Early Alert and Intervention System in Common First Year Courses for Engineering Students

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Abstract

As retention and graduation rates of undergraduate students becomes increasingly important across higher education, more institutions are examining methods of increasing student persistence. This is particularly true in STEM fields, where performance in key first year courses can be predictive of a student's likelihood to be retained to these majors. Both academic and non-academic factors can influence a student's decision to persist in a STEM major, and supporting students across both areas is critical to ensuring their success. However, there is a long-standing lack of academic achievement data early in a student's first term when interventions would be most effective. This paper explores the further development of an Early Alert & Intervention System (EAIS) that was implemented in the College of Engineering (CoE) at the University of Nebraska – Lincoln (UNL) during the 2022-2023 Academic Year. The goal of the program was to work with instructors in key first year engineering, construction, and computing courses to identify struggling students early, and make individualized interventions early enough in the term to have an impact on a student's success and retention. The effects of two specific and structured intervention programs are also reviewed. Results of this study show promise for identifying students struggling in their first term of a STEM program.

Keywords

Early alert, intervention, student success, engineering, computing, construction

Introduction

As higher education enters a period of declining enrollments, retention of students is taking an increased priority at many institutions. This is particularly important in STEM fields like Engineering that have had historically struggled with retention of students. Yoder [1] reported that nationally, first-to-second year retention rates for engineering students had remained relatively stable from 2003 to 2014 at approximately 80%. Rates for 6-year graduation of engineering students were reported to have slowly risen from approximately 55% to 60% from 2008-2015. Both of these statistics leave room for improvement. In addition, retention, and graduation rates for Hispanic/Latinx and African American students were behind the average for all students during these time frames as well.

As institutions look at meeting the growing national demand for engineers, and increasingly restrictive institutional budgets, retaining more of the students recruited to STEM fields will only increase in importance. Work from the field of higher education administration has long known that many factors go into a student deciding to remain engaged in a major or degree. Tinto [2]

postulated that a student's ability to achieve a college degree was an interaction between their commitment to their degree and to their institution. A strong commitment to both is required for a student to persist on to graduation. Tinto [3] later elaborated on this work to acknowledge that social factors outside academics can influence a student's ability to become incorporated into the social life of an institution. Further work in the field showed that students have key experiences during the early part of their first collegiate term that can have major impacts on their ability to finish a college degree. Levitz [4] stated "A freshman's most critical transition period occurs during the first two to six weeks." It is during this time that students often set their social networks and academic habits that they will carry with them through their time in their degree.

Based on this work, colleges and universities established many different strategies to encourage students to adapt positive and healthy habits. These include summer bridge and orientation programs, first year seminar courses, and common first year experiences, which have been shown to have a positive influence on retention and graduation rates [5]. However, there continues to exist a need to identify students during this critical transition period. Institutions should be establishing methods of outreach to these first term students to encourage them to overcome any challenges that presented themselves during this critical transition to the college environment. Some work has been done to explore early alert programs in individual courses for math and engineering students [6] [7] [8]. These have shown promise for identifying students and helping them to be successful. However, these have largely been focused on individual courses and not scaled to the level of an entire college.

The Early Alert and Intervention System (EAIS) that is examined in this paper evaluates a process that was originally developed to support students in an individual math course but scaled up to the level of the entire College of Engineering at the University of Nebraska – Lincoln. The EAIS system was designed to help identify struggling students in both the freshmen and sophomore year. This paper examines the effectiveness of identification and looks at two specific structured outreach mechanisms for supporting students. While the system tracked and provided interventions for all students enrolled in the selected courses, the paper only examines the EAIS system's effects on new incoming freshmen students for the Fall 2022 semester.

Method and Process
The goal of the EAIS process is to establish a framework to quickly identify students who are struggling early in a term. It uses data points across multiple courses sections and student affairs initiatives at the institution. Once a student is identified, the intention is to reach out to the student on an individual level and help them think critically about the academic and nonacademic factors involved in their struggles, set goals for improvement, and connect them with appropriate campus resources. In line with Noel & Levitz's [4] research that the most critical time of a freshmen's transition is during the first two to six weeks of their first term, the goal was to gather data and initiate interventions during this time frame. The basic framework was laid out in Asgarpoor's paper [8], as indicated by figure 1 below.

Figure 1: Proposed Steps of EAIS Process
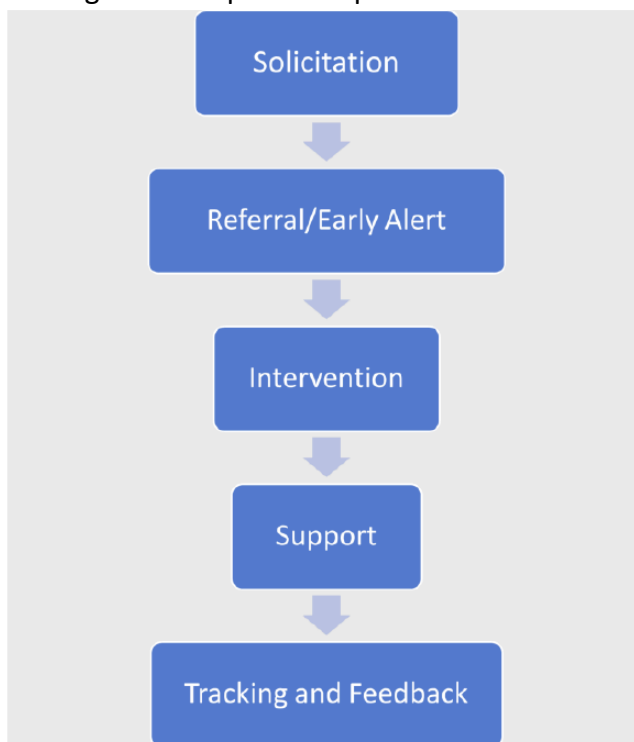
Step 1: Solicitation. Identification of key and common first year courses that impact a student's retention in STEM majors.

Step 2: Referral/Early Alert. Monitoring pre-course assessments, early term course achievement, attendance, and faculty referrals to identify students struggling early in the term.

Step 3: Intervention. Reach out to students by faculty, academic advisors, and/or student affairs professionals to help students think critically about their struggles.

Step 4: Support. Connect students to appropriate campus resources and follow up with them to ensure progress.

Step 5: Tracking and Feedback. Post term evaluation of identified students to see if they were appropriately flagged for struggles and evaluation of success of the program.

For the scaling to the college level, key courses were identified by faculty as the most impactful to a student's success in the first term. These included common first term mathematics courses such as Calculus 1, the ENGR 10 first year seminar course common to first year students in CoE, and various intro courses to each major. Instructors of these courses were given various methods of participating. Examples of participation included passive monitoring of online grade book by the Retention and Student Success Coordinator, active meetings to discuss individual students with the Retention and Student Success Coordinator, passive referrals from instructors as needed, and/or examining course pre-assessments and main course assignments. In addition,

data on student success was included from university wide initiatives, including a fourth week student satisfaction survey, Canvas/Course Management System usage data, and resident hall information and referrals.

Outreach attempts to identified students included emails, SMS messaging, and phone calls from CoE Student Affairs staff and contacts with instructors. Once contact was made, students were encouraged to meet with a specially designated student affairs staffer or their academic advisor. At that meeting, students were asked to critically reflect on their progress in their course, and what resources would be most appropriate to support them. Students were monitored for follow up and to check on improvement in courses success.

In addition, two specific and structured outreach processes were also established. For first year students placed on academic probation with the College of Engineering for having a cumulative GPA below a 2.4 after the fall semester, they were encouraged to participate in spring semester recovery program called Spring into Success (SiS). Spring into Success was implemented for the Spring Semester 2023. This consisted of, at minimum, monthly emails to freshmen students on probation in the College of Engineering. In addition, students were encouraged to meet with a designated student affairs professional at least twice during this semester to talk about academic success, what barriers might have caused a difficulty the prior semester and to promote awareness of UNL's probation and dismissal policies. Some of these students expressed interest in more regular outreach and were on advisors' lists to be checked in on a weekly basis.

For the Spring into Success email communications, each month there was a short lesson and activity. Time management, goal setting, and the importance of reviewing class syllabi were promoted at the beginning of the semester. Throughout the semester students were encouraged to evaluate how their time management was going, to think about their well-being as a student and to track their progress on their goals. At the end of the semester these students were sent resources to assist with calculating the GPA and anticipating next steps. These things were discussed with students who set up a second meeting with the advisor coordinating the SIS program.

Second, students enrolled in a specific scholarship cohort program in the College of Engineering who were identified through EAIS were referred to the coordinators for their program, so interventions could be worked into their weekly assignments required for their scholarship. Their interventions were managed by the dedicated scholarship staff and were followed up on a weekly basis. A large percentage of students enrolled in this scholarship program have lower incoming predictors of success than the average student in CoE, such as lower ACT composition scores, lower ACT Math sub scores, and/or lower high school high school GPAs. This makes their retention of particular importance to the college.

Results and Discussion

For the Fall 2022 semester, 22 courses were identified for the inclusion of the EAIS process as common courses taken by incoming freshmen and sophomore students. Data on student success was collected from the first week of the term and used immediately for outreach attempts to students. Data was continued to be collected for the purposes of outreach through the 8th week of the semester, adding and removing students as necessary from the EAIS system reach outs. Data points that were collected included the results of first week course readiness exam results, early course assignment, quiz, and exam scores, attendance, and grade book data. While data was collected through the first 8 weeks of the term, most students were first flagged for EAIS during weeks 2-4 of the semester. Very few new flags were raised past this point.

For the purposes of this paper, only data on first year students is being reported. During the Fall 2022 semester, 913 first-time freshmen were tracked for the purposes of the EAIS program over 22 total courses. Of those 364 students received at least one flag in any course as part of the EAIS system. Retention and success data of these students can be seen in Table 1:

Table 1:

Flagged in EAIS	N	Retained to CoE For Fall 23	Retained to Institution	Avg CGPA Post Spring
No	549	81.6%	91.4%	3.366
Yes	364	61.0%	71.2%	2.709
Grand Total	**913**	**73.4%**	**83.4%**	**3.104**

Students flagged as part of the fall EAIS process had statistically significant lower retention to the College of Engineering ($p = 9.2\text{E-}07$) and cumulative GPAs ($p = 7.1\text{E-}12$). Since cumulative GPA is a known risk factor for graduation, students flagged in the fall semester represent a long-term risk to graduation rates.

Freshmen students who continued in the College of Engineering for the spring semester were tracked through the spring semester as well. 13 common second semester courses in engineering and mathematics were selected for spring semester. The same process and data collection processes were instituted for flagging students for early alerts. Results of spring semester retention and tracking are seen in Table 2:

Table 2:

Flagged in EAIS	N	Retained to CoE For Fall 23	Retained to Institution	Avg CGPA Post Spring
No	709	84.5%	89.8%	3.337
Yes	107	63.6%	66.4%	2.365
Grand Total	**816**	**81.7%**	**86.8%**	**3.209**

Again, statistically significant results in retention to the College of Engineering ($p = 9.0\text{E-}05$) and cumulative GPA ($p = 2.4\text{E-}13$) were observed. Of particular concern is that the cumulative GPA of students flagged in the spring EAIS process is below the 2.4 required for good standing in the College of Engineering. This places these students as both short- and long-term retention risks

to the college. It also suggests that the spring EAIS process might have a greater predictive effect on long range retention to CoE. This places even those students who continue in their CoE major to sophomore year are at risk of not being retained past that point.

While outreach attempts were made to all flagged students, not all took the opportunity to respond or engage with the support. Those who did respond were encouraged to meet with the Engineering student success staff so the college could gain a better understanding of what barriers were preventing their success and to encourage perseverance. In these meetings or correspondence, students were suggested ideas of free campus resources such as tutoring, office hours or mental health services depending on their situation. Some of the most common situations were that students needed improvement in their study habits and time management, they had concerns about finances or motivation, or they were experiencing health or family difficulties. The student support staff worked to validate their experiences and tried to help the students see that they do belong within the College of Engineering. In these meetings students and staff worked together to come up with actionable steps students could take to overcome these barriers.

In the spring semester, students who were flagged as part of EAIS and had less than a 2.4 cumulative GPA were given the opportunity to participate in the Spring into Success Program to provide them with structure to learn about academic probation and gain additional academic success skills. This intervention was a low to medium intensity intervention that largely required a student to opt into participation. These represented the students who were most likely to not be retained to CoE. Table 3 shows the retention and success data of these students.

Table 3:

Flagged in Fall EAIS and <2.4 CGPA	N	Retained to CoE For Fall 23	Retained to Institution	Avg CGPA Post Spring
Not Active in SIS	**49**	**26.5%**	**28.6%**	**1.568**
Not Flagged in Spr EAIS	32	25.0%	28.1%	1.668
Flagged in Spr EAIS	17	29.4%	29.4%	1.379
Active in SIS	**36**	**50.0%**	**55.6%**	**1.878**
Not Flagged in Spr EAIS	15	73.3%	73.3%	2.292
Flagged in Spr EAIS	21	33.3%	42.9%	1.581
Grand Total	**85**	**36.5%**	**40.0%**	**1.699**

As table 3 shows, students who were active in the structured Spring Into Success Program and were not flagged in a new course in the spring had a 1st to 2nd year retention rate to CoE majors of 73.3%, a significant improvement over students who were not actively participates in SIS, or who were active but continued to be flagged in SIS courses for the spring. However, an average post spring term cumulative GPA for this group below the required 2.400 for good standing in the College of Engineering means they will continue to present a retention risk during the 2nd year of their program. This suggests that this group would continue to benefit from intensive intervention. For all other groups participating in Spring into Success, neither retention to the college nor their cumulative GPA were statistically significantly improved.

Finally, students enrolled in a CoE Scholarship Cohort Program and flagged as part of the EAIS system were examined to see if their higher touch points had an impact on their retention and

academic success. This program represented an intensive and highly structured intervention for students flagged in EAIS. Table for presents the achievement data for this group.

Table 4:

Scholarship Cohort Students	N	Retained to CoE For Fall 23	Retained to Institution	Avg CGPA Post Spring
Not Flagged In Fall or Spr EAIS	16	100.00%	100.00%	3.424
Flagged in Either Fall or Spr EAIS	24	83.33%	87.50%	3.333
Grand Total	**40**	**90.00%**	**92.50%**	**3.369**

As seen in table 4, students participating in the intensive scholarship cohort program had retention and GPA points above those of the average CoE Student. Students who were flagged as part of EAIS in either semester also saw retention and cumulative GPA met or exceeded the results of non-scholarship cohort students who were not flagged at in any EAIS class. This suggests that the intensive support of the program does influence flagged students to be successful in STEM programs. This is also significant because students participating in this specific scholarship cohort have lower average incoming predictors of success than the average student for the College, suggesting that high touch point interactions could be a possible intervention for students flagged early in their courses, and who have lower incoming predictors of success.

Conclusion and Future Work

The College of Engineering wide Early Alert and Invention System does seem to be effective at identifying first year students likely to face struggles with their cumulative GPA early during the first and second term, giving faculty and student affairs professionals the opportunity to direct limited resources to students most in need of support. In addition, the EAIS system is also effective at identifying students less likely to be retained to the College of Engineering. Although the fact that class level Early Alert Programs do seem to be able to be scaled to the college level, there remains a significant difficulty in getting students to engage with faculty and staff during this outreach opportunities. Students engaged with structured support systems such as Spring into Success or an intensive scholarship program with high interactions with support staff show promise that flagged students can be successful and retained to College of Engineering programs. However, more work needs to be done to establish methods of successfully supporting students who are not in, or do not engage with, these programs. This is an area for further research in Early Alert Programs. Another area for further exploration is increased participation of faculty in interventions. Both in-classroom faculty participation and faculty mentors could be areas to increase the effectiveness of EAIS interventions.

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