‘Plus Two’ Peer-Led Team Learning Improves Student Success, Retention, and Timely Graduation

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Abstract – A ‘Plus Two’ strategy has integrated Peer-Led Team Learning (PLTL) as a required component of first semester general chemistry at the University of Texas at El Paso (UTEP). Since fall 2000, the C-or-better passing rate has improved from the historic average near 53% to the current rate above 70%, translating into an additional 160 students successfully progressing each year into their science, engineering, and mathematics majors. In 2006 the Plus Two Peer-Led Chemistry Program at UTEP earned the Star Award from the Texas Higher Education Coordinating Board for its innovative active-learning curriculum intervention for improving student success, retention, and timely graduation in the engineering and science disciplines. Plus Two substitutes two hours of Workshop: small-group, active learning guided by an undergraduate STEM student (Peer Leader) for one hour of large section lecture per week in the three-credit-hour chemistry course. Retention of students for the four semesters subsequent to the Plus Two innovation improved from 70% to 75% and the number of students receiving undergraduate degrees within nine semesters jumped from approximately 34% to 47%. A National Science Foundation award (DUE - 0653270) entitled I-STAR: Integrated Student Success, Teaching, and Retention, has now extended the Plus Two strategy to six other large section lower division courses leading to STEM degrees at UTEP.

Index Terms –Graduation rate, Peer-led team learning, Retention, Student success, Undergraduate majors.

‘Plus Two’ Successes at UTEP

A pedagogy of engagement [1] to embed student-centered [2], active [3], small-group [4], collaborative [5] learning in several large service courses in science and mathematics has evolved at the University of Texas at El Paso (UTEP) that has implications for student performance and retention [6] in Engineering, Science and Mathematics disciplines. In fall 2000, the Plus Two [7] Workshop Model was successfully integrated within the first semester general chemistry course at UTEP. The formal linking of Workshop and lecture under the Plus Two Model embeds Peer-Led Team Learning (PLTL) [8, 9, 10] into the curriculum in a required, integrated fashion so that all students enrolled take part in the benefits of the student-engaged PLTL intervention. Plus Two Peer-Led Workshop has led to markedly improved student success in this course and in following courses based on retention in subsequent semesters and timeliness to degree.

Plus Two Workshop has provided an innovative PLTL strategy for enhancing student success in first semester general chemistry (Figure 1). This course is a gatekeeper course because every undergraduate student at UTEP intending a major in engineering, science, and mathematics must pass this first semester general chemistry course with a grade of C or better in order to gain entry into their respective STEM major. The results of the Plus Two Workshop intervention strategy have been significant and have dramatically improved the flow-through to STEM majors at UTEP. The dramatic data break seen in Figure 1 at year 2001 gives evidence for the effectiveness of the Workshop intervention in this course.

In each one of the past five years, Plus Two Workshop has resulted in approximately 100 more engineering students and 50 more science students per year (based on the approximate 2 to 1 engineering to science enrollment in the course) successfully progressing into their majors at UTEP. Inclusion of the Plus Two PLTL Workshop has an effect beyond this one course. A novel (for PLTL) aspect to the Plus Two Workshop program at UTEP is the incorporation...
Semesters than students who took general chemistry prior to
higher retention rates for each of the four subsequent
in the 'Plus Two' PLTL general chemistry courses showed
These data show a residual effect on retention. Students
taking first semester general chemistry (3rd), etc.
returned to take at least one course the third semester after
taking first semester general chemistry (2nd), those who
enrolled at UTEP the next semester (1st), those students who
enrolled in first semester general chemistry and subsequently
intervention). The bar graphs represent students who
the period which included the Plus Two PLTL Workshop
Workshop Model] or 2001 – 2004, the program data during
UTEP but prior to implementation of the Plus Two PLTL
intervention and three cohorts subsequent to the
intervention (in fall 2001, spring 2002, or fall 2002) were
considered in this analysis.

Figure 2 shows the Relative Retention rates for students
subsequently re-enrolling at UTEP for each of the four
consecutive semesters after taking the first semester general
chemistry course.

The percentages given in Figure 2 represent the
accumulated percentages of all the students within the stated
period (either 1997 – 2000 [i.e. during the period of NSF
Model Institutions of Excellence funding and intervention at
UTEP but prior to implementation of the Plus Two PLTL
Workshop Model] or 2001 – 2004, the program data during
the period which included the Plus Two PLTL Workshop
intervention). The bar graphs represent students who
enrolled in first semester general chemistry and subsequently
enrolled at UTEP the next semester (1st), those students who
returned to take at least one course the second semester after
taking first semester general chemistry (2nd), those who
returned to take at least one course the third semester after
taking first semester general chemistry (3rd), etc.

These data show a residual effect on retention. Students
in the ‘Plus Two’ PLTL general chemistry courses showed
higher retention rates for each of the four subsequent
semesters than students who took general chemistry prior to
the implementation of ‘Plus Two’ PLTL Chemistry Workshop.

Furthermore, differences were analyzed between the two
sets of cohorts in the timeliness to graduation (Figure 3).
Four cohorts of students prior to the ‘Plus Two’ PLTL
Workshop intervention and three cohorts subsequent to the
intervention (in fall 2001, spring 2002, or fall 2002) were
considered in this analysis.

For the four cohorts prior to the implementation, an average
of 32.8% of the students had earned a degree by the 4 ½ year
mark. In contrast, 45% of the students taking the ‘Plus Two’
PLTL general chemistry intervention had earned the
undergraduate degree by the 4 ½ year mark. All these data
clearly demonstrate that ‘Plus Two’ PLTL Workshop has
had a significant positive impact on UTEP student success:
in the course, in subsequent semesters, and in timeliness to
degree.

THE ‘PLUS TWO’ MODEL

The Texas Higher Education Coordinating Board forbids
adding a required component onto a course already
consisting of the number of hours of lecture equal to the
number of semester credit hours for such course (e.g. three
credit hours for a course consisting of three lectures per
week). The ‘Plus Two’ Workshop Model changed the
credit hour first semester general chemistry course in fall
2000 from the format of three hours of large section lecture
to the new format of just two hours of large section lecture
per week. By “trading for” one hour of lecture per week,
room was made for incorporating this rich, new learning
experience, the PLTL Workshop, a comprehensive team-
based, small-group learning environment, led by a trained
Peer Leader. At the time of registration, students enrolling
in first semester general chemistry must link the enrollment
in lecture with simultaneous enrollment in a Workshop
section. They now receive two hours of lecture plus two
hours of required small group instruction per week overseen
by an undergraduate Peer Leader. ‘Plus Two’ PLTL
Workshop has now been fully integrated into the first
semester general chemistry curriculum and impacts every student enrolled in this large service course at UTEP.

Students enrolled in ‘Plus Two’ Workshop are grouped into workshops of about 12 students; each workshop section meets for two hours per week and is guided by one undergraduate Peer Leader. Peer Leaders use active learning methods to build learning teams and to strengthen student understanding of chemical principles. Peer Leaders use Workshop to conduct two kinds of guided activities with their students: 1) collaborative problem solving and report out conducted in a room with tables and 2) hands-on activities called Explorations (described below) conducted in a laboratory.

Not all Peer leaders are majoring in chemistry: In fact, only about half the Peer Leaders in general chemistry have historically been chemistry majors. This diversity helps the Peer Leaders relate to their Workshop students.

In order to accommodate the large number of students enrolled in the first semester general chemistry service course (now about 850 students annually), inclusion of the small group Workshop innovation requires training and oversight of a team of about 15 undergraduate Peer Leaders within the first semester general chemistry instructional process during the long semesters. ‘Plus Two’ Workshop training occurs through annual several-day training sessions, weekly preview and review sessions and by holding monthly Saturday retreats with the Peer Leaders.

GOALS OF PLTL WORKSHOP

At its onset in fall 2000, the main goal of the ‘Plus Two’ intervention strategy in chemistry was to improve student performance (pass rate with grade of A, B, or C) in course. This has clearly been demonstrated. A second goal was to encourage students to consider the undergraduate major in chemistry. Much to the surprise of the instructors in the course, this has also been borne out! Compared to data from other institutions, the Chemistry Majors’ data from UTEP are impressive (Figure 4).

EXPLORATIONS

Explorations [11] are short (30-minute) hands-on activities that provide real-world examples of chemical processes of a more descriptive and qualitative nature than the rather lengthy experiments conducted in the usual, ‘regular’, chemistry laboratory course. This three-clock hour, one credit hour laboratory course still exists for both semesters of general chemistry at UTEP. But by academic year 2000-2001, almost one third of the students enrolling in first semester general chemistry lecture were no longer enrolling in the parallel three-clock-hour wet chemistry laboratory course. This deficiency in hands-on experience for one-third of the students resulted from the decision in the mid 1990’s of some engineering disciplines here to release their students from the requirement to co-enroll in the parallel three-hour laboratory. At about the same time as ‘Plus Two’ Workshop was introduced into the first semester experience, an NSF Model Institutions of Excellence grant provided funding to modify a small lecture room into a modern teaching laboratory. This lucky coincidence of physical building modification and significant program modification enabled us to address the lack of hands-on laboratory experience for a large fraction of the students in the general chemistry curriculum.

Explorations are guided inquiry. They cloak ‘the lion’ of fundamental science in the ‘sheep’s clothing’ of fun stuff. They brew interest in teaching as they ferment interest in learning.

• Explorations allow students to feel, hear, smell, and see chemistry in action
• They help to develop good observational skills and usually require no data taking nor data manipulation
• Explorations do not duplicate nor are they intended to replace the usual three-clock-hour “wet chemistry laboratory” experience which parallels most chemistry lecture courses.
• Students experience chemistry; then reach conclusions about the reactions taking place.
• Explorations offer a springboard for Peer Leaders to ask and to model student development of the Why, . . . ?
  How, . . . ? questions: the “Important” first step so necessary to developing good critical thinking by students in chemistry
• They provide the experiential fodder for simple ‘Writing to Learn’ practice exercises the Peer Leaders ask ‘on the spot’ of their Workshop students
• They provide a memorable experience opportunity for Peer Leaders to use later in the course for ‘Circular Learning’ (e.g. Bad Breath Indicator first used as an example of acid, then later as an example of Lewis acid/base chemistry).
Observation of simple reactions helps build an understanding of chemical processes, chemical “thinking.” Students experience a sensory (usually visual) event, then have to grapple with what is happening chemically. One goal of “doing” the Explorations is for students to give good chemical explanations of the science taking place in their own words rather than to provide the opportunity for students to perform sets of calculations or plot graphs of the data they collect.

Professors often choose to do “lecture demonstrations” to spur student interest and to provoke a more personal student connection to science. In many ways Explorations provide this motivational, more personal connection and the ‘fun’ aspect of the Exploration activities may be partially responsible for the significant trend observed in Figure 4. The students themselves are “doing the demonstrations.” Explorations also provide ample opportunity for Peer Leaders to ask questions to engage their students.

**NEW DIRECTIONS**

The Chemistry Peer Leader Program received the Texas Higher Education Coordinating Board STAR Award [12] in November 2006. Because of the extraordinary success of this program, the National Science Foundation recently awarded to UTEP a Science Talent Expansion Program grant named I-STAR, ‘Integrated Student Success, Teaching, and Retention’ (DUE-0653270) to extend the Plus Two Workshop format into six other courses at UTEP: second semester general chemistry; first semester non-majors’ organic chemistry; first semester majors’ organic chemistry; first semester calculus-based general physics; second semester calculus-based general physics; and the large pre-calculus service course for the institution.

To date, more than ninety Peer Leaders have been involved within the first semester general chemistry ‘Plus Two’ Workshop program at UTEP. With the inclusion of the fledgling I-STAR Program Peer Leaders, this number is now more than 130 undergraduates since fall 2000.

The Plus Two Program and the results discussed here also address the 2005 National Academy of Sciences’ call for broadening participation and preparing the next generation of STEM professionals and for producing more and better-trained STEM teachers [13]. An unexpected, but significant, additional benefit of the Plus Two Workshop Program at UTEP has been to increase the number of students who are considering middle school and high school teaching as a career. This may well have taken place by virtue of the extensive opportunity Peer Leaders have leading groups of students in a significant learning environment. Peer Leaders guide students to help each other with the course material; they direct student-centered learning. PLTL Workshop provides real clinical practice to Peer Leaders, one of the three essential characteristics for modern teacher preparation recommended by the Carnegie Corporation’s Teachers for a New Era Program [14]. The undergraduate peer leaders are helping their fellow students succeed in STEM disciplines; many are finding themselves engaged and intrigued with instruction – the kind of engagement allowing them to visualize a lifetime devoted to learning and teaching in a secondary and tertiary educational capacity [15].

**REFERENCES**


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