Student Supports and Instructor Transparency Identified in Engineering Syllabi over Nine Semesters

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Abstract

Support systems for students, including opportunities for direct interactions with instructors and access to campus resources, are important contributors to student success in engineering courses. Additionally, policies regarding student expectations and behavior in the context of engineering courses allow instructors to communicate both transparency and empathy to students, creating opportunities to directly impact student success. The switch to remote learning practices during a global disruption presented an opportunity for instructors to reevaluate the ways in which they interacted with students, provided access to learning supports and personal resources, and communicated the expected behaviors of students within engineering courses. These practices are often documented within course syllabi, which have traditionally been used to communicate classroom policies between instructors and students. The purpose of this study was to examine changes in the available support systems for engineering students and instructor communication of course policies using course syllabi across nine semesters. Findings can help inform instructional decision making of new engineering educators. A previously established Course Change Typology was utilized to deductively code course syllabi from one engineering department at a midwestern R1 university. A total of 218 syllabi were coded, encompassing core engineering courses from Spring 2019 to Spring 2023 with 53 unique instructors represented. A subset of codes from the Course Change Typology that related to student support and instructor communication were presented in the results. Results were presented based on the percentage of courses displaying evidence of each code level. The findings indicated that the presence of opportunities for instructional support increased from 95% of courses to 100% of courses over the observed period from Spring 2019 to Spring 2023. Instructor communication relative to student personal support resources increased from being present in 33% of courses to being present in 65% of courses from Spring 2019 to Spring 2023. On average, penalties were consistently more present across all semesters (~2 per syllabus) than leniencies (~1 per syllabus), and neither dimension experienced significant changes over time. From Spring 2019 to Fall 2021, 43% of syllabi on average included discussions of academic dishonesty policies, experiencing a notable increase to an average of 76% presence in syllabi for all semesters following Fall 2021. While opportunities for instructional support and communication of personal support resources increased during and after the disruption (Spring 2020 – Spring 2023), there is still room for improvement in how instructors provide support and communicate resources in syllabi. The implications of these findings and recommendations for new engineering instructors based on results are detailed in the paper.

I. Introduction

Capacity for change is an imperative tool for improvement of educational practices in science, technology, engineering, and mathematics (STEM) [1]. However, despite an identified necessity for change in the ways that engineering instructors teach their students, instructors have generally been slow to adopt new teaching practices advised by researchers [2]. Interaction with students is a fundamental aspect of teaching that instructors have the ability to directly impact. Current literature in engineering education research points to the idea that increasing student-instructor interaction and communication contributes greatly to student success in engineering and design courses [3], [4]. In Spring 2020, the COVID-19 outbreak resulted in a transition to distance learning for academic institutions across the globe, and this change required engineering instructors to reevaluate the ways in which they were able to interact and communicate with students to adequately support their learning [5]. The COVID-19 disruption presented an opportunity for researchers to study if a disruption could result in meaningful change in the personal and academic support systems communicated to mechanical engineering students.

One way to uncover how instructors adapt their teaching practices over time is through the examination of their course syllabi. For decades, syllabi have been used as a contract between student and instructor, as well as documentation of the topics covered and learning opportunities offered in a course [6]. Discussion of office hours, contact information, and instructor communication are key components to be included in a course syllabus [7]. Effective syllabi contain information regarding resources for student learning, such as availability of tutoring sessions, writing centers, or student disability services [6]. Syllabi also provide an opportunity for instructors to exhibit empathy or provide motivation to students through the communication of course policies. Demonstrations of empathy have the potential to provide additional support to students within the classroom and influence student success [8], [9]. Furthermore, past studies have demonstrated that fundamental information about a course can be deduced from course syllabi [10], [11], [12]. However, there has been a lack of research exploring the ways in which course syllabi can be used to examine transparency and support systems provided to students in engineering courses. The purpose of this study was to observe and analyze changes in available student supports and instructor transparency as detailed in mechanical engineering course syllabi over a five-year period, inclusive of a transition to virtual learning in Spring 2020. Findings can be used by new engineering educators to inform the development of syllabi.

II. Background

Many components found within syllabi can be used to determine if engineering instructors are making changes to student supports and instructor transparency in a course. Opportunities for instructor-student interactions and information about external resources are often included within syllabi to provide students with different forms of support available to them throughout a semester. Additionally, details about course policies and established expectations within syllabi can be analyzed to draw conclusions about how an instructor's transparency with students varies over time. When syllabi are developed using existing research and recommended best practices, each of these components can contribute to the success of students within engineering courses.

A. Student Supports

This study focuses on student supports offered through two primary avenues: direct instructor-student interactions and external support resources provided by the institution. Providing engineering students with course-related supports through interactions in office hours and similar opportunities, instructors are able to contribute to students' success [13] and sense of belonging [14]. Instructor communication of university support resources additionally aids students in knowing where to look for general academic and personal supports when needed, furthering student well-being and retention in higher education [15].

Instructor-Student Interactions. In this study, student-instructor interactions refer to communicated opportunities such as posted office hours, instructor appointment availability, and course discussions that occur outside of the class meeting time. Research findings have suggested that student-instructor interactions outside of the classroom lead to greater student cognitive development, academic engagement, and persistence in collegiate courses for students [13], [16]. Communication between students and faculty about course topics beyond classroom interactions has additionally been linked to greater rates of success and student learning in engineering courses, demonstrated through higher GPAs, grades, and understanding of conceptual ideas [17], [18], [19]. Furthermore, support interactions with instructors have been shown in previous literature to improve sense of belonging for minority students in engineering programs. One study on student-instructor interactions that occur specifically during office hours or similar meetings resulted in indications of a greater sense of community and belonging for female engineering students [14]. Efforts to increase sense of belonging are viewed as important in education research because while sense of belonging is regarded as a primary contributor to rates of student retention and graduation, it is often lessened for underrepresented communities in engineering programs [20].

External Resources. Beyond direct interactions with instructors, students in engineering courses receive personal and academic support from general university resources. Examples of personal supports for university students include mental health resources, disability services, and healthcare. While engineering students experience high levels of stress relative to other disciplines of study in university settings, it has been shown that they are less likely to seek out professional mental health support [21]. Multiple studies have indicated a need for greater accessibility of mental health resources and professional help for engineering students [22], [23]. Student use of university-wide learning support systems in engineering, such as library services and tutoring, also contribute to student retention and success [24]. Access to academic support resources provided by the university is especially necessary for retention of underrepresented student populations [15].

B. Instructor Transparency

Transparent teaching methods prioritize clear communication with students about the structure of a course and the reasoning behind that structure. Personalizing and clearly outlining course policies and expectations of students within a syllabus allows an instructor to engage in transparent teaching methods from the outset of a course. Existing studies indicate that increasing transparency between instructors and students in higher education has notable positive

impacts on student success, particularly among underrepresented populations [25]. Transparency creates opportunities for students to feel more involved in their education and prepared for the structure of a course while requiring minimal additional effort on the part of the instructor.

Expectations. Establishing expectations within a syllabus, particularly regarding the level and types of effort required of students to perform well in a course, allows instructors to be transparent about a class's workload immediately. Emphasizing effort in a classroom also creates an environment where students are able to benefit from increased work ethic, regardless of innate ability [26], [27], [28]. When expectations have been communicated for a course, students have often lived up to those expectations. Whether this is due to self-fulfilling prophecies or accurate and reasonable predictions of effort, however, has remained unclear. Furthermore, the impact of different expectations on students has remained largely unclear [29]. The importance of established course expectations has increased with rapidly changing classroom environments caused by the COVID-19 pandemic [30]. As a whole, these expectations have set a precedent of transparency between instructors and students, which has been proven to support student confidence and overall success [25].

Course Policies. Communication of policies can consist of establishing both penalties and leniencies within a course. Penalties have served as a method of motivation that encourages students to stay on track within a course and apply genuine effort to understanding concepts and completing assignments [31]. These policies have most commonly appeared in the form of late work penalties but have also consisted of repercussions for academic honesty violations, poor classroom attendance, or other unmet behavior expectations. Late work penalties have been shown in previous works to promote student learning [32]. Academic dishonesty policies have become particularly relevant in recent years due to the increase in academic integrity violations with more common virtual instruction modes [33]. Leniencies, on the other hand, have provided instructors with the opportunity to express understanding towards students and create room for students to make mistakes in a course with space for forgiveness. These policies most commonly show up in the form of grading leniencies, where certain scores are dropped from the calculation of an overall final grade in a course. While the impact of these policies in terms of a student's performance has been generally disagreed upon between existing studies [34], [35], leniencies have created the space for instructors to display empathy in a course, which has been widely desired by students [36], [37]. Furthermore, demonstrations of instructor caring have been linked to improved student motivation, which directly impacts student success [8].
Examining the evolution of course policies and expectations of students as they are discussed within syllabi may provide insight into how instructors as a whole have adapted over time with respect to transparent teaching methods. An understanding of the changes observed within syllabi is a key aspect to identifying the ways in which engineering educators have both succeeded and failed to adapt their classrooms to align with best practices over the past several years.

III. Research Purpose & Questions

The purpose of this study was to observe and analyze changes in available student supports and instructor transparency as detailed in course syllabi for one engineering department over a five-year period, inclusive of a transition to virtual learning in Spring 2020.

1. In what ways, if any, did the available student supports change over a five-year period as indicated in course syllabi?
2. In what ways, if any, did instructor transparency change over a five-year period as indicated in engineering course syllabi?

IV. Methods

A. Settings & Participants

Participants in this study were instructors from a single engineering department at a midwestern R1 university. Nine semesters (Spring 2019 to Spring 2023) were observed, with 219 total syllabi collected from 53 unique instructors of core courses. "Core courses" consisted of courses which were required for undergraduate students in the department. The observed courses included all undergraduate levels, from introductory courses to design and capstone courses. Table 1 displays the distribution of syllabi, instructor, and course counts for each academic semester. Each semester, 19-20 courses were observed, taught by 18-22 instructors with 21-23 syllabi analyzed. Syllabus count sometimes exceeds instructor count (e.g., Spring 2019, Fall 2020) due to instances in which an instructor taught more than one course. For similar reasons, there were two instances where instructor count was less than course count (Fall 2022 and Spring 2023). Instructor count also exceeded course count (e.g., Fall 2019) on occasions where multiple sections of the same course were taught by different instructors.

Table 1. Syllabus, course, and instructor counts by semester

Semester	Syllabus Count	Instructor Count	Course Count
Spring 2019	21	20	19
Fall 2019	22	22	19
Spring 2020 (Original)	21	19	19
Spring 2020 (Revised)	21	19	19
Fall 2020	22	20	20
Spring 2021	22	20	19
Fall 2021	22	21	19
Spring 2022	22	20	19
Fall 2022	22	18	19
Spring 2023	23	18	19
All Semesters	**218**	**20**	**53**

Table 2 outlines the program year and generic course titles of the 20 courses examined in this study. As is common in engineering degree programs, the third year had the greatest number of core courses while the first year had the least number of required courses as students are taking fundamental courses such as math and science during the first two years of their undergraduate engineering degree.

Table 2. Core courses by program year

Year	Generic Course Titles
First	Introduction to CAD
Second	Thermodynamics I, Statics, Intro to Engineering Design
Third	Thermodynamics II, Fluid Mechanics, Statistics, Elastic Bodies, Kinematics, Elements of Machine Design, Control Systems, Materials, Manufacturing, Dynamics, Measurements
Fourth	Heat Transfer, Engineering Design I, Engineering Design II, Thermal Fluids, Kinematic and Machine Design

B. Data Collection

The syllabi analyzed for this project were collected directly from the engineering department. Most syllabi were available through the department due to the ABET re-accreditation process, which this university was undergoing during the time of data collection. In instances where the department did not have the syllabi, course instructors were contacted directly. In the Spring 2020 semester, the university closed for in-person courses due to the global COVID-19 pandemic. Due to this closure, instructors were required to provide students with a revised syllabus in March 2020 to account for the mandated switch to virtual learning. As a result, the data in this study included both the original course syllabi for Spring 2020 and the revised syllabi.

C. Data Analysis

To detect changes over time, collected syllabi were deductively coded using a previously established Course Change Typology. The typology was originally developed by two researchers on the project, refined using feedback from two conference workshops [38], [39], and utilized in three previous studies [10], [11], [12] as a part of a larger project. The Course Change Typology consisted of 59 codes in total, which were separated into the following four categories:

I. "General" codes, which focused on generic information pertaining to each course, including instructor IDs, course numbers, and course types
II. "What" codes, which identified the implementation of ABET student outcomes (ABET, 2024) into course activities

III. "How" codes, which were used to observe the ways in which course content was delivered and student understanding was evaluated
IV. "Environment" codes, which recorded traits of syllabi pertaining to support systems, transparency, communication, and fairness available to students

Data analysis in this study primarily focused on changes detected in syllabi using "Environment" codes. The specific subset of "Environment" codes from the Course Change Typology used in this paper are outlined in Table 3, along with the definitions of each code and meanings of each numeric level assigned to the respective codes. The codes in the Course Change Typology were applied to syllabi by seven undergraduate researchers who each completed the process of inter-rater reliability to establish consistency and trustworthiness in the recorded code values. The inter-rater reliability process consisted of four rounds of coding a random set of syllabi, focusing on one of the four themes within the typology during each round. Code values were then compared between researchers using simple percent majority. In cases where the value of a code differed between coders, the researchers discussed and came to an agreement on how that code should be applied to syllabi, and appropriate adjustments were made within the dataset. This iterative process repeated until researchers reached agreement 80% of the time or more for application of every code to syllabi in each round. Code values were then analyzed based on the percentage of courses in each semester displaying evidence of code levels. Figures displaying these relationships are presented in the Results section of this paper.

Table 3. "Environment" syllabus code definitions used in this paper

Outcome	Definition
SYL_Exp	Expectations are outlined in terms of the amount of effort that is required of students to be successful in the course
SYL_ACADIS	Description of academic dishonesty
SYL_GetHelp	Ways to get help within the course beyond posting time for office hours
SYL_OffHrs_Loc	Location where office hours will be held beyond typical office settings
SYL_OffHrs_Hours	Total number of (Instructor and TA) office hours per week
SYL_Personal_On_CampusSupports	Personal supports for students (e.g., CAPS (mental health), student services for disabilities, recreation facilities, etc)
SYL_Learning_On-CampusSupports	Supports for learning (e.g., writing center, library, tutoring, etc)
SYL_PEN	Number of grading penalties outlined in the syllabus
SYL_LEN	Number of grading leniencies/forgiveness's in syllabus

V. Results

A. Student Supports

Instructor-Student Interactions. The SYL_GetHelp code was used to determine the types of course-specific instructional support offered to students in syllabi. Figure 1 demonstrates the variation in office hours observed from Spring 2019 to Spring 2023. Here, office hours are defined as instructional interactions between instructor and student that occur intentionally and outside of class time. Traditional office hours indicate that the instructor provided a regular schedule of availability for students to seek help in the course. Office hours by appointment signify that the instructor allowed students to schedule office hours for instructional help outside of the usual communicated timeframe for traditional office hours. As indicated in Figure 1, evidence of office hours generally increased over time, with all observed spring courses offering some form of office hours after 2020. Evidence of only traditional office hours was highest in the Fall 2022 and Spring 2023 semesters. Availability of office hours by appointment increased after Spring 2020 but decreased again after Spring 2022. Indications of both traditional office hours and office hours by appointment were consistently observed at the highest rates over time.

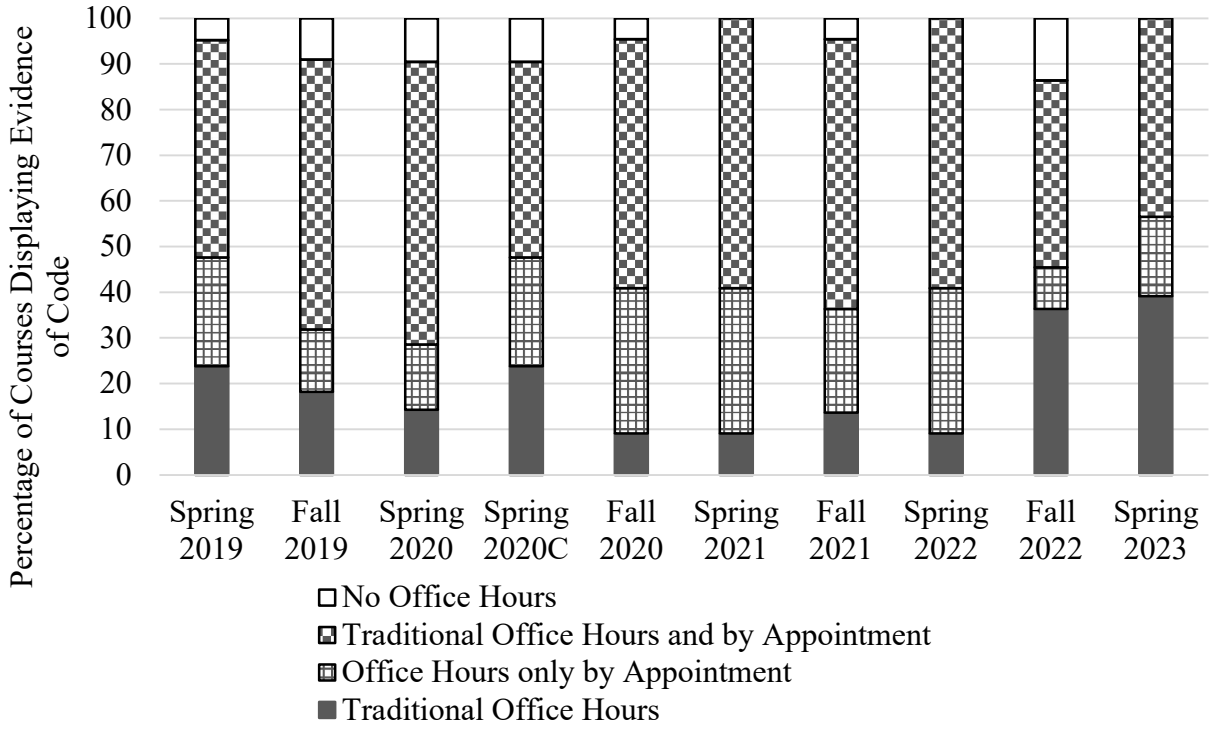

Figure 1. *Types of Office Hours Indicated in Syllabi over Time*

The variation in locations where office hours were held by semester, identified with the SYL_OffHrs_Loc code, is displayed in Figure 2. It is possible that the percentages for each location in any given semester sum to greater than 100%; this is because instructors would often

indicate that office hours were held in more than one location. Indicators of a typical office setting (or a course without office hours) decreased greatly from Spring 2020 to Spring 2021 but increased again to levels similar to those observed before COVID-19. Online office hours first appeared in Spring 2020 after COVID-19 in 71.4% of courses; evidence decreased over time but remained present in all following semesters, with levels remaining around 22% in Spring 2023. Office hours held in a library or learning center were observed at minimal levels over time. Overall, the location of office hours was not specified the majority of the time within the observed timeframe; the "not specified" level was only surpassed by online office hours in the Spring and Fall 2020 semesters.

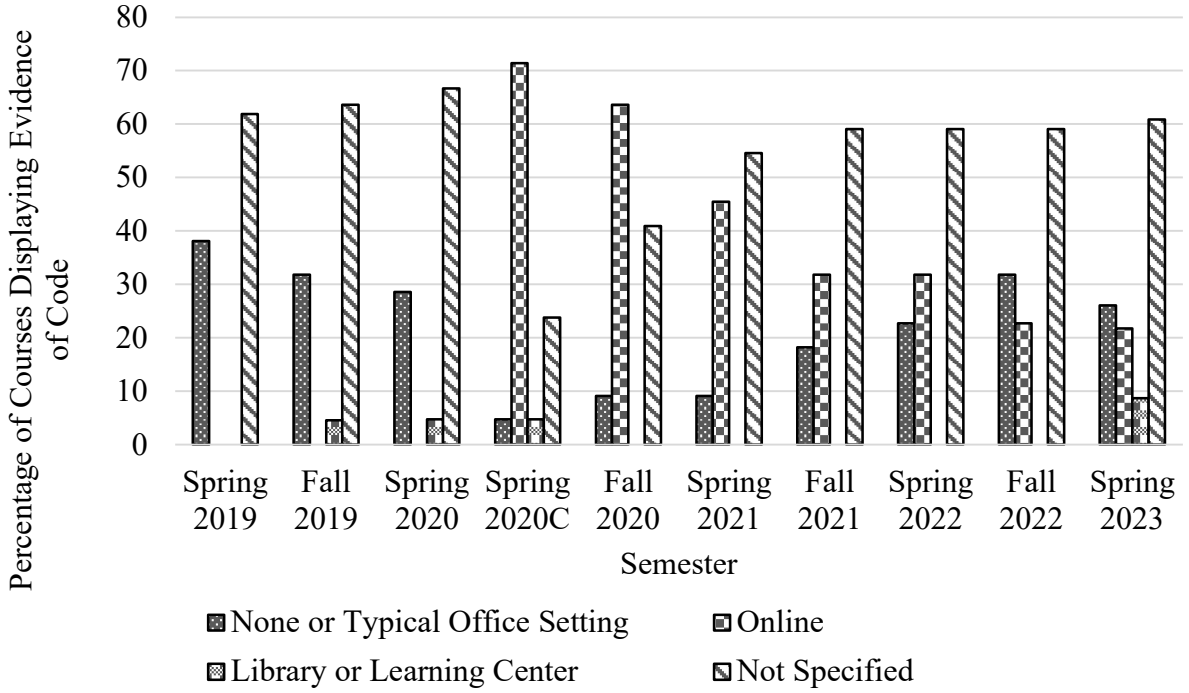

Figure 2. *Locations of Office Hours Identified in Syllabi over Time*

External Support Resources. Evidence of instructor communication of campus learning supports was determined using the SYL_On-Campus_LearningSupports code. Campus learning supports are defined as academic resources provided broadly by the institution, such as tutoring services, writing centers, or libraries. Figure 3 displays the percentage of courses in which campus learning supports were communicated in syllabi each semester. The presence of university-wide learning support information remained very low (0-5% of courses) from Spring 2019 to Fall 2021 until reaching 45.5% in Spring 2022. However, the presence of learning supports decreased gradually again through Fall 2022, with again less than 5% of courses displaying evidence in Spring 2023.

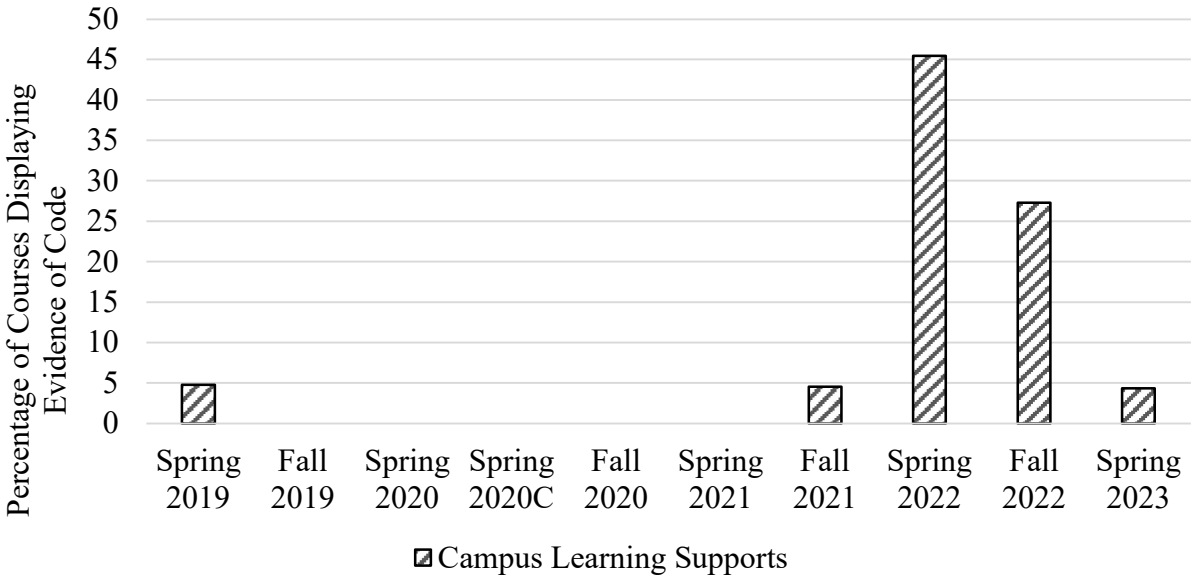

Figure 3. *Learning Support Information in Syllabi over Time*

The SYL_Personal_On-CampusSupports code was used to identify instructor communication of university-wide personal resources for student use. Examples of personal supports include mental health resources, services for students with disabilities, and COVID-19 testing locations. Information about personal supports included in syllabi were coded into 4 levels: university boilerplate, personalized information, boilerplate and personalized information, and general weblink to university information. A university boilerplate is defined here as a standard statement developed by the institution and available to instructors for use in syllabi. Figure 4 provides an example of a university boilerplate for the disability services office, which was coded as a personal support during data analysis.

Statement on students with disabilities: If you anticipate or experience barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can discuss your options. To establish reasonable accommodations, I may request that you register with Services for Students with Disabilities (SSD). If you are eligible for services and register with their office, make arrangements with me as soon as possible to discuss your accommodations so they can be implemented in a timely manner. SSD contact information: 232 Canfield Admin. Bldg.; 402-472-3787; acontreras3@unl.edu.

Figure 4. *Screenshot of an Example University Boilerplate*

Figure 5 displays the variation in types of personal support information included in syllabi over time. From Spring 2019 to Spring 2020, university boilerplates were the only observed form of personal support information. In Fall 2020, approximately 9% of courses incorporated personalized information about personal supports available to students, but this percentage decreased for future semesters with only Spring 2021 and Spring 2022 containing further indicators of personalized information. After Spring 2021, the usage of a general link to the

university webpage for personal support information became more common, reaching 30% of observed courses in Spring 2023.

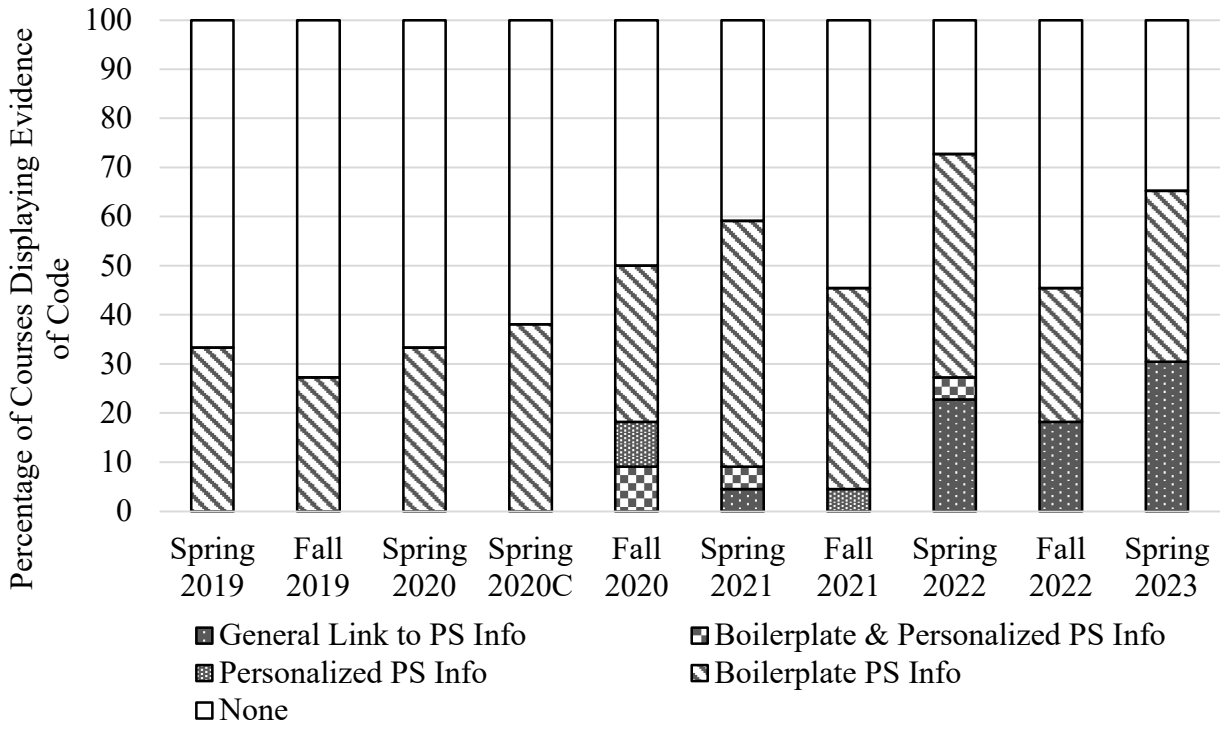

Figure 5. *Evidence of Personal Support Information in Syllabi over Time*

B. Instructor Transparency

Expectations. Results of the SYL_Exp code, identifying the level of expectations communicated to students via syllabi, are recorded in Figure 6. Prior to COVID-19, expectations were less commonly outlined in syllabi, with a range of 33% to 43% of syllabi having no mention of expectations between Spring 2019 and Spring 2020. Data from Spring 2020 following the transition to a virtual environment had the highest portion of syllabi outlining student responsibilities, with only 24% of syllabi having no mention of these expectations. This number, however, returned to previous levels in subsequent semesters, having one more notable drop again in Spring 2023 (26% of syllabi with no mention). Prior to COVID, more syllabi (9% to 14%) covered expectations through a general mention of effort being required for success. Following semesters had consistently fewer (0% to 9%) general mentions of expectations, but higher levels of specific expectations within syllabi, with all semesters from Spring 2020 (post-COVID) to Spring 2023 having more than 55% of syllabi showing evidence of communicated expectations other than general efforts or beyond the typical expectations for a lecture or laboratory course.

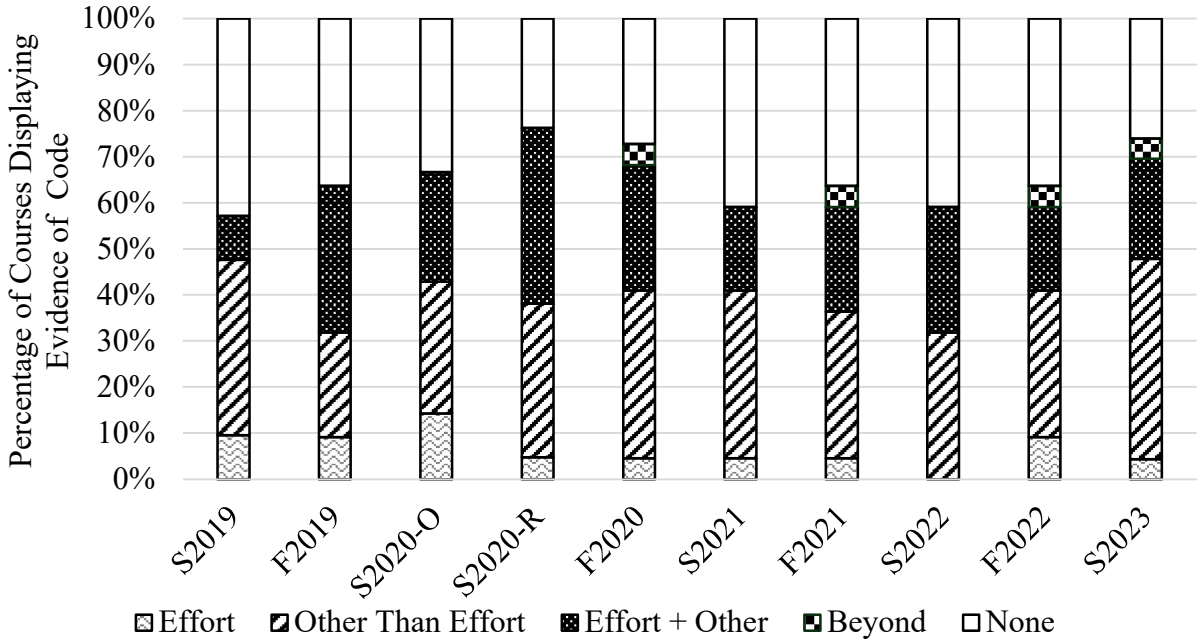

***Figure 6**. Results of SYL_Exp code over nine semesters*

Fairness – Academic Dishonesty. The results of the SYL_ACADIS code, which recorded evidence of academic integrity policies found within syllabi, are featured in Figure 7. The presence of academic integrity policies in syllabi generally increased over time, being present in only 33% of syllabi in Spring 2019, peaking with 91% of syllabi mentioning academic integrity in Spring 2022, and having presence in 74% of syllabi in Spring 2023. Following Fall 2021, more than a third of all syllabi included only a link to the university academic integrity policies.

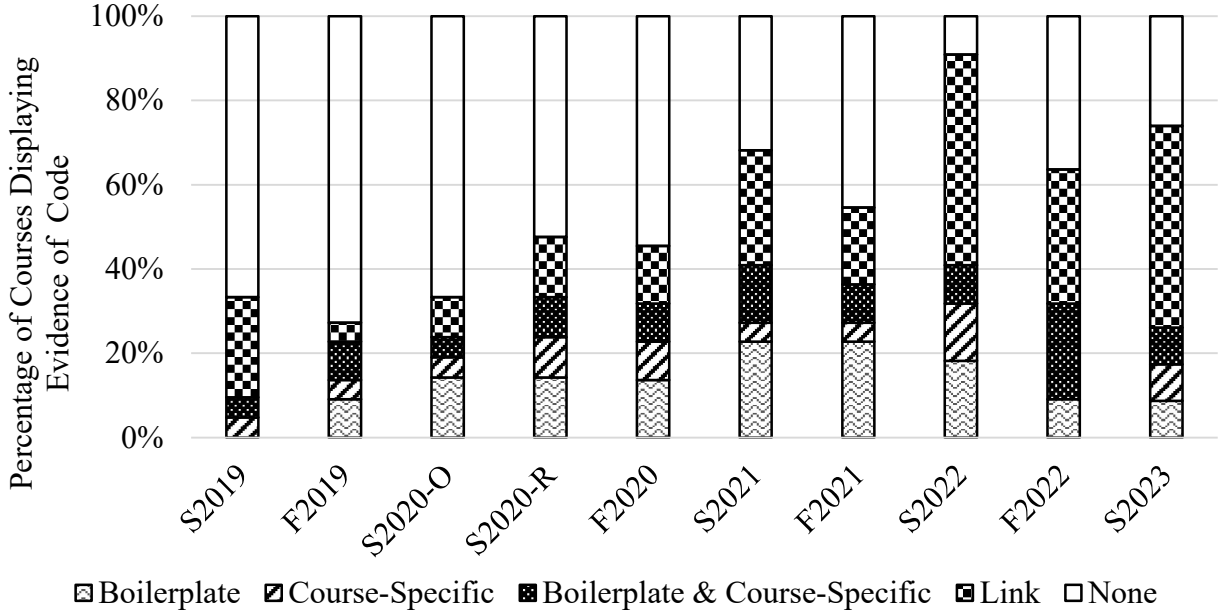

***Figure 7**. Results of SYL_ACADIS code over nine semesters*

Fairness – Penalties & Leniencies. Figure 8 displays a box and whisker plot of the data resulting from the SYL_PEN and SYL_LEN codes, which recorded the number of grading penalty and grading leniency policies outlined within syllabi, respectively. The patterned boxes on the plot display the center half of all data resulting from both codes for each semester. The arms extending from each box represent the maximum and minimum values from each data set, and the colored dots above certain columns represent counts that were considered outliers from each semester. The median of each semester's data is denoted by a horizontal line placed within each colored box, and the averages from each semester are denoted by an "X" symbol. Neither of these codes displayed any notable trends over the time period observed. The SYL_PEN code, however, did consistently maintain higher median, average, and maximum counts than the SYL_LEN code across all semesters. This indicates that the number of penalties counted in syllabi was, on average, higher than the number of leniencies. The median number of penalties counted within syllabi was 2 for all semesters aside from Fall 2021, which produced a median count of 2.5 penalties per syllabus. Leniencies, on the other hand, had a consistent median of 1 leniency per syllabus from Spring 2019 to Spring 2020 (revised). From Fall 2020 onward, the median count of leniencies per syllabus fell to 0 for the remainder of the observed time period.

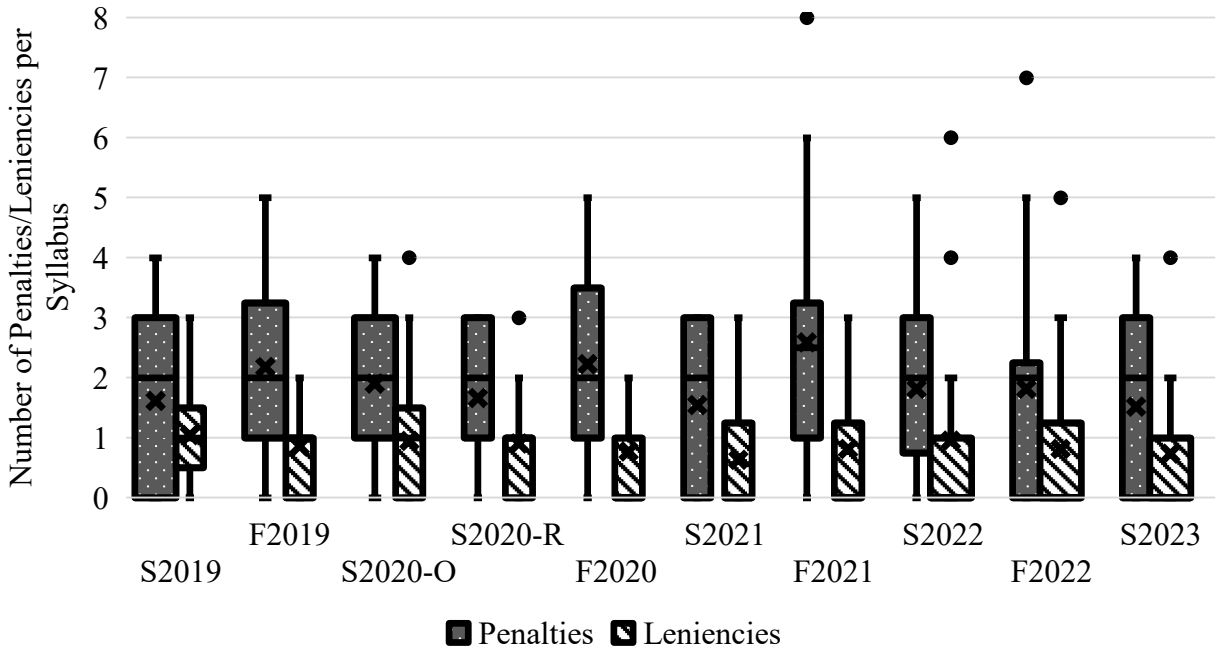

Figure 8. *Results of SYL_PEN and SYL_LEN codes*

VI. Discussion

A. Student Supports

Instructor-Student Interactions. The observed increase in opportunities for direct student support through course office hours indicates a positive change over the nine semesters. An increase in number of office hours offered allows students more opportunities to attend, potentially increasing the use of office hours by students. Increased student use of office hours has been correlated with improved course performance [40] as well as greater retention and sense of belonging for underrepresented female students in engineering [14]. Therefore, providing more opportunities for office hours is beneficial for student success and retention in engineering programs, and the observed trends in this study show increased alignment with recommended practices regarding availability of office hours as more instructors began to offer office hours over time.

However, there is room for improvement based on best practices in the locations where office hours were most often held. Previous research has indicated that it is beneficial for office hours to be held in public spaces, rather than private offices. One mathematics instructor's study on public space office hours demonstrated that students were better able to bond with peers in a group setting. Holding office hours in spaces such as student centers and coffee shops increased collaborative problem solving, supported the retention of students in higher education, and decreased the power dynamic of an instructor and student in a private office [41]. Additionally, when underrepresented minority students have the agency to choose the environment for office hours (outside of a traditional office or classroom setting), they are less likely to encounter microaggressions and more likely to find the office hours supportive [42], [43]. Since very few course syllabi contained indicators of office hours in a public or chosen space outside of a typical office setting (e.g., library, learning center, coffee shop), it is recommended that more instructors hold office hours in a location separate to their office, such as a public library space or campus learning center, to better engage students in collaboration and provide a supportive environment for all students.

While online office hours began and peaked in Spring 2020 in over 70% of courses, the availability of online office hours was observed to decrease over time, appearing in only a little over 20% of courses in Spring 2023. While not every student prefers online office hours, some have reported in previous studies that they found online office hours more convenient and less intimidating [44]. It is recommended that instructors provide an online office hour option to students (even if a traditional in-person office hour is already held) to make courses more accessible and inclusive for those students that prefer this form of support.

External Support Resources. While the presence of campus learning support information in syllabi did begin to increase in Fall 2021, there was no lasting significant change in evidence of learning support information sustained by Spring 2023. This indicates a need to improve the communication of campus learning supports and university-wide academic resources to students in syllabi. Learning supports such as tutoring centers and academic resource offices have helped retain students in engineering studies [45], and university writing centers have been shown to improve student aptitude in engineering laboratory courses [46]. Due to the impact of campus learning supports on student success and retention in engineering, it is recommended that

instructors continue to use syllabi to communicate to students about these resources and where to find them.

There was an increase in the percentage of course syllabi containing information on university-wide personal supports over time, primarily due to a growing inclusion of a general link to a university support webpage with personal support information. Information on services for students with disabilities was observed most often. The observed increase in personal support information aligns positively with best practices in communicating supports to engineering students. Including information about university disability services available to students in a syllabus helps ensure that a course is accessible for disabled students; the first time that a student interacts with a course is often when reading the syllabus, and by including personal support information like disability services details, the instructor is setting the tone for the semester regarding accessibility and inclusion for students [47]. There is also a need for instructors to highlight university mental health resources due to disproportionately high levels of stress and mental health crises for students in engineering [21], [22]. It is best practice for engineering instructors to include information about personal resources for students offered by the university in their course syllabi to best support student success, well-being, and accessibility.

There was additionally little evidence of instructors supplementing boilerplate statements with personalized information on personal supports in syllabi. It is recommended that instructors personalize the information they provide about student disability services and other personal support resources rather than solely use provided boilerplate statements in their syllabi. The practice of personalizing written communication in syllabi enhances the impact and memorability of the information and may lead to increased student engagement with the resources detailed [48].

B. Instructor Transparency

Expectations. The lack of significant change in the ways that expectations were communicated to students across the observed semesters indicates a lack of adaptation within classrooms to new best practices. However, the consistent presence of established expectations that were more specific than just communicating a need for effort within a course does indicate that instructors have incorporated at least some transparency into course syllabi. Clearly communicated expectations have been connected to improved student understanding of and compliance with said expectations [30]. A large portion of syllabi still contained no mention of expectations, indicating a lack of communication between instructors and students about what the demands of a given course would be. This goes against recommended implementations of transparency in courses and creates uncertainty among students, which may result in students being unable to meet an instructor's expectations [49].

It is recommended that instructors use syllabi as an initial opportunity to clearly and specifically define the expectations of a course. Clearly defining these expectations may include providing details about long-term projects, assignment frequency, time commitments outside of class, required readings, attendance and participation, as well as communicating how these expectations will be reflected in the final grade for a class. The statements establishing these expectations should be personalized to emphasize their importance and increase a student's understanding of and engagement with these expectations [48]. If employing a flipped-classroom approach in which students are expected to guide their own learning outside of the classroom, it is imperative that this format be clearly communicated to students [50].

Academic Dishonesty. One of the most notable changes observed in syllabi regarding academic dishonesty was the increased incorporation of only a link to university academic integrity policies following Fall 2021. This is likely due to the implementation of a new course policies link which was distributed to instructors at this university near Fall 2021. While this link may have provided students with a useful collection of general university guidelines, analysis indicates that most often, these links were included without any personalized statements regarding academic integrity. Research indicates that utilizing personalized tools within learning improves student engagement and promotes more positive instructor-student relationships [48]. Furthermore, incorporating personalization into the learning process, whether that be within classroom instruction or course policies, creates a more inclusive learning environment by accounting for the needs of increasingly diverse arrays of students [51], [52].
Personalizing academic dishonesty statements may include outlining what constitutes as academic dishonesty within a course, particularly beyond blatant plagiarism. For example, the acceptability of the use of artificial intelligence within academia is widely disagreed upon, and providing course-specific guidelines about such topics may help define any course-specific consequences associated with instances of academic dishonesty. Including details about academic dishonesty policies in a course syllabus helps ensure that cases of academic dishonesty are being handled proactively and consistently, which benefits students, faculty, and administration [53].

Penalties & Leniencies. Penalties were consistently identified more often than leniencies within the observed syllabi during this study, with very little variation in frequency of either trait across the nine semesters. The lack of change in policy across a period that included a major global disruption indicates that many instructors did not utilize this disruption as an opportunity to reevaluate their course policies, despite an established demand for adjustments in classrooms during the COVID-19 pandemic [54], [37]. Prioritizing a balance of leniencies and penalties within a classroom helps promote behavior that benefits learning while also accommodating for the various demands and unforeseen circumstances of a college student's life outside of the classroom [54], [55]. Further encouragement of beneficial behaviors may be accomplished by including statements that justify the reasoning behind a course policy within a course syllabus [56]. Clearly outlined penalties within a course provide students with structure and punish behaviors that are harmful to learning, which helps foster student success [57] and reflects the expectations they may encounter when entering a career after college [58]. Incorporating leniency into these policies, however, better recognizes students as individuals, facilitating "non-traditional" student needs [59] and accounting for the numerous commitments that students often have outside of class [54], [60]. Examples of ways in which course policies can be balanced between penalty and leniency include utilizing small-interval deduction systems within late policies [61], allowing a limited number of absences within graded attendance policies [57], [56], providing occasional and challenging opportunities for extra credit [60], and offering individualized make-up opportunities that allow students to demonstrate understanding while highlighting their unique strengths [62]. Additionally, policies must be clearly outlined within syllabi in order to provide students with necessary information from the beginning of a course and contribute to the transparency shared between students and instructors.

VII. Recommendations

Recommendations based on the findings discussed above are summarized below in Table 4.

Table 4. Recommendations for instructors based on best practices

Area of Focus		Recommendations	Citations
Student Supports	Instructor-Student Interactions	1. Provide multiple opportunities for support interactions outside of the classroom, such as holding office hours multiple times throughout the week. 2. Provide an online office hours option in addition to in-person office hours. 3. Hold office hours in accessible public spaces, such as student centers or libraries, rather than in private offices.	[40], [14], [41], [42], [43], [44]
	External Support Resources	1. Communicate information about university-wide academic resources such as libraries, tutoring services, and writing centers in course syllabi. 2. Communicate information about university-wide personal supports such as disability services, psychological counseling, and healthcare services in course syllabi. 3. Personalize support information in syllabi rather than solely relying on university boilerplate statements.	[45], [46], [47], [21], [22], [48]
Instructor Transparency	Expectations	1. Use syllabi to clearly define and justify expectations in a personalized manner. 2. Discuss the practicality of these expectations with students. 3. Enforce expectations as they are established within syllabi.	[30], [48], [50], [49]
	Academic Dishonesty	1. Specify what constitutes as academic dishonesty for a course within syllabi. 2. Establish the consequences of academic dishonesty violations within a syllabus. 3. Proactively address academic dishonesty cases.	[51], [52], [53]
	Penalties & Leniencies	1. Clearly outline penalty and leniency policies within course syllabi. 2. Utilize balanced systems such as small-interval deductions, allotted absences, or individualized make-up policies.	[61], [57], [56], [62]

VIII. Limitations

The primary limitation of this study was the lack of an established template or format at this university for the syllabi provided by instructors. Because the department being studied did not have concrete guidelines for what should and should not be included in syllabi, not all data

analyzed provides a complete picture of what occurred within a classroom. For example, an instructor not listing their office hours or failing to mention specific leniencies built into their course structure does not necessarily indicate a lack thereof. The way information was presented within each syllabus varied, resulting in the possibility of researchers misinterpreting the provided data. Additionally, it should be noted that the presence of different syllabus traits does not represent their inherent value to a student's education. While a professor may thoroughly outline the support systems and classroom policies relevant to students in their course, the way these traits are actually implemented into a classroom severely impacts student success as well. The most effective method for identifying any gaps or inaccuracies within the data would be to combine the syllabus values with additional sources of data, including information from learning management systems, which will be incorporated into future work.

IX. Conclusion

In this study, course syllabi from nine semesters of engineering core courses were analyzed using a Course Change Typology to investigate changes over time in student support information, encompassing instructor-student interactions and external resources, as well as instructor transparency, demonstrated through communicated expectations for students, penalties, and leniencies. Findings indicated that opportunities for course-specific instructor-student interactions increased over the nine semesters observed, primarily through offered office hours. Instructor communication of personal support information in syllabi increased, notably with the addition of a general link to a university resource webpage, while learning support communication did not exhibit a sustained increase over time. It is recommended that instructors increase opportunities for interaction and support by offering a greater number of office hours for students, holding office hours in public spaces, and including university support information in course syllabi. Furthermore, analysis did not indicate a significant change in the presence of expectations or general course policies surrounding penalties and leniencies established within syllabi. However, there was a notable increase in mentions of academic dishonesty following Fall 2021. As a whole, instructors may improve transparency and student success by incorporating more detail about classroom policies and expectations within their syllabi and striking a balance between penalty and leniency policies.

Future work will continue to use the Course Change Typology to analyze other traits of engineering syllabi. Additionally, data pulled from learning management systems will be utilized in tandem with the Course Change Typology values in order to minimize limitations and reference a more thorough dataset. This data will be converted using a scoring rubric to represent how closely an instructor's practices aligned with current best practices in engineering education and how these practices changed over time.

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