implemented to familiarize students with the engineering profession, motivate them to see themselves as future engineers, and to enhance their problem-solving skills.

A student's first year can permit positive faculty-student interactions, student-student interactions, and community building [22]. Also, programs and activities that lead to mentoring and discussion between students have been identified as best practices for retention in engineering [23]. Therefore, through ENGR194, students were placed into mathematics study groups based on their semester course registrations. ENGR194 also included team-based entrepreneurial projects which promoted communication skills and a greater sense of belonging among their peers. Further, ENGR194 also paired students with a faculty member based on their major to provide individual mentorship, which has been identified to be critical for student success [24] and a best practice for retention in engineering [23].

Introductory Engineering Course (ENGR194) Framework and Modules

Bransford et al. introduced a framework called "How People Learn" (HPL) to define an effective learning environment [25]. Their framework includes four main criteria:

- *Learner-centered*- considers an environment with the focus on students' prior skills, knowledge, attitude and belief that they bring into an institution.
- *Knowledge-centered*- refers to the interconnection between one discipline to another and helps students to become knowledgeable.
- *Assessment-centered*- helps students to revise and improve their thinking and learning process.
- *Community-centered*- considers that the environment, students and instructors form a supportive learning community in a class.

These four criteria need to be aligned such that they mutually support one another and enhance students' learning, development, and motivation towards learning [18]. The HPL framework was used to develop an effective learning environment for ENGR194.

ENGR194 has eight main modules including math and science discussion groups, developing a four-year graduation plan, major selection, entrepreneurship challenge, time and stress management, introduction to undergraduate research projects and internships, engineering identity construction, and introduction to math applications in engineering disciplines. In addition, at the conclusion of the course, a comprehensive survey was administered to evaluate the course effectiveness and assess the students' satisfaction of the course. Results from the survey are used to formulate modifications in future years.

- **Math and Science Discussion Groups:** The purpose of this module is to help students to get higher grades in their math courses and improve their learning experience. In the first session of this module, students were placed into groups of three to four. The teams decided on a communication method and planned a meeting schedule for the semester. A composition notebook was provided to each group to document their meetings and to record a brief reflection of each meetings. Students were required to bring their group notebooks to the ENGR194 class. Notebook checks were performed randomly during the semester to keep track of the learning process.
- **Four-year Graduation Plan Development:** The purpose of this module is to guide student to develop their plan for taking courses during their undergraduate years. In the first session of this module, the instructor described some important rules and guidelines regarding taking courses based on the undergraduate catalog and asked them to complete forms detailing their four-year plans that were provided to them. Students were then instructed to check their forms with their faculty mentors, modify the forms, and submit them to the ENGR194 instructor.
- **Major Selection:** The purpose of this module is to familiarize students with their chosen major. The students were asked to consider important questions regarding their major selection such as:
    - Why am I interested in this major?
    - What are the job prospects for someone who has a degree in this field?
    - Are there additional requirements/expectations beyond my B.S. degree?
    - Does this major align with my life goals?

  Then, the instructor introduced available resources for answering these types of questions such as engineering societies at the University, career services, online resources, etc.
- **Entrepreneurship Challenge:** This module had two main sessions. The first one was an introduction to entrepreneurship. During this session, students formed teams and each team was tasked with developing a business idea. They were given time to think about different aspects of their ideas such as the need for the idea, demand, novelty, designing/fabrication procedure, potential costs, and profitability. Finally, in the second session, student teams presented their ideas to faculty judges who scored the presentations and chose a winning team.
- **Time and Stress Management:** Time and stress management was introduced by experts from the Counseling Center of the University. During this module, students were taught the signs and symptoms of stress and instructed on its impacts. They were given stress management techniques and available resources at the University were shared with them. They also learned how to plan their daily schedules to better utilize their time through a group activity. A handout was given to assess what the students learned about the symptoms of stress and stress management techniques.
- **Introduction to Undergraduate Research Projects and Internships:** This module was designed to introduce students to the concept and purpose of research during undergraduate studies. The steps for getting involved in research including choosing a field of research, identifying faculty and their research interests, and arranging meetings with them were

introduced to students. Finally, opportunities in different engineering disciplines at the University were discussed via a presentation by two faculty members.

- **Engineering Identity Construction:** The objective of this module is to facilitate students' introspection and assist them in the formation of culturally affirmative identities as engineering students and future engineering professionals. The instructors provided the students with background on identity construction from published research and discussed the elements of identity through different hands-on activities. Specifically, the following topics where the focus of this module:
    - Increasing self-awareness of students with respect to the group
    - Developing strengthened relationships with others in the course
    - Ability to find readings that may assist them in constructing their own affirmative identities and finding role models
- **Introduction to Math Applications in Engineering Disciplines:** This module was designed to address why engineers need to learn mathematics – a common question among students. In this regard, various instructors representing different engineering disciplines were invited to the class to discuss the current math applications in their field of study.

Evaluation and Results

Evaluation Methods

To evaluate the effectiveness of ENGR194 on retention and academic success of first-year engineering students, three different C-Groups are defined by the combinations of enrollment in this class and the SBP:

- C-Group 1 consisted of 18 students who had taken ENGR194 in Fall 2018 and had participated in SBP of Summer 2018.
- C-Group 2 consisted of 21 students who had taken ENGR194 in Fall 2018 but did not participate in the SBP of Summer 2018.
- C-Group 3 consisted of 272 students who had taken neither ENGR194 in Fall 2018 nor the SBP of Summer 2018.

We further divided C-Groups 2 and 3 into two sub-groups to evaluate the impact of PELL-eligibility (low-income). C-Group 1 is not broken because all the students in this comparison group are PELL-eligible.

- C-Group 2.1 consisted of eight low-income students
- C-Group 2.2 consisted of 13 students who are not low-income.
- C-Group 3.1 consisted of 93 low-income students
- C-Group 3.2 consisted of 179 students who are not low-income.

Notably, the SBP is only offered for S-STEM scholars and was not available for other College of Engineering students, like ENGR194 was. Further, all S-STEM scholars were required to enroll in ENGR194 as part of their augmented curriculum.

In addition, all the students in the three C-Groups are academically (based on their high school GPA and ACT/SAT score) comparable. For being academically comparable, we use Selective Index (SI) which is a metric introduced by the College of Engineering at the University of Illinois at Chicago for admission purposes [26]. SI is calculated using a linear regression model with standard admission GPA and composite ACT as its inputs, and it ranges from 0 to 40. An SI score of 26 was the cutoff to qualify for the S-STEM Scholarship. Table 1 provides SI statistics for all C-Groups. There was no apparent difference in SI between C-Groups, suggesting all comparison groups were academically comparable.

Table 1. SI statistics for each C-Group

Metrics	**C-Groups**						
	1	**2**	**2.1**	**2.2**	**3**	**3.1**	**3.2**
Sample Size	18	21	8	13	272	93	179
Min of SI	30	30	30	31	30	30	30
Mean of SI	33.16	33.44	33.75	33.25	32.66	32.32	32.83
Max of SI	38	39	39	38	38	38	38

Results and Discussion

The following metrics were evaluated between the C-Groups: the percentage of students who dropped out of the University after their first year, average cumulative GPA, average math and science grades of the students in their first two semesters (Fall 2018 and Spring 2019). Moreover, for the students who changed their major, the average number of semesters until a student changed their major (both within and outside the College of Engineering) was compared using Fisher Exact probability test. All statistical tests performed using R version 3.6.2. Statistical significance was accepted at $P \leq 0.05$.

Table 2 presents the percentages of students with a major change and dropout from the University and Table 3 indicates results of the statistical test for comparing the proportion of major change between different C-Groups.

These results indicate that the percentage of students who changed their majors within the College of Engineering in the first semester in C-Group 1 and C-Group 1&2 (included all 39 students who took ENGR194 course) is greater than that proportion for C-Group 3. In other words, students from C-Group 1 decided to change their majors inside the College of Engineering earlier than C-Group 3. Also, under the significant level of 95 percent, there is a significant difference between the proportion of C-Group 1 students who changed their major during the first semester and that proportion of C-Group 2 students. In other words, the percentage of C-Group 1 students who changed their major in the first semester is greater than the percentage of C-Group 2 students who changed their major in the first semester. However, these results are not conclusive between C-Groups 2 and 3 (p-value for comparing C-Groups 2 and 3 is greater than 5 percent). We think that the SBP has had an important impact on C-Group 1 regarding the major change in the first semester, but ENGR194 does not seem to have a significant impact on the major change during the first semester.

Table 2. Average percentage of major changes and dropout for C-Groups

Metrics \ C-Groups	1	2	2.1	2.2	3	3.1	3.2
Major Change **Inside** Eng. in 1st Semester	27.78 %	0.0 %	0.0 %	0.0 %	4.41 %	5.38 %	3.91 %
Major Change **Outside** Eng. in 1st Semester	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Major Change **Inside** Eng. in 2nd Semester	5.60 %	0.0 %	0.0 %	0.0 %	1.84 %	4.30 %	0.56 %
Major Change **Outside** Eng. in 2nd Semester	0.0 %	0.0 %	0.0 %	0.0 %	1.84 %	3.23 %	1.12 %
Major Change **Inside** Eng. in 3rd Semester	0.0 %	4.76 %	0.0 %	7.69 %	1.10 %	1.08 %	1.12 %
Major Change **Outside** Eng. in 3rd Semester	0.0 %	0.0 %	0.0 %	0.0 %	1.47 %	3.23 %	0.56 %
Dropped Out After 1st year	5.60 %	14.29%	37.50 %	0.0 %	9.56 %	5.38 %	11.73 %

Table 3. Statistical analysis of the major changes in the first semester for C-Groups

C-Groups	N	P-value
C1	18	0.01488
C2	21	
C1&2	39	0.04745
C3	272	
C1	18	0.00200
C3	272	
C2	21	0.4024
C3	272	

Another important observation is that no students in C-Groups 1 and 2 switched to a major outside engineering within the University of Illinois at Chicago. However, 3.31% of students in C-Group 3 switched to a non-engineering major during their first two semesters. Again, this is considered a direct impact of ENGR194 and its success in retaining engineering students within the College of Engineering.

The results also reveal that the percentage of students who dropped out of the university is 5.6%, and 9.56% for C-Groups 1 and 3, respectively. Even though, the hypothesis test of the equality of the proportions cannot be rejected (P-value = 0.8373), it can be concluded that both Summer Bridge Program and ENGR194 course have had a positive impact on the first-year retention rate. Also, the dropout rate for C-Group 2.1 which includes eight low-income students who took ENGR194 but not supported by the S-STEM Scholarship, is 37.50 %. The same rate for C-Group 2.2 which includes 13 PELL-ineligible students who took ENGR194 and were not supported by the S-STEM Scholarship is 0. Due to the low sample sizes of these two groups, we are unable to statistically draw any conclusions about the difference between the dropout rates of their corresponding populations. However, we suspect that the reason for the large difference between the dropout rates of these two samples could be that the economically disadvantaged status of the students in C-Group 2.1, and therefore their inability to pay for their education, has forced three of these students to leave the University.

Table 4 represents the average number of credit hours, college GPAs, and their cumulative for each semester of Fall 2018 and Spring 2019 for all C-Groups.

Table 4. Average hours and GPAs of C-Groups

C-Groups	Term Hours		Term GPA		Cum. Hours	Cum. GPA
	Fall 18	Spring 19	Fall 18	Spring 19		
C-Group 1	16.55	15.28	3.48	3.42	31.83	3.45
C-Group 2	16.57	16.04	3.64	3.42	32.62	3.53
C-Group 2.1	16.37	15.25	3.62	3.30	31.63	3.47
C-Group 2.2	16.69	16.54	3.66	3.49	33.23	3.57
C-Group 3	14.58	14.36	3.25	3.11	28.94	3.18
C-Group 3.1	14.61	14.68	3.22	3.06	29.29	3.14
C-Group 3.2	14.56	14.20	3.27	3.13	28.74	3.20

To evaluate the impact of ENGR194 on the cumulative GPA using statistical testing, we consider two main groups including C-Group 1&2 and C-Group 3 (272 students not registered in ENGR194). In addition, the effect of PELL status was determined by comparing groups including C-Group 1&2 with PELL eligibility criteria (18 students of C1 and 8 students of C2.1) and C-Group 3.1 (with 93 students). Table 5 and Figure 1 show the details of the cumulative GPA and box plots for the comparison groups.

Table 5. Cumulative GPA analysis of C-Groups

Groups		N	Mean	SD	Min	Q1	Median	Q3	Max
Not Pell Eligible	1&2	39	3.49	0.55	1.34	3.41	3.70	3.84	4.00
	3	272	3.18	0.87	0.56	2.88	3.50	3.84	4.00
Pell Eligible	1&2	26	3.45	0.62	1.34	3.41	3.40	3.63	4.00
	3	93	3.16	0.84	0.56	2.88	2.81	3.46	4.00

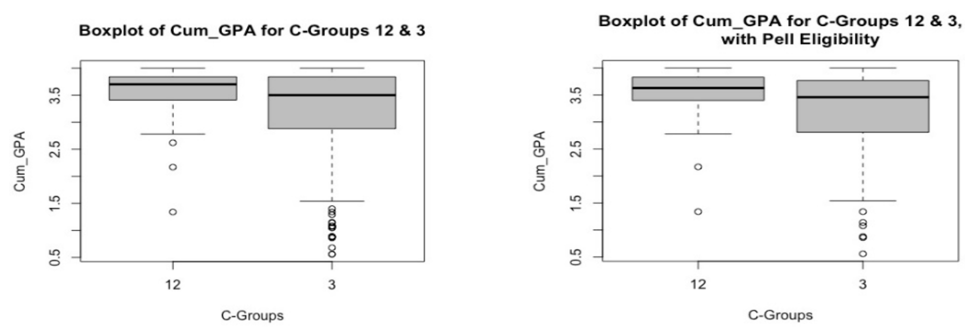

Figure 1. Boxplots of C-Groups

Since the distribution of the cumulative GPA does not follow the Normal distribution (the details are presented in Figure 2 and Table 9 in the appendix), nonparametric one-tailed Mann-Whitney U test is performed to evaluate the effectiveness of ENGR194 course on cumulative GPA for the defined C-Groups.

As Table 6 shows, for C-Groups 1&2 and 3, students who took ENGR194 had better cumulative GPAs in comparison with those did not take the course.

On the other hand, for PELL-eligible groups the impact of ENGR194 on GPAs of low-income students is not significant. In other words, we cannot conclude that low-income students who attended ENGR194 had better performance in terms of the cumulative GPA in comparison with low-income students who did not attend the course.

Table 6. Mann Whitney U-test comparison for C-Groups

Groups		N	W	P-value
Not Pell Eligible	1&2	39	W= 6259.5	0.03441
	3	272		
Pell Eligible	1&2	26	W= 1464	0.05065
	3	93		

Table 7 presents the number of students from different C-Groups who registered in the main math and science courses during the Fall 2018 and Spring 2019 semesters. For sample size considerations, we chose Calculus I (Math 180) to perform statistical analysis, since the majority of students from all C-Groups took that course.

Table 7. Number of students registered in math and science courses for all C-Groups

C-Groups	1	2	2.1	2.2	1 & 2	1 & 2-Pell	3	3.1	3.2
Total Sample Size	18	21	8	13	39	26	272	93	179
MATH 180	12	10	3	7	22	15	172	68	104
MATH 181	12	16	5	11	28	17	181	65	116
MATH 210	5	8	5	3	13	10	65	17	48
PHYS 141	8	14	6	8	22	14	70	22	48
PHYS 142	2	1	0	1	3	2	6	2	4
CHEM 122	8	10	3	7	18	11	114	40	74

Tables 10 through 15 (in the appendix section) represent the average percentage of grades in math and science courses including MATH 180, 181, and 210, PHYS 141 and 142, and CHEM 122 that considered the main courses should be taken by the first-year engineering students, for all C-Groups.

To evaluate the impact of ENGR194 on Math 181, we performed Chi-squared and Fisher Exact probability tests for comparing the proportion of students with grades A, B and D, F between different groups. The results are presented in Table 8.

The results reveal that the differences are not significant. In other words, we cannot conclude that the students who took ENGR194 have had a better performance (proportion of A and B grades) in Math181 in comparison with the students who did not take that course. Also, the results are not conclusive for the poor performance (category of D and F grades) in the same groups that means taking ENGR194 did not have a positive or negative impact on performance in Math 181. Therefore, we consider revising this module to offer ENGR194 course for the second time at the University of Illinois at Chicago.

Table 8. Statistical analysis of the Math181 grades for C-Groups

Grade Category	Groups	N	P-value ki-squared	P-value Fisher
A and B grades	1&2	28	0.1792	0.2684
	3	181		
D and F grades	1&2	28	0.7320	0.6657
	3	181		

Conclusion and Future Work

The goal of this paper is to evaluate the effect of an introductory engineering course called ENGR194 on retention and academic success of the first-year freshman engineering students. The HPL framework has been employed to design the learning environment in both teaching and learning activities to develop students' skills and help them to get involved with various activities to attain the knowledge effectively.

Based on the results, it is clear that both C-Groups (C-Groups 1 and 2) of the students who attended ENGR194 have gained a wide range of advantages from this course as part of their preparation to become engineers. These students had significantly higher cumulative GPAs and their University dropout rate after the first year was lower, and C-Group 1 had the lowest percentage. This assessment shows that both the SBP and ENGR194 course as part of the S-STEM Scholarship support system have had a significant positive impact on retaining first-year engineering students. It is critical to continue assessment, maintenance, and adaptation to fit the evolving needs of the future engineers in order to have a successful course curriculum in any subject [27]. Lessons learned from our experience can be used to build a successful introductory engineering course. We will continue to evaluate the effectiveness of our support system in academic success and retention of first-year engineering students.

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Appendix

Figure 2 shows the plots for the comparison groups. The histograms and Q-Q plots show that the distribution of the cumulative GPA does not follow the Normal distribution. The results of the normality tests presented in Table 9 also confirm that.

Table 9. P-value of Normality test methods for cumulative GPA for C-Groups

Groups/ Method		Jarque Bera (J-B)	Shapiro-Wilk (S-W)	Anderson-Darling (A-D)	Kolmogorov-Smirnov (K-S)
Not PELL-Eligible	**1&2**	6.338e-13	4.612e-06	2.986e-06	0.08832
	3	<2.2e-16	<2.2e-16	<2.2e-16	1.048e-07
PELL Eligible	**1&2**	2.174e-07	7.481e-05	8.74e-05	0.1247
	3	1.911e-07	1.977e-08	1.886e-11	0.1032

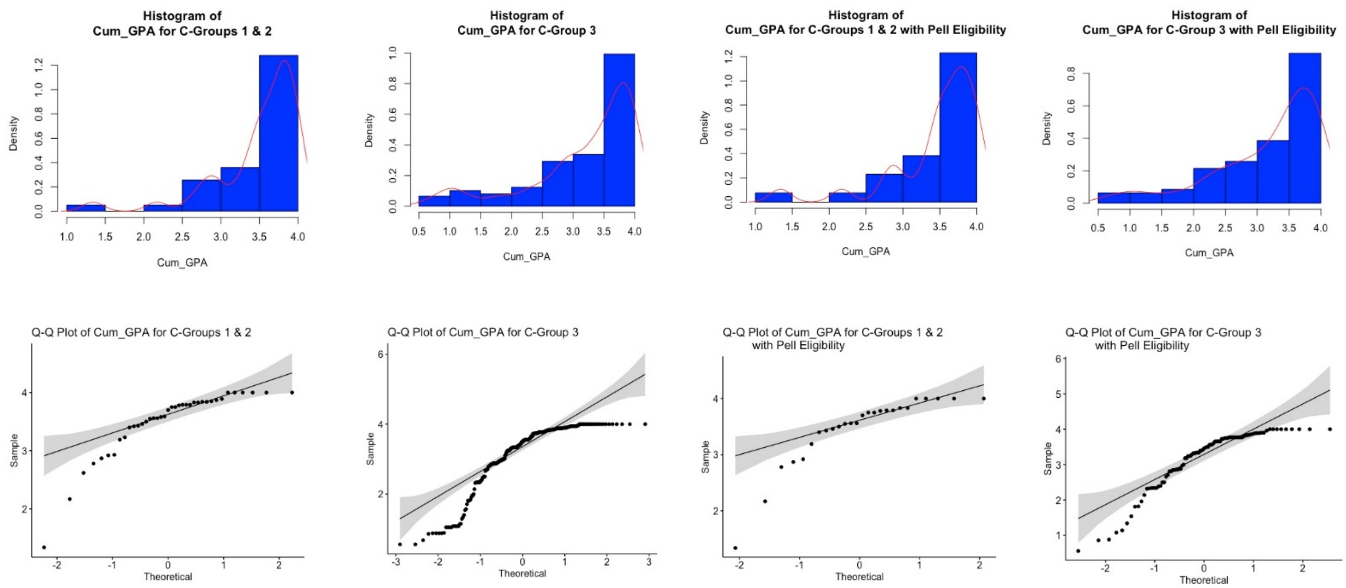

Figure 2. Histogram and Q-Q Plots of Comparison Groups

Tables 10 through 15 represent the average percentage of grades in math and science courses for C-Groups.

Table 10. Average percentage of grades in Math 180 of C-Groups

Grades \ C-Groups	1	2	2.1	2.2	3	3.1	3.2
A	50	80	100	71	48	41	52
B	25	20	0	29	32	35	30
C	8	0	0	0	16	22	11
D	17	0	0	0	4	2	5
F	0	0	0	0	1	0	2

Table 11. Average percentage of grades in Math 181 of C-Groups

Grades \ C-Groups	1	2	2.1	2.2	3	3.1	3.2
A	84	50	80	64	45	42	47
B	0	44	20	27	38	37	37
C	0	6	0	9	12	15	10
D	8	0	0	0	3	5	3
F	8	0	0	0	2	1	3

Table 12. Average percentage of grades in Math 210 of C-Groups

Grades \ C-Groups	1	2	2.1	2.2	3	3.1	3.2
A	100	75	60	100	66	76	63
B	0	25	40	0	23	12	27
C	0	0	0	0	7	6	8
D	0	0	0	0	2	6	0
F	0	0	0	0	2	0	2

Table 13. Average percentage of grades in PHYS 141 of C-Groups

Grades \ C-Groups	1	2	2.1	2.2	3	3.1	3.2
A	64	14	0	26	24	23	25
B	0	43	33	50	29	27	29
C	12	36	67	12	29	27	29
D	12	7	0	12	11	18	8
F	12	0	0	0	7	5	8

Table 14. Average percentage of grades in PHYS 142 of C-Groups

Grades \ C-Groups	1	2	2.1	2.2	3	3.1	3.2
A	100	0	-	0	50	0	75
B	0	100	-	100	50	100	25
C	0	0	-	0	0	0	0
D	0	0	-	0	0	0	0
F	0	0	-	0	0	0	0

Table 15. Average percentage of grades in CHEM 122 of C-Groups

Grades \ C-Groups	1	2	2.1	2.2	3	3.1	3.2
A	63	40	33	43	20	13	24
B	0	40	33	43	45	55	39
C	27	20	33	14	32	30	33
D	0	0	0	0	2	0	4
F	0	0	0	0	1	2	0

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