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Fostering A Positive Collaborative Learning Experience in an Optional Student Success Program

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Abstract: The evolution of a student success program for the gatekeeper general chemistry course at a primarily STEM focused university is discussed with regards to student participation and program effectiveness. The program advanced from its beginnings as a minimally utilized study session into a peer-assisted active-learning environment with significant participation. The current model shares similarities with typical supplemental instruction models consisting of a problem-solving workshop with instructor and peer-led support, and a focus on active collaborative learning. The program provides incoming students, most of which are non-chemistry majors, an opportunity to improve their academic skills through peer interactions resulting in higher levels of performance in the college environment. Student participation in the program was significantly strengthened through campus-wide advertisement and the incorporation of a small, tangible incentive. Participation and course performance data indicate enhanced student success for those attending the non-mandatory sessions at least once a week.

Key words: STEM education, general chemistry, gatekeeper course, supplemental instruction, collaborative learning, non-mandatory attendance

1. Introduction

Institutions of higher education often implement programs to help students improve their academic skills. The main focus of these programs is to assist underrepresented, high-risk, or lower-performing students, particularly freshmen, in achieving their academic goals (Glennen & Baxley, 1985; Huang et al., 2003; Inglis et al., 2011; Karlen, 2003; McClenney, 2012; Schwitzer & Thomas, 1998). While there is no shortage of evidence toward the benefits of these programs (Glennen & Baxley, 1985; Karlen, 2003; McClenney, 2012; Schwitzer & Thomas, 1998), college educators frequently experience that “students don’t do optional” when it comes to academic resources and assistance (McClenney, 2012; Mendler, 2015; Schwitzer & Thomas, 1998). Making these programs mandatory is often considered necessary to get students to participate and acquire the benefits (Mendler, 2015; Schwitzer & Thomas, 1998). This paper discusses the longstanding, non-mandatory Learning Enhancement Across Disciplines (LEAD) program (Winiarz, 2016) at Missouri University of Science & Technology (Missouri S&T) and its development from a minimally utilized general-chemistry study session into a peer-assisted, active-learning environment with widespread participation.

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LEAD is a non-mandatory student success program that began in 2001 as an introductory-physics-course learning center. Generally, LEAD sessions utilize aspects of both supplemental instruction (Congos, 1993; Lundeberg, 1990) and learning community models (Smith, 1991). Keeping with a typical supplemental instruction model (Congos, 1993), LEAD sessions were facilitated by course instructors and undergraduate peer learning assistants (PLA) to monitor student progress and guide them in problem solving strategies. PLAs were chosen by the campus-wide LEAD program director based on their current overall GPA score (minimum of 3.6) but only if they received a letter grade of "A" in the course to which they would be assigned (Bieniek & Winiarz, 2015). The program grew into a campus-wide assistive instructional tool for any course in which it is deemed beneficial. Currently over 50 courses spread across 15 academic departments and disciplines are conducting activities under this LEAD program (Winiarz, 2015). As students advance to higher-level courses LEAD remains a consistent aspect of their college life, making the program not only beneficial for incoming freshmen but also a learning aid as students continue to advance towards their degree.

2. General Chemistry LEAD Program

One of the largest courses to utilize LEAD is the first-semester general chemistry course (CHEM 1310), the first in a series of two general chemistry courses. Many majors require this course and for most students it is the first basic science course at the university. Enrollment in the course typically exceeds 1,000 students annually with more than 80% of those students being freshmen. The course is taken primarily by students pursuing engineering degrees while only 15% major in chemistry-related disciplines. Students often find general chemistry to be more challenging than expected because many enter the college environment with insufficient time-management skills and a lack of study skills necessary for timely progress toward graduation. As incoming freshmen, they spend much of their time developing new social groups and transitioning to the new environment of a college campus (Bailey, 2009; Barnett et al., 2013; Hicks & Heastie, 2008; NCPPHE, 2010). These conditions can lead to students experiencing substantial anxiety over a "sink-or-swim" situation if there is only limited support to develop academic skills and not enough opportunities to improve desired behavioral skills (soft-skills) such as work ethics, time management, self-reliance, persistence, and responsibility (Andrews & Higson, 2008; Robles, 2012).

For CHEM 1310, LEAD was initially implemented as optional supplemental-instruction session to foster collaborative learning. In spite of this intention, students often used these sessions as a place to complete their homework or other assignments, frequently with minimal peer interaction. Because students who attended LEAD appeared to show improvement in their course performance, changes were made to encourage a larger number of students to participate. This was considered to be especially important for the high number of first-semester non-chemistry majors enrolled in the course who may be intimidated, frustrated, or frightened by the amount and depth of material covered in the course.

Prior to 2009, LEAD sessions experienced a fairly consistent daily attendance around 1% of all students enrolled in CHEM 1310 on each day sessions were offered which is consistent with previous research (McClenney K., 2012; Mendler A., 2015). To increase this rather low participation, the benefits of LEAD sessions were advertised campus-wide with large promotional posters. In addition, session attendance was strongly encouraged for all students but especially for those experiencing difficulties with the course material. The number of attendances and time per attendance were tracked using a card reader to swipe student IDs as they entered and left the room of the session. To further encourage participation a tangible incentive (Norcross et al., 1993;

Padilla-Walker et al., 2005) in the form of a point of extra credit was offered for each day a student would attend a LEAD session for at least 30 minutes. This gave them the opportunity to earn up to 40–50 extra points, which was less than 5% of the total points assigned in the course. During the first semester that these changes were implemented attendance increased to around 10% of all students enrolled in the course on each day when LEAD was offered. However, students attending during this initial phase of enhancement again focused primarily on homework and other assignment completion.

Subsequent changes in the General Chemistry LEAD program were implemented after three years of steadily increasing attendance. It was observed that a number of students would attend sessions only to receive the extra-credit points while not actually putting forth an effort towards improving their study skills or the mastery of the course material. Hence, in 2012 the small-group collaboration sessions were converted into an enhanced program of peer-led problem solving and self-testing. In this enhanced LEAD, chairs and tables were removed from the session room and replaced by chalk and dry-erase boards. Students were not permitted to use the sessions for homework completion but instead additional practice problems were provided to help students master course material. The practice problems ranged in difficulty from basic concept practice to advanced material requiring the combination of several chemical and physical theories. Because research suggests that student-student interaction strongly promotes student success, collaboration among students was encouraged for establishing social contacts and developing communication skills (Johnson & Johnson, 1985; Kuh et al., 2008). Due to the consistently high utilization of the program, extra credit was viewed less necessary and reduced to a maximum of about 2% of all points possible (20-30 points).

The increasing attendance required more assistance, which was provided by the chemistry department through hiring additional undergraduate PLAs. The role of these additional assistants was to aid students in approaching a problem (Kopp, 2000) but not to lecture on chemistry or solve problems with or for the students. PLAs were selected based on their communication skills and how well they facilitated an active-learning environment, rather than focusing on grade point averages, chemical knowledge, or the student's major, which is typical in many supplemental instruction models (Congos, 1993; Lundeberg, 1990). Weekly meetings were used to discuss upcoming course material and share issues PLAs may have encountered while guiding students.

One additional small, but noteworthy change was replacing the ID card reader affixed to the wall at the entrance of the LEAD room with a mobile swipe card reader kept by the instructor. This change was initially made to prevent students from swiping their card and garnering extra credit points without actually attending, or swiping for other students who are not attending. However, the change to a mobile ID card reader offered the additional benefits of facilitating a direct interaction between student and instructor, and providing a comfortable and casual first student-instructor contact. Anecdotally, this made both students and instructor feel more connected, which in turn may assist with intrinsic motivation and course engagement (Gasiewski, 2012).

3. Student Impact

During the initial semester of implementing the extra-credit incentive for participation, 58% of students attended at least one session with 27% of students participating in five or more sessions; five sessions is equivalent to one week of attendances or one attendance per written exam. Student participation at sessions experienced a near continual increase with 86% of enrolled students attending at least once, and 52% of enrolled students attending five or more sessions during 2014. The only exception to the increase in attendance occurred in

2013, which may be attributed to changing from the more traditional model to the enhanced sessions, where a completion of homework or other assignments was not permitted. More complete attendance information is summarized in Table 1.

Table 1 Percentage of Student Participation in General Chemistry I LEAD Sessions by Number of Attendances

Year	Attended	Number of Attendances					
	LEAD (%)	0 (%)	1–4 (%)	5–9 (%)	10–14 (%)	15–20 (%)	> 20 (%)
2009	58.80	41.20	31.20	12.00	4.27	2.93	8.40
2010	68.47	31.53	29.42	12.27	5.67	6.33	14.78
2011	70.88	29.12	28.06	13.70	9.57	7.18	12.37
2012	78.59	21.41	28.86	17.29	9.31	6.52	16.62
2013	77.96	22.04	31.53	18.72	11.33	8.74	7.64
2014	86.44	13.56	34.58	20.40	10.70	10.20	10.57

Participation determined through student ID tracking data.

From the data in Table 1, a virtually stable session attendance is evident for the 1–4 attendances range while attendance ranges of 5–9, 10–14, and 15–20 experienced substantial growth. This notable increase shows that, over the years, students learned to appreciate participation, even after changing to the enhanced model.

While the goal of increasing participation was fairly successful, it is equally important to determine the impact of LEAD on student learning and performance. Figure 1 indicates that changes in the program did not significantly change the pass-fail rate in the course. It shows however, that among those who passed, LEAD has become an ever more popular assistive tool.

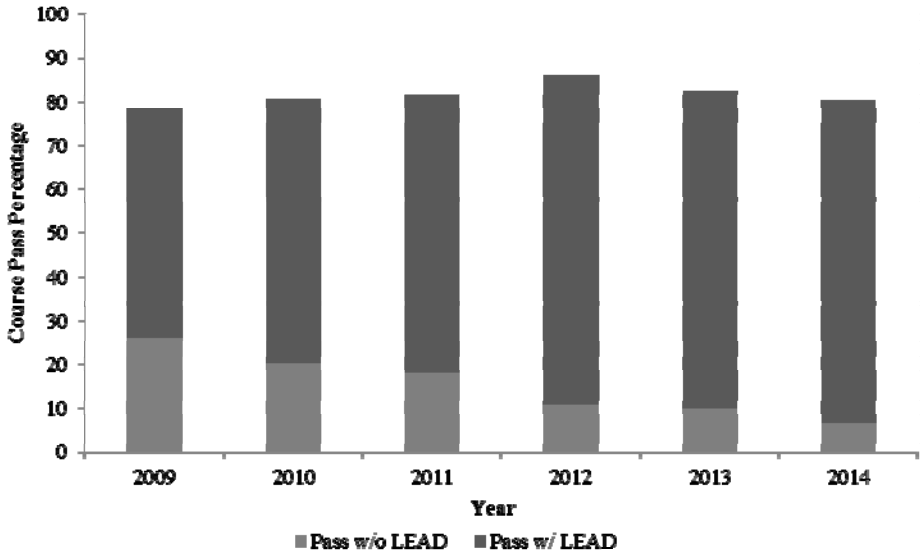

Figure 1 Percentage of Students with a Passing Grade for General Chemistry Versus Annual LEAD Participation

A comparison of average attendances with overall letter-grade in the course indicates that student success strongly correlates with participation as summarized in Figure 2. This suggests that attendance may be used as a predictor of student success in the course. Alternatively, it indicates that weaker performing students should strongly be encouraged to utilize LEAD so that they may become more proficient with the course material.

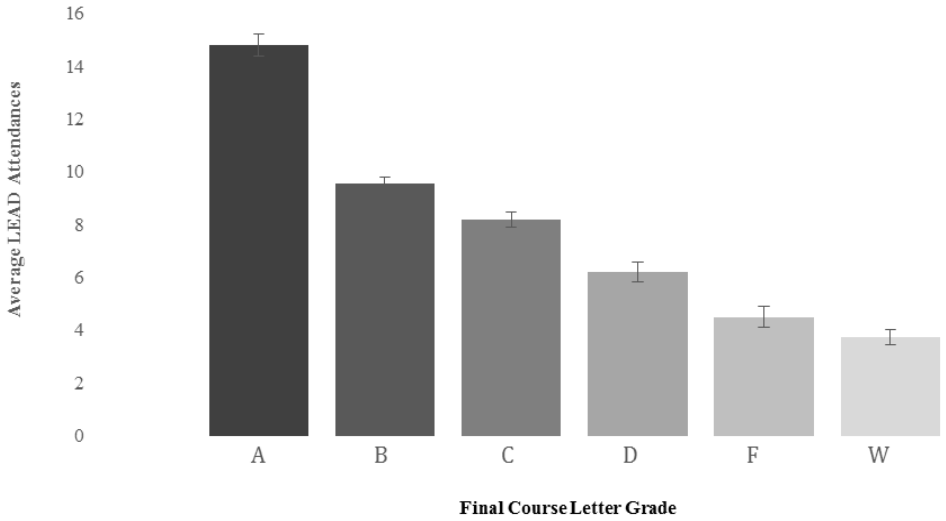

Figure 2 Average Number of LEAD Sessions Attended as a Function of Students' Final Grade Achieved in CHEM 1310. Only Data for Students Attending at Least One LEAD Session Are Included.

The average final score data for CHEM 1310 was also found to correlate with the number of attendances as represented in Figure 3. From these data it can be seen that with no participation in LEAD students still would achieved on average a passing grade in the course. But it is similarly noteworthy that even with low participation student performance already improved substantially. At about one attendance per week the standard deviation of the average final score (gray lines in Figure 3) predicts a passing grade even for lower performing students. Additional analysis of the data shows that for zero attendances the median percentage score was 5% lower than the average percentage score. For students attending 7 or more sessions, the average and median percentage scorescoincide.

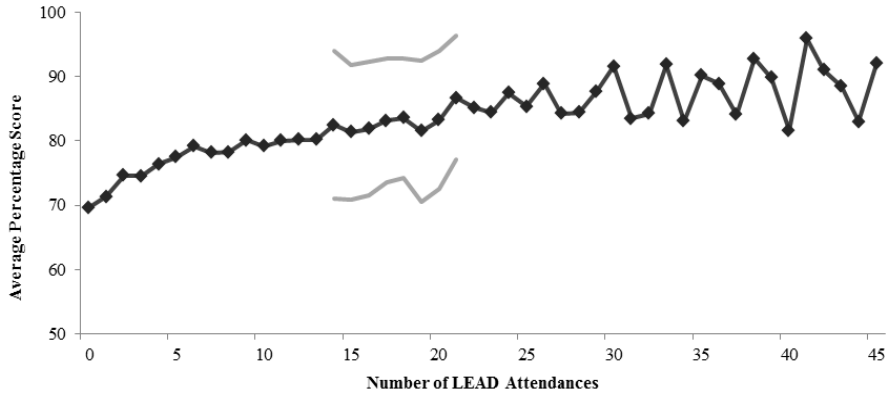

Figure 3 Average Course Scores in Percent as A Function of LEAD Attendances for All Data Collected from 2009–2014. The Upper and Lower Gray Lines Represent the Standard Deviation around an Attendance that Equals One-Time-Per-Week Participation. The Data Become Less Reliable at Higher Number of Attendances as There Were Fewer Students Who Participated This Often.

4. Conclusion

The LEAD program at Missouri S&T has a longstanding tradition of assisting students in their academic development and success. To increase participation in the general-chemistry LEAD sessions several changes were

initiated including strong campus-wide promotional advertising and a tangible incentive toward the final grade. These initial measures were highly successful in increasing student participation. Surprisingly, a subsequent reduction in the extra-credit offering did not result in a decrease in attendance. The only instance where overall participation decreased was during the change from traditional, study-hall sessions to an enhanced, active problem-solving model. This drop may ultimately be attributed to students showing an aversion to changes in teaching and learning styles. However, after an initial year of enhanced LEAD, attendance recovered and continued to increase even beyond its former maximum. This indicated that students adjusted well to the change and generally appreciated the benefits of peer-led learning. There was no need to offer more than a minimum tangible incentive or provide an opportunity for students to complete their mandatory homework problems or other assignments.

While the pass rate for the course was not significantly impacted by students' participation, it did appear to serve as a valuable assistive instructional tool for maintaining student success. It also provided for a common location where students can practice and master course material, and at the same time increase student-student and student-instructor interactions. LEAD gave instructors a unique opportunity to identify issues students encounter with the material on a larger scale rather than assisting them individually. Attendance data from this non-mandatory program may be used as a predictor for student success. It is expected that when this data is combined with other quantitative data such as homework assignment submission and class attendance it could provide an effective early identifier of students prone to failure in the course.

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