Students' Perceptions on Challenge Based Instruction

Fernando A. Flor[1], Xiaohui Wang[1], Cristina Villalobos[1], Robert Freeman[2],
Stephen W. Crown[2], Horacio Vasquez[2]

[1]School of Mathematical & Statistical Sciences, University of Texas –
Rio Grande Valley, Edinburg, Texas 78539, United States
[2]Mechanical Engineering Department, University of Texas –
Rio Grande Valley, Edinburg, Texas 78539, United States

Abstract
A form of problem-based learning, Challenge Based Instruction (CBI) is developed upon the philosophical framework of "How People Learn", which illustrates that for a learning environment to be effective, it must possess four common dimensions (pictured above): a focus on knowledge, the learner, assessment and the community (Bransford et al 1999). Therefore, CBI incorporates important cognitive and affective elements recommended for retaining underrepresented minority students (Altschuld & White, 2006; Boaler, 2002). A challenge begins with an open-ended problem followed by the opportunity to generate ideas and questions about the challenge. Then, students encounter multiple perspectives on the issue and have the opportunity to revise their initial ideas in light of new information. In the final phases of CBI, students test their developing understanding of the challenge before going public with a final response.

In this project, we employed pre- and post-surveys to assess students' perceptions of CBI in various STEM (Science, Technology, Engineering, and Mathematics) classes. Participants of the survey included college students in a STEM course, high school students enrolled in the Dual Enrollment Engineering Academy program, and high school students enrolled in the fourth year TexPREP program in the past two years.

Key Words: Challenge Based Instruction, Survey

1. Introduction

Until fairly recently, the quest to comprehend the underlying aspects of the human mind remained an elusive task – as the very nature of the human brain proves to be more intricate than we can possibly imagine. However, as humanity's technological prowess unfurls, an unstoppable outpour of scientific work on the brain and mind brought about auspicious outcomes leading to our overall comprehension of the mind – including the processes of learning and thinking, made possible by the mind.

John D. Bransford's pedagogical findings – in the subject of cognitive science – rid one of the typical elusive trap one finds when attempting to understand the mysterious nature of the mind. In *How People Learn: Brai*n, *Mind, Experience and School*, Bransford identifies technological advances as providing a fuller understanding of memory, knowledge, problem solving, early foundations of learning – including "metacognition" – and symbolic thinking emerging from the culture and community of the learner.

Bransford claims that in order for a learning environment to be effective, it must possess four common dimensions explicitly focusing on: knowledge, the learner, assessment, and community.

Knowledge-Centered Environments serve as a catalyst for students to comprehend and transfer information effectively. Such environments provide sufficient grounds for learners to learn their way through any discipline of their choice. In such environments, learners develop mental heuristics closely related to the acquisition of knowledge and become more apt at making sense of abstract ideas.

Learner-Centered Environments focus on the knowledge, skills, attitudes, and beliefs that learners bring to the educational setting — each individual is encouraged to incorporate their individual life experiences with the learning process. Ultimately, learners can make effective connections between their subjective experiences of reality and their respective subject matter.

Assessment-Centered Environments are an efficient way of providing feedback and revision to both the teacher and the learner to gauge the progress of the entire implementation of any pedagogical method. Formative assessments are used to provide feedback to improve both learning and teaching, while summative assessments are used to measure learner' outcomes at the end of activities. It is important to accept assessment as paramount for designing, implementing and carrying out a learning environment aimed at learner progression.

Community-Centered Environments encourage a sense of community amongst all learners. Some aspects regarded and included as a part of a microcosmic community – other than the classroom – are the school, the learner's home, and the connection these all have with the broader community. Understanding the importance of community is crucial for academic achievement.

Challenge Based Learning (CBI) methods – those based on a so-called "Legacy Cycle" – guide the student through a regulated pedagogical odyssey. In the Legacy Cycle, Instructors emulate research-based environments in order to transform students into independent thinkers. The cycle guides students through the routine any veteran researcher follows in order to develop any professional research work.

Challenge Based Instruction begins by initially asking a challenge question, mainly causing the student to think deeply about the current topic under discussion. The individual student is encouraged to exploit any a priori perceptions regarding said question. Moreover, all students are then prompted to communicate with one another in order to construct a "game-plan" for developing their research. Once the group identifies their necessary strategy, they are then provided resources – books, articles, outside experts – to provide a wider lens for their topic. Then, the students seek additional information they deem necessary and revise their original ideas based on new findings. After that, the students are asked to "test their mettle" in order to re-evaluate their knowledge and perhaps seek out additional information – as in the previous step. Once the above is resolved, the students are free to conclude their work and bring forth their *magnum opus* to the public.

One is able to easily identify an abundant overlap between the Legacy Cycle and the all too familiar scientific method. It is thus the purpose of CBI to develop individuals into efficient independent researchers.

The purpose of this study was to assess students' perception CBI implementations across various classes from different location in the South Texas region known as the Rio Grande Valley.

2. Methods

To gauge students' perception of CBI, pre and post surveys were distributed to three groups of students:

1. Dual Enrollment Engineering Academy (DEEA) that was hosted at South Texas College. We used data from the years of 2014 and 2015.

   A new "Introduction to STEM" course was developed and taught for the first time during the summer of 2009 to dual-enrollment college students at South Texas College (STC). During 2009 and 2010, 53 and 57 students, respectively, took the "Introduction to STEM" course. This course is taught simultaneously at the McAllen and Weslaco STC campuses. CBI with hands-on activities was implemented in this new course; challenges, lecture and handout materials, hands-on activities, and assessment tools were developed and implemented in the areas of basic electronics, mechatronics, renewable energy, statics, dynamics, chemistry, reverse engineering, and forward engineering.

2. Texas Pre-Freshman Engineering Program (TexPREP) that was hosted at University of Texas-Pan American. We used data from year 2014.

   The TexPREP program is a four-year academic program that runs seven weeks each summer serving middle and high school students. The curriculum for the first three years of the TexPREP program is well-established and consistent among the 35 TexPREP sites. Only a handful of TexPREP sites offer a fourth year program and our DoD project developed a generalized curriculum that delivers STEM content in a CBI framework with challenges.

3. A research course offered by the Department of Political Science (C-POLS), which falls in the domain of STEM courses, at the University of Texas-Pan American. We used data from the 2015 spring semester.

The surveys were collected and analyzed initially to identify the overall perception of the CBI implementation. Although the specific survey questions differed across the three groups, each focused precisely on the individual students' affective and cognitive experiences. Categorical variables – such as level of agreement to a certain statement regarding the use of challenges – were used to determine the overall perspective of CBI amongst these groups in the end-affect surveys. Students were asked to gauge their level of agreement with a 5-Likert scale (strongly disagree, disagree, neutral, agree and strongly agree).

Other variables, such as gender, grade point average, and status as a First-Generation College Student (FGCS) were identified in order to provide additional insight on the

effect of CBI on said metrics. Terenzi et al (1996) identify FGCS as a student coming from a low-income home who is the first in their family to pursue a postsecondary education. Additionally, the College Board claims any student without a college-going tradition to qualify as a FGCS. In this study we adopted a rather flexible interpretation of what it means to be a FGCS. Any student whose grandparents and parents did not receive a Bachelor's degree – or whose college attendance is unknown – is considered a FGCS. Moreover, we considered sibling impact: a FGCS student may or may not be the eldest in their generation and therefore his/her older sibling's education experience is likely to impact on him/her. In this manner, we developed a wider scope when identifying such individuals using an Exceptional First Generation College Student (EFGCS) status. The EFGCS status has three levels: "No" indicating the student was not FGCS; "Yes" indicating the student was FGCS but had at least an older sibling with college experience; "Yes[2]" indicating the student was not only FGCS but also without any older sibling who had college experience. It is worth to point out that for high school students in DEEA and TexPREP programs, their FGCS status were based on the assumption that they went to college. Therefore, FGCS and EFGCS serve as family influence indicators for all participants in our study.

The main focus of our study was to assess students' perceptions on CBI in various classes. Students were mostly Hispanic students from the Rio Grande Valley, Texas. Among all three groups (DEEA, TexPREP, and C-POLS), we studied whether the status of an individual as a FGCS or EFGCS had any impact on their overall grade point average, their expected performance in the program, their expected time studying for class, and their self-perceived Mathematics and Science backgrounds. Additionally, we attempted to see if those perceptions were also jointly influenced by a student's gender.

We performed a series of descriptive and inferential statistics procedures to determine if there exists any significant differences in the way these groups perceive their own abilities as well as the pedagogical methods they underwent. The SPSS and R softwares were used for statistical analysis.

3. Results

3.1 Distributions among factors

The distributions among gender, FGCS and EFGCS status are shown in Table 1 for three groups of students.

Table 1. Gender, FGCS and EFGCS status distributions.

Program		Gender		FGCS		EFGCS		
		Male	Female	No	Yes	No	Yes	Yes^2
C-POLS	Pre (N=22)	8 (36%)	14 (64%)	10 (45%)	12 (55%)	10 (45%)	7 (32%)	5 (23%)
	Post (N=24)	11 (46%)	13 (54%)	13 (54%)	11 (46%)	13 (54%)	5 (21%)	6 (25%)
DEEA	Pre (N=55)	34 (62%)	21 (38%)	38 (69%)	17 (31%)	38 (69%)	9 (16%)	8 (15%)

	Post (N=55)	34 (62%)	21 (38%)	40 (73%)	15 (27%)	40 (73%)	7 (13%)	8 (15%)
TexPREP	Pre (N=31)	24 (77%)	7 (23%)	24 (77%)	7 (23%)	24 (77%)	4 (13%)	3 (10%)
	Post (N=27)	22 (82%)	6 (19%)	18 (67%)	9 (33%)	18 (67%)	6 (22%)	3 (11%)

We observed that the percentages of FGCS among DEEA and TexPREP students are no more than one-third, which is low. In the C-POLS group, there were about 50% of FGCS students, which is less than the 68% of FGCS ratio claimed by the university (OIRE 2013). Another interesting finding is that the female student percentages among the three groups are opposite: there were less female enrollments in DEEA and TexPREP than in the college level political sciences course. If we defined "underrepresented" as composing less than half of the entire sample, the female students and FGCS students were underrepresented in DEEA and TexPREP programs. On the other hand, in the college setting, the case is totally different and at least half of the group were female student or FGCS students.

Table 2. Students' perception of course difficulty level and their expected grades, and expected study hours (for each subgroup of students) at the beginning.

Program	Perception of difficulty level	Expected Grade and Study Hours				
		A/Excellent	B/Good	C/Fair	Unknown	total
C-POLS	Easy	1 (4.5%) Expected study hours: 4	--	--		1 (4.5%)
	Moderate	10 (45.5%) Expected study hours: mean=6.95, SD=3.2	6 (27.3%) Expected study hours: mean=3.2, SD=0.75	--		16 (72.7%)
	Difficult	4 (18.2%) Expected study hours: 4.83, SD=3.01	--	1 (4.5%) Expected study hours: 10		5 (22.7%)
	total	15 (68.2%)	6 (27.3%)	1 (4.5%)		22
DEEA	Easy	3 (5.5%)	--	--	--	3 (5.5%)
	Moderate	29 (52.7%)	6 (10.9%)	--	--	35 (63.6%)
	Difficult	11 (20%)	4 (7.3%)	1 (1.8%)	1 (1.8%)	17 (30.9%)
	total	43 (78.2%)	10 (18.2%)	1 (1.8%)	1 (1.8%)	55
TexPREP	Easy	3 (9.7%)	--	--	--	3 (9.7%)
	Moderate	9 (29%)	9 (29%)	1 (3.2%)	2 (6.5%)	21 (67.7%)
	Difficult	3 (9.7%)	--	2 (6.5%)	2 (6.5%)	7 (22.6%)
	total	15 (48.4%)	9 (29%)	3 (9.7%)	4 (12.9%)	31

Next, we examine the C-POLS students' perception on their respective course's difficulty

level and their expected grade, as well as their expected weekly study hours for this course at the beginning of the semester. We found that there were a little less than half of the college students who viewed the course at a moderate difficulty level claimed that they expected an "A" grade, and expected themselves to spend relatively longer weekly study hours (mean=6.95 hours) for the course. However, about 30% of the college students who also viewed the course at a moderate difficulty level claimed that they expected a "B" grade, and expected to spend shorter weekly study hours (mean=3.2 hours) for the course. It was interesting that there were about 20% of college students who viewed the course at difficult level but expected to get an "A" grade, while they expected to study an average of 4.83 weekly hours for the course.

Six percent (6%) of the DEEA participants and 10% of TexPREP participants felt the programs' material was easy, while 31% of the DEEA participants and 23% for TexPREP participants felt it was difficult.

3.2 Significant findings on C-POLS students' perceptions

Students' self-reported confidence levels on their mathematics and science backgrounds that are supposed to help them succeed in the class were collected in pre survey. For C-POLS students, the average confidence levels on their mathematics background was 65 (out of 100 of total score) with standard deviation of 29.49, and the average confidence levels on their science background was 67.86 (out of 100 of total score) with standard deviation of 26.15. Neither gender nor FGCS groups had an impact on students' confidence levels.

Via different survey statements in the post survey, we examined students' perception on the challenges they experienced. Table 3 provides students' perceptions according to gender and FGCS groups using cross-tabs, as well as hypothesis testing results.

Table 3. Cross-tab with hypothesis testing results for C-POLS students' perceptions.

Survey Statements	Rating levels and percentage		Gender		FGCS	
			Male	Female	No	Yes
Sample size	N=24		10	14	12	12
I enjoyed the class	Neutral	3 (12.5%)	1 (10%)	2 (14.3%)	0	3 (25%)
	Agree	9 (37.5%)	5 (50%)	4 (28.6%)	4 (33.3%)	5 (41.7%)
	Strongly Agree	12 (50%)	4 (40%)	8 (57.1%)	8 (66.7%)	4 (33.3%)
			Fisher exact test: p=0.63		Fisher exact test: p=0.15	
I found that the challenges in this course were confusing	Strongly disagree	2 (8.3%)	0	2 (14.3%)	2 (16.7%)	0
	Disagree	12 (50%)	5 (50%)	7 (50%)	6 (50%)	6 (50%)
	Neutral	6 (25%)	3 (30%)	3 (30%)	3 (25%)	3 (25%)

	Agree	4 (16.7%)	2 (20%)	2 (14.3%)	1 (8.3%)	3 (25%)
			Fisher exact test: p= 0.75		Fisher exact test: p= 0.51	
Working together with classmates helped my overall learning experience	Disagree	1 (4.2%)	0	1 (7.1%)	0	1 (8.3%)
	Neutral	6 (25%)	3 (30%)	3 (21.4%)	1 (8.3%)	5 (41.7%)
	Agree	9 (37.5%)	4 (40%)	5 (35.7%)	5 (41.7%)	4 (33.3%)
	Strongly Agree	8 (33.3%)	3 (30%)	5 (35.7%)	6 (50%)	2 (16.7%)
			Fisher exact test: p= 0.99		Fisher exact test: p= 0.12	
The challenges did nothing to enhance my learning	Disagree	9 (37.5%)	5 (50%)	4 (28.6%)	7 (58.3%)	2 (16.7%)
	Neutral	10 (41.7%)	5 (50%)	5 (35.7%)	3 (25%)	7 (58.3%)
	Agree	3 (12.5%)	0	3 (21.4%)	1 (8.3%)	2 (16.7%)
	Strongly Agree	2 (8.3%)	0	2 (14.3%)	1 (8.3%)	1 (8.3%)
			Fisher exact test: p= 0.30		Fisher exact test: p= 0.16	
The work with challenges has motivated me to pursue my education in a STEM discipline (from two questions)	Disagree	12 (50%)	6 (60%)	6 (42.9%)	7 (58.3%)	5 (41.7%)
	Neutral	9 (37.5%)	3 (30%)	6 (42.9%)	5 (41.7%)	4 (33.3%)
	Agree	3 (12.4%)	1 (10%)	2 (14.3%)	0	3 (25%)
			Fisher exact test: p= 0.85		Fisher exact test: p= 0.28	
The challenges helped me apply my knowledge that I attained in lecture (from two questions)	Disagree	2 (8.3%)	1 (10%)	1 (7.1%)	1 (8.3%)	1 (8.3%)
	Neutral	4 (16.7%)	0	4 (28.6%)	2 (16.7%)	2 (16.7%)
	Agree	18 (75%)	9 (90%)	9 (64.3%)	9 (75%)	9 (75%)
			Fisher exact test: p= 0.13		N/A	
I enjoyed the overall experience with challenges (from two questions)	Disagree	1 (4.2%)	0	1 (7.1%)	0	1 (8.3%)
	Neutral	1(4.2%)	0	1 (7.1%)	0	1 (8.3%)
	Agree	22 (91.7%)	10 (100%)	12 (85.7%)	12 (100%)	10 (83.3%)
			Fisher exact test: p= 0.99		Fisher exact test: p= 0.48	

We found that gender and FGCS status did not have a significant impact on C-POLS students' perceptions. In summary, 91.7% of students agreed that they enjoyed the overall experience with challenges; the majority (87.5%) of students enjoyed the C-POLS course; 70.8% of the students agreed or strongly agree that working together with classmates helped their overall learning experience; 75% of students agreed that the challenges helped them to apply knowledge that they attained in lecture. On the other hand, a little more than one-third (37.5%) of students disagreed that the challenges did nothing to enhance their learning while 41.7% had a neutral opinion on this; a small portion (16.7%) of students in the course agreed that the challenges were confusing while a quarter of students had neutral opinion on this; only 12.4% of students agreed on that the work with challenges has motivated them to pursue education in a STEM discipline. The low agreement on the challenges effect on motivating pursuing STEM education is possibly because the college students taking C-POLS course had already determined their non-STEM majors.

3.3 Significant findings on DEEA students' perceptions

Students' self-reported confidence levels on their mathematics and science backgrounds that are supposed to help them succeed in DEEA program were collected in pre survey. For DEEA students, the average confidence levels on their mathematics background was 89 (out of 100 of total score) with standard deviation of 14.04. Neither gender nor FGCS groups had an impact on students' confidence levels in their mathematics background. The average confidence levels on their science background was 84.88 (out of 100 of total score) with standard deviation of 13.12. When examining gender effect, we found that male students (mean=89, SD=10.25) had significant higher confidence (p-value=0.001, 95% CI of the difference=5.11~18.36) on their science background than female students (mean=77.61, SD=14.2). FGCS groups did not yield significant impact on students' confidence levels on their science background.

Via different survey statements in the post-survey, we examined DEEA students' perception on the pedagogical methods they underwent. Table 4 provides students' perceptions according to gender and FGCS groups using cross-tabs, as well as hypothesis testing results.

Table 4. Cross-tab with hypothesis testing results for DEEA students' perceptions.

Survey Statements	Rating levels and percentage		Gender		FGCS	
			Female	Male	No	Yes
Sample size	N=55		21	34	40	15
I enjoyed the class and overall experience of working with challenges (from two questions)	Neutral	2 (3.6%)	0	2 (5.9%)	1 (2.5%)	1 (6.7%)
	Agree	53 (96.4%)	21 (100%)	32 (94.1%)	39 (97.5%)	14 (93.3%)
			Fisher exact test: p=0.52		Fisher exact test: p=0.48	
I found that the challenges in this	Strongly disagree	3 (5.5%)	1 (4.8%)	2 (5.9%)	3 (7.5%)	0

course were confusing	Disagree	21 (38.2%)	6 (28.6%)	15 (44.1%)	16 (40%)	5 (33.3%)
	Neutral	21 (38.2%)	12 (57.1%)	9 (26.5%)	14 (35%)	7 (46.7%)
	Agree	10 (18.2%)	2 (9.5%)	8 (23.5%)	7 (17.5%)	3 (20.0%)
			Fisher exact test: p= 0.15		Fisher exact test: p= 0.82	
Working together with classmates helped my overall learning experience	Disagree	1 (1.8%)	1 (4.8%)	0	1 (2.5%)	0
	Neutral	5 (9.1%)	1 (4.8%)	4 (11.8%)	5 (12.5%)	0
	Agree	21 (38.2%)	8 (38.1%)	13 (38.2%)	14 (25%)	7 (46.7%)
	Strongly Agree	28 (50.9%)	11 (52.4%)	17 (50%)	20 (50%)	8 (53.3%)
			Fisher exact test: p= 0.61		Fisher exact test: p= 0.54	
The challenges did nothing to enhance my learning	Strongly disagree	31 (56.4%)	10 (47.6%)	21 (61.8%)	22 (55%)	9 (60%)
	Disagree	21 (38.2%)	10 (47.6%)	11 (32.4%)	15 (37.5%)	6 (40%)
	Neutral	3 (5.5%)	1 (4.8%)	2 (5.9%)	3 (7.5%)	0
			Fisher exact test: p= .60		Fisher exact test: p= .79	
This program has motivated me to study a STEM discipline in college (from two questions)	Disagree	6 (10.9%)	3 (14.3%)	3 (8.8%)	5 (12.5%)	1 (6.7%)
	Neutral	11 (20%)	5 (23.8%)	6 (17.6%)	8 (20%)	3 (20%)
	Agree	38 (69.1%)	12 (61.9%)	25 (73.5%)	27 (67.5%)	11 (73.3%)
			Fisher exact test: p= 0.56		Fisher exact test: p= 0.99	
The challenges helped me apply my knowledge that I attained in lecture (from three questions)	Disagree	0	0	0	0	0
	Neutral	0	0	0	0	0
	Agree	54 (100%)	21 (100%)	33 (100%)	39 (100%)	15 (100%)
			N/A		N/A	

We found that gender and FGCS status did not have a significant impact on DEEA students' perceptions. In summary, all students agreed that the challenges helped them to apply knowledge that they attained in lecture; almost all (96.4%) of the students agreed that they enjoyed the class and overall experience working with challenges; almost all (95.6%) of the students disagreed or strongly disagreed that the challenges did nothing to

enhance their learning; 89.1% of the students agreed or strongly agreed that working together with classmates helped their overall learning experience. On the other hand, a small portion (18.2%) of students in the course agreed that the challenges were confusing while about one-third (38.2%) of students had a neutral opinion on this. Most importantly, 69.1% of students agreed that the program has motivated them to study a STEM discipline in college, and this percentage was 61.9% for female students and 73.5% for male students.

3.4 Significant findings on TexPREP students' perceptions

Students' self-reported confidence levels on their mathematics and science backgrounds that are supposed to help them succeed in TexPREP program were collected in pre survey. For DEEA students, the average confidence levels on their mathematics background was 89.25 (out of 100 of total score) with standard deviation of 19.91. Neither gender nor FGCS groups had an impact on students' confidence levels in their mathematics background. The average confidence levels on their science background was 81.27 (out of 100 of total score) with standard deviation of 25.58. When examining gender effect, we found that male students (mean=87.17, SD=20.98) had significant higher confidence (p-value=0.016, 95% CI of the difference=5.13~47.11) in their science background than female students (mean=61.04, SD=32.74). FGCS groups did not yield significant impact on students' confidence levels on their science background.

Via different survey statements in the post survey, we examined TexPREP students' perception on the pedagogical methods they underwent. Some of the survey statements focused on comparing the 4th year TexPREP program with the previous years' TexPREP program and students' school work. Table 5 provides students' perceptions according to gender and FGCS groups using cross-tabs, as well as hypothesis testing results.

Table 5. Cross-tab with hypothesis testing results for TexPREP students' perceptions.

Survey Statements	Rating levels and percentage		Gender		FGCS	
			Male	Female	No	Yes
Sample size	N=27					
The program did not change my level of interest in STEM disciplines for college	Strongly Disagree	3 (11.1%)	3 (13.6%)	0	2 (11.1%)	1 (11.1%)
	Disagree	4 (14.8%)	4 (18.2%)	0	3 (16.7%)	1 (11.1%)
	Neutral	14 (51.9%)	11 (50%)	3 (60%)	9 (50%)	5 (55.6%)
	Agree	3 (11.1%)	2 (9.1%)	1 (20%)	2 (11.1%)	1 (11.1%)
	Strongly Agree	3 (11.1%)	2 (9.1%)	1 (20%)	2 (11.1%)	1 (11.1%)
			Fisher exact test: p= 0.79		Fisher exact test: p= 0.99	
Compared to the knowledge that I obtained from the previous years'	Strongly disagree	3 (11.1%)	3 (13.6%)	0	3 (16.7%)	0
	Disagree	4 (14.8%)	4 (18.2%)	0	2 (11.1%)	2 (22.2%)

TexPREP programs, the knowledge I gained this 4th year TexPREP program benefits my understanding and interests of STEM the most	Neutral	6 (22.2%)	4 (18.2%)	2 (40%)	3 (16.7%)	3 (33.3%)
	Agree	10 (37%)	9 (40.9%)	1 (20%)	7 (38.9%)	3 (33.3%)
	Strongly Agree	6 (22.2%)	2 (9.1%)	2 (40%)	3 (16.7%)	1 (11.1%)
			Fisher exact test: p= 0.31		Fisher exact test: p= 0.67	
This program has motivated me to study a STEM discipline in college	Strongly Disagree	2 (7.4%)	2 (9.1%)	0	2 (11.1%)	0
	Disagree	4 (14.8%)	4 (18.2%)	0	3 (16.7%)	1 (11.1%)
	Neutral	10 (37.1%)	7 (31.8%)	2 (40%)	5 (27.8%)	4 (44.4%)
	Agree	5 (18.5%)	4 (18.2%)	1 (20%)	2 (11.1%)	3 (33.3%)
	Strongly Agree	6 (22.2%)	4 (18.2%)	2 (40%)	5 (27.8%)	1 (11.1%)
			Fisher exact test: p= 0.93		Fisher exact test: p= 0.55	
Compared to my regular school classes, this 4th year TexPREP program is more beneficial to my understanding and interests in STEM	Strongly Disagree	5 (18.5%)	5 (22.7%)	0	5 (27.8%)	0
	Disagree	2 (7.4%)	2 (9.1%)	0	0	2 (22.2%)
	Neutral	6 (22.2%)	4 (18.2%)	2 (40%)	4 (22.2%)	2 (22.2%)
	Agree	8 (29.6%)	7 (31.8%)	1 (20%)	4 (22.2%)	4 (44.4%)
	Strongly Agree	6 (22.2%)	4 (18.2%)	2 (40%)	5 (27.8%)	1 (11.1%)
			Fisher exact test: p= 0.61		Fisher exact test: p= 0.09	
The projects and/or assignments helped me apply my previous knowledge that I attained in lecture (from two questions)	Disagree	8 (29.6%)	8 (36.4%)	0	5 (27.8%)	3 (33.3%)
	Neutral	11 (40.7%)	9 (40.9%)	2 (40%)	9 (50%)	2 (22.2%)
	Agree	8 (29.6%)	5 (22.7%)	3 (60%)	4 (22.2%)	4 (44.4%)
			Fisher exact test: p= 0.22		Fisher exact test: p= 0.45	
Compared to the previous 3 years' TexPREP programs, I rate the 4th year	Strongly Disagree	3 (11.1%)	2 (9.1%)	1 (20%)	2 (11.1%)	1 (11.1%)
	Disagree	6 (22.2%)	5 (22.7%)	1 (20%)	3 (16.7%)	3 (33.3%)
	Neutral	4 (14.8%)	4 (18.2%)	0	4 (22.2%)	0

TexPREP program as the most enjoyable one	Agree	10 (37.1%)	8 (36.4%)	2 (40%)	6 (33.3%)	4 (44.4%)
	Strongly Agree	4 (14.8%)	3 (13.6%)	1 (20%)	3 (16.7%)	1 (11.1%)
			Fisher exact test: p= 0.95		Fisher exact test: p= 0.60	
Compared to regular classes in my school, the 4th year TexPREP program with projects and assignments is more enjoyable	Strongly Disagree	5 (18.5%)	5 (22.7%)	0	5 (27.8%)	0
	Disagree	1 (3.7%)	1 (4.5%)	0	1 (5.6%)	0
	Neutral	7 (25.9%)	5 (22.7%)	2 (40%)	5 (27.8%)	2 (22.2%)
	Agree	10 (37%)	9 (40.9%)	1 (20%)	3 (16.7%)	7 (77.7%)
	Strongly Agree	4 (14.8%)	2 (9.1%)	2 (40%)	4 (22.2%)	0
			Fisher exact test: p= 0.31		Fisher exact test: p= .02	
I do not like the 4th year TexPREP program	Strongly Disagree	6 (22.2%)	4 (18.2%)	2 (40%)	4 (22.2%)	2 (22.2%)
	Disagree	9 (33.3%)	8 (36.4%)	1 (20%)	5 (27.8%)	4 (44.4%)
	Neutral	5 (18.5%)	4 (18.2%)	1 (20%)	3 (16.7%)	2 (22.2%)
	Agree	3 (11.1%)	2 (9.1%)	1 (20%)	3 (16.7%)	0
	Strongly Agree	4 (14.8%)	4 (18.2%)	0	3 (16.7%)	1 (11.1%)
			Fisher exact test: p= 0.63		Fisher exact test: p= 0.82	
Working together with classmates on projects and assignments helped my learning a lot	Strongly Disagree	2 (7.4%)	2 (9.1%)	0	1 (5.6%)	1 (11.1%)
	Disagree	1 (3.7%)	0	1 (20%)	1 (5.6%)	0
	Neutral	8 (29.6%)	6 (27.3%)	2 (40%)	4 (22.2%)	4 (44.4%)
	Agree	10 (37%)	9 (40.9%)	1 (20%)	8 (44.4%)	2 (22.2%)
	Strongly Agree	6 (22.2%)	5 (22.7%)	1 (20%)	4 (22.2%)	2 (22.2%)
			Fisher exact test: p= 0.37		Fisher exact test: p= 0.63	
This 4th year TexPREP program did nothing to	Strongly Disagree	7 (25.9%)	4 (18.2%)	3 (60%)	5 (27.8%)	2 (22.2%)
	Disagree	10 (37%)	10 (45.5%)	0	5 (27.8%)	5 (55.6%)

enhance my learning	Neutral	3 (11.1%)	3 (13.6%)	0	3 (16.7%)	0
	Agree	4 (14.8%)	2 (9.1%)	2 (40%)	3 (16.7%)	1 (11.1%)
	Strongly Agree	3 (11.1%)	3 (13.6%)	0	2 (11.1%)	1 (11.1%)
			Fisher exact test: p= 0.04		Fisher exact test: p= 0.71	
I found that the challenges were confusing	Strongly Disagree	3 (11.1%)	3 (13.6%)	0	1 (5.6%)	2 (22.2%)
	Disagree	11 (40.7%)	10 (45.5%)	1 (20%)	6 (33.3%)	5 (55.6%)
	Neutral	6 (22.2%)	3 (13.6%)	3 (60%)	4 (22.2%)	2 (22.2%)
	Agree	7 (25.9%)	6 (27.3%)	1 (20%)	7 (38.9%)	0
			Fisher exact test: p= 0.20		Fisher exact test: p= 0.12	

In terms of gender effect, we found that a student's gender only significantly impacted a students' perception the 4th year TexPREP; explicitly stating that the program did nothing to enhance their learning. A majority of female students clearly indicated to strongly disagree (60%) on the aforementioned while male students' perception had the full spectrum of agreements: 18.2% strongly disagree, 45.5% disagree, 13.6% neutral, 9.1% agree and 13.6% strongly agree.

In terms of FGCS effect, we found that a student's status as a first generation college student only significantly impacted students' perception on the 4th year TexPREP program relative to regular school classes. FGCS generally rated the 4th year TexPREP program with projects and assignments as being most enjoyable. FGCS students clearly indicated agree (77.7%) on said statement, while (22.2%) took a neutral position. Non-FGCS students' perception had the full spectrum of agreements: 27.8% strongly disagree, 5.6% disagree, 27.8% neutral, 16.7% agree and 22.2% strongly agree when asked if the CBI methods used in their classes were enjoyable.

It is also worth noting that FGCS status yielded toward significant (p-value = 0.09) impact on students' perception on that compared to regular school classes, this 4th year TexPREP program was more beneficial to their understanding and interests in STEM. There were no FGCS students who provided a strongly disagree rating, while 27.8% of non-FGCS students gave a strong disagree rating; no non-FGCS students gave a disagree rating, while 22.2% FGCS students gave a disagree rating; there were 22.2% of non-FGCS students who gave a rating of agree while 44.4% of FGCS student gave an agree rating; there were 27.8% of non-FGCS student who gave a strongly agree rating, while only 11.1% FGCS students gave a strongly disagree rating.

We found that 70.3% of students agreed that the projects and/or assignments helped them to apply previous knowledge that they attained in lecture. About half of the students gave agreed or strongly agreed on the following aspects:

- Compared to the knowledge that I obtained from the previous years' TexPREP programs, the knowledge I gained in this 4th year TexPREP program benefits my understanding and interests of STEM the most.
- Compared to the previous 3 years' TexPREP programs, I rate the 4th year TexPREP program as the most enjoyable one.
- Working together with classmates on projects and assignments helped my learning a lot
- I found that the challenges were confusing

We found that only 22.2% of students rated agree or strongly agree to the statement that the program did not change their level of interest in STEM disciplines for college; and only a quarter of students rated agree or strongly agree to the statement that they did not like the 4th year TexPREP program.

4. Conclusion

The scope of our study was to determine whether or not CBI methods had any effect on the manner in which any particular student, regardless of their individual status, perceived their respective course. We examined the proportions of each group consisting of female students, FGCS and EFGCS; these partitions provided additional insight in the aforementioned manner. Firstly, it became apparent that FGCS compose the underrepresented partition in both the DEEA and TexPREP student bodies. On the other hand, in the C-POLS group, FGCS made up approximately half of the student body, which is still lower than the proportion of FGCS at the University of Tecas – Rio Grande Valley. Incidentally, in terms of the percentages female students amongst DEEA, TexPREP and C-POLS students, we observed opposing results emerging. There were fewer female students enrolled in DEEA and TexPREP courses than in the college level political science course.

When it came to indentifying college students' perception on the C-POLS course's difficulty, less than half who rated it at a moderate level also claimed to expect an "A" grade in the course. Moreover, the C-POLS students rating the course at a moderate level also expected themselves to spend relatively longer weekly study hour in preparation for class. About one-third of these C-POLS students rating their course at a moderate difficulty expected to receive a "B" grade and also expected to spend shorter weekly study hours for the course – a possible by-product of FGCS having to work daily to support themselves. Six percent (6%) of the DEEA participants and 10% of TexPREP participants rated the programs' material as "easy", while 31% of the DEEA participants and 23% for TexPREP participants felt it was difficult.

The most striking results from our study surfaced as we examined the categorical responses the students provided in their respective surveys; these responses were all produced as an attempt to gauge the students' perception of their experiences with the CBI methods. We found that gender and FGCS status did not have a significant impact on C-POLS students' perceptions. Such low agreements, particularly in regards of motivating students to pursue a STEM education, could be a direct consequence of the C-POLS student's predetermined career path and degree plan. Moreover, We found that gender and FGCS status did not have a significant impact on DEEA students' perceptions. In terms of gender effect, for the TexPREP group, we found that a student's gender only significantly impacted a students' perception the 4th year TexPREP. Female TexPREP students were found more likely to strongly disagree with the statement claiming the TexPREP program does nothing to enhance their learning. It is also worth

noting that FGCS status yielded toward significant impacted on students' perception on that compared to regular school classes, this 4th year TexPREP program was more beneficial to their understanding and interests in STEM. Our findings suggest that all together, most students have a propensity to take a liking to the CBI method than not. Questions of interest arising from such findings may wish to probe exactly why it would be the case that these subgroups find CBI methods more helpful than any of their counterparts; such questions provide framework for future work in the subject.

Acknowledgements

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