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Detecting Dimensions of Significant Learning in Syllabi Using a Course Change Typology

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Detecting Dimensions of Significant Learning in Syllabi using a Course Change Typology

Abstract

This research paper addresses the need for an instrument to detect the changes in the use of research-based approaches over time. Change occurs within three broad dimensions – what is being taught, how it is being taught, and the learning environment. This work focuses on the "what" instructors are teaching to provide context for the "how" and "environment" changes. The "what" has been operationalized in terms of significant learning of technical and professional skills as per ABET student outcomes. The purpose of this study was to characterize the extent to which significant learning of technical and professional skills are represented in syllabi from core engineering courses. Different types of course syllabi were examined (i.e., Lecture, Lecture/Lab, Capstone) from Fall 2019 through Spring 2022 from one engineering department's core courses at a large Midwest R1 institution. Descriptive statistics were used to examine the sensitivity of a typology to differences between course types and over time. Application of the Course Change Typology was useful in uncovering details about the typology dimensions of Significant Learning – Technical and Significant Learning – Professional utilized within different types of courses and changes over time.

Introduction

A top priority for organizations dedicated to engineering research and practice has been revolutionizing engineering classrooms to better prepare the next generation of engineers [1], [2], [3]. Instructors are adopting research-based approaches to teaching that are changing classrooms but these changes are often difficult to detect and track in ways that are useful for research and departmental action. Change occurs within three broad dimensions – what is being taught, how it is being taught, and the learning environment. This work focuses on the "what" instructors are teaching to provide context for the "how" and "environment" changes. The "what" has been operationalized in terms of significant learning of technical and professional skills as per ABET student outcomes.

The next generation of engineers need to be able to aptly employ their professional skills alongside their analytical skills to function effectively in the workplace and contribute to communities and economies. This implies a balance and integration of professional and technical skills acquisition. ABET EC2000 formally acknowledged that it is not sufficient for engineering education to primarily focus on technical skills development. The revision of the ABET student outcomes [4] continues to highlight the need for both technical and professional skill development. In prior research about whose responsibility it is develop these skills, it was noted that industry and academia primarily felt it was the responsibility of academia [5].

To improve the balance of technical and professional skill development across the curriculum, colleges or departments of engineering need meaningful ways to monitor and assess change. Therefore, it is necessary to develop instruments that are sensitive to change, are underpinned by research evidence, and can detect change from data that are readily available through teaching artifacts. The purpose of the current study was to characterize the extent to which significant learning of technical and professional skills are represented in syllabi from core engineering courses. Two dimensions of a course change typology were applied to a collection of syllabi to examine the sensitivity of the instrument to detecting difference in course type and changes across time. The disruption to higher education caused by the COVID-19 pandemic provided an opportunity to examine if significant learning of technical and professional skills changed.

Background

Development of the Course Change Typology

A larger longitudinal study (beyond the scope of the current paper) is being conducted to connect course change and faculty adaptability. The development of the Course Change Typology is intended to enable the classification of teaching practices and strategies engineering instructors use so that the extent to which a Wide Array of Teaching Practices and Strategies (WATPS) are being implemented in a course can be determined. A WATPS are linked to evidence-based practices and by tracking WATPS, stakeholders can identify movements in improving engineering education. The Course Change Typology (Table 1) was developed by two senior researchers using existing literature including work about significant learning [6], motivation [7], and instructors' role in student learning [8], [9]. From the literature, a list of research-based teaching practices and strategies that collectively could indicate a WATPS and could be detected in syllabi and learning management system data was assembled into codes.

Table 1. Original Course Change Typology dimensions and descriptions

Dimension	**Description**
Significant Learning - Technical	Degree of focus on engineering domain learning: *ABET 1 (problem solving; STEM principles), 2 (design) and/or 6 (experimentation & data)*
Significant Learning - Professional	Evidence of addressing professional skills development: *ABET 3 (communication), 4 (ethics), 5 (teaming, leadership), or 7 (learning strategies) via course grade or course activity*
Significant Learning - Integration	Evidence of bringing together technical and professional outcomes into learning experience
Active Learning	Opportunity for students to engage with material in sense-making activities and see different perspectives
Assessment	Degree of variety of substantive assessments and provision of formative feedback
Instructor Rapport	Opportunities to interact with instructor with attention to students' needs and demonstration of concern for individual circumstances (flexibility and empathy)
Transparency & Fairness	Indicators of helping students understand the course roadmap through guide-posting, organization, and explicitness

The codes were then grouped thematically into the seven dimensions of the Course Change Typology. Roughly, the themes of Significant Learning map to "what", the Active Learning and Assessment map to "how", and the Instructor Rapport and Transparency & Fairness map to "learning environment." The codes for the dimensions of Significant Learning – Technical and Significant Learning – Professional were the focus of the current study. Significant Learning was operationalized using the ABET student outcomes.

Feedback about the Course Change Typology was solicitated at two engineering education conference workshops [10], [11]. Modifications to the Course Change Typology were suggested for the dimensions of Instructor Rapport and Transparency & Fairness while the other five dimensions were agreed upon as being comprehensive and understandable.

ABET Student Outcomes

In an effort to ensure graduates from engineering programs meet various technical and professional requirements to be successful in the workforce, the Accreditation Board of Engineering and Technology (ABET) approved Engineering Criteria 2000 (EC2000) [12]. The development of EC2000 was a multi-year process; workshops were hosted to identify concerns of college deans and faculty, industry professionals, practicing engineers, and education researchers before publishing recommendations for change in undergraduate engineering programs [12]. These recommendations formed the basis for EC2000 which focused for the first time on student outcomes upon completion of an engineering degree program rather than on what was taught [4].

Today, there are seven ABET outcomes that graduates from all accredited undergraduate engineering programs must meet. Outcomes are split between technical learning and professional skill development in order to produce engineers that are well-prepared to enter the workforce [4]. The ABET outcomes focused on technical skill development are:

- ABET 1: Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET 2: Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- ABET 6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions

STEM problem solving, design, and experimentation are the specific technical skills that ABET accredited programs focus on. These skills are anticipated to equip engineering graduates to be technically proficient in the workplace. The ABET outcomes focused on professional skill development are:

- ABET 3: Communicate effectively with a range of audiences
- ABET 4: Recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

- ABET 5: Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- ABET 7: Acquire and apply new knowledge as needed, using appropriate learning strategies

Communication, ethics, teamwork, and learning strategy development have been identified as key elements of success in the engineering workplace [4]. By incorporating these elements of professional development into undergraduate curriculum, students have time to learn and grow in these areas before they enter the workforce. This combination of technical and professional skill development helps to launch recent graduates into successful careers, making it important for instructors to ensure that they are supporting students' growth in these areas.

The adoption of a WATPS enables instructors to support students in meeting all ABET outcomes throughout their undergraduate studies. Developing an understanding of how instructors use a WATPS to meet these outcomes provides the ability to create a support system to further adoption of a WATPS across engineering courses and programs.

Research Purpose and Questions

The purpose of the current study was to characterize the extent to which significant learning of technical and professional skills are represented in syllabi from core engineering courses by applying two dimensions of the Course Change Typology (Significant Learning – Technical and Significant Learning – Professional) and how the presence of each dimension changed over time. The research questions that guide this study are:

1. When the two dimensions of the Course Change Typology (Significant Learning – Technical and Significant Learning – Professional) are applied to course syllabi in a single engineering department, can differences be detected by course type?
2. Are there differences in the level to which the ABET outcomes are addressed by course type?
3. Are there differences in the level to which the ABET outcomes are addressed over time by course type?

Methods

Setting and Participants

The setting for this study was a large R1 University located in the Midwestern United States. The college of engineering at the university was comprised of seven departments and consisted of approximately 175 instructors that contributed to the undergraduate teaching mission each semester. All departments were invited and agreed to participate in data collection.

Data Collection

As part of a larger study, teaching artifacts were gathered from each engineering department. These artifacts included course syllabi for all engineering courses taught from the Fall 2019 through the Spring 2022 semesters. The Spring 2020 semester included two syllabi – one from the start of the semester and a modified COVID syllabus from March to end of the semester. The modified COVID syllabus was a requirement of the university. For this study, syllabi from a single department were chosen for analysis as the Course Change Typology was being developed and tested. From these syllabi, the core courses required for students were selected for coding. Core courses were selected for analysis as they are routinely taught, are required of all students in that major, and have enrollment numbers greater than 10. This resulted in a total of 128 course syllabi to be analyzed over the entire data collection period.

Data Analysis

Data analysis began with determination of the Course type from the syllabi. Designations of Lecture, Lecture/Lab, or Capstone were used. The course type code was used as an identifier to separate courses into well-defined course types for further analysis. These course types were utilized as it is expected that these course types will focus on particular ABET student outcomes. Lecture is most likely to focus on ABET 1. Lecture/Lab is most likely to focus on ABET 1 and 6. Capstone is most likely to focus on ABET 2, 3, 4, and 5. These classifications of a course type allow for the examination of the sensitivity of the Course Change Typology.

The data analyzed for this study included only the codes relative to two dimensions of the Course Change Typology (Significant Learning – Technical and Significant Learning – Professional). The two dimensions were operationalized in terms of ABET student outcomes though the ABET student outcomes were not always explicitly stated and had to be inferred from course assignments, activities, schedule, and content. In addition to determining whether an ABET student outcome was addressed in a syllabus, the level to which the ABET student outcome was addressed in the syllabus was also coded (Table 2). An additional code for course type was utilized for contextual purposes.

Table 2. Level of outcome code for each ABET outcome identified

Code	**Definition**
No Evidence (0)	Student outcome is omitted from course
Declared But No Evidence (1)	Student outcome is stated as being met, but there is no evidence in course content
Low (2)	5-45% of class periods or course grade is dependent on ABET student outcome
Medium (3)	45-75% of class periods or course grade is dependent on ABET student outcome
High (4)	75-100% of class periods or course grade is dependent on ABET student outcome

Two novice researchers applied the Course Change Typology codes deductively to the syllabi. These researchers established an inter-rater reliability of 90% (simple agreement) for each ABET code and Level of Outcome code before coding all the core syllabi from a single department.

Figure 1 illustrates an example of how Level codes were applied to one course syllabus. The grade breakdown for this course was distributed between STEM content (homework and exams) and open-ended design problems. This meets Student Outcomes ABET 1 and ABET 2. Based on the percentage of the final grade that was attributed to each outcome, they receive Level of Outcome codes of 4 and 2 respectively. Once coding was completed, descriptive statistics were used to show the frequency of each code by course type and across time.

Grading:	Homework Project Midterm Exams (2) Final Exam	10% 10% 50% 30%	**ABET_1: 4** 90% of grade **ABET_2: 2** 10% of grade
Homework:	Homework assigned on Tuesday will be due the following Tuesday. Small design projects will be assigned throughout the semester. Design projects are open-ended problems, which may have several answers.		
Exams:	Two midterm exams will be given during the semester. The dates of the midterms will be announced one week in advance. The final exam will be comprehensive and be given according to the university schedule. The midterm and the final exams will be open book and notes.		

Figure 1. Section of a coded syllabus

Results

The following sections provide an overview of the results by course type relative to each dimension of the Course Change Typology analyzed. The second section outlines the level at which each dimension was present by course type. The final section focuses on how the levels changed over time for each course type.

Overview

Using descriptive statistics, the relationship between course type and student outcomes supported by classroom teaching practices was analyzed. Table 3 shows the percentage of syllabi that contained evidence of each ABET Student Outcome by course type from all syllabi collected from the Fall 2019 through the Spring 2022 semesters.

Table 3 shows that ABET outcome 1 was represented across all lecture style courses and ABET outcome 6 was not represented in any of the lecture courses. For combination lecture and lab style courses, ABET outcomes 1 and 6 were represented in over 90% of syllabi, and ABET 5 was represented in over half of the syllabi. ABET 2, 3, 4, and 5 were represented in all capstone course syllabi.

Table 3. ABET Student Outcomes indicated in Syllabi by Course Type (*n* = 128 syllabi)

Course Type	ABET Outcomes						
	Significant Learning - Technical			**Significant Learning - Professional**			
	1 (ProbSolv)	**2 (Design)**	**6 (Exp/Data)**	**3 (Comm)**	**4 (Ethics)**	**5 (Team/Lead)**	**7 (LearnStrat)**
Lecture (*n* = 90)	100%	28.9%	0%	13.3%	4.4%	18.9%	1.1%
Lecture/ Lab (*n* = 26)	96.2%	23.1%	92.3%	38.4%	0%	61.5%	0%
Capstone (*n* = 12)	16.7%	100%	0%	100%	100%	100%	0%

Course Type Analysis

Each course type was also analyzed to identify the level at which ABET student outcomes were represented in student activities outlined within the syllabi. Table 4 shows the percentage of syllabi that contained student activities related to each ABET outcome for lecture courses. For Lecture courses, there were high indications of course activities aligned with Significant Learning - Technical (ABET 1, 98.9% of courses), and very low indications of Significant Learning – Professional (ABET 3, 4, 5, 7). There was a noticeable absence of opportunities (100% no evidence or declared but no evidence) for students to engage with ethics (ABET 4), experimentation (ABET 6), and learning strategies (ABET 7) in these courses. Opportunities for design (ABET 2), communication (ABET 3), and teamwork (ABET 5) existed at low levels (20%, 8.9%, and 13.3% respectively) when present.

Table 4. Level percents by student outcome for lecture courses (*n* = 90 syllabi)

Typology Dimension	**ABET Outcome**	**No Evidence**	**Declared but no Evidence**	**Low**	**Medium**	**High**
Significant Learning - Technical	1 (ProbSolv)	0%	0%	0%	1.1%	98.9%
	2 (Design)	71.1%	7.8%	20%	1.1%	0%
	6 (Exp/Data)	100%	0%	0%	0%	0%
Significant Learning - Professional	3 (Comm)	86.7%	4.4%	8.9%	0%	0%
	4 (Ethics)	95.6%	4.5%	0%	0%	0%
	5 (Team/Lead)	81.1%	5.6%	13.3%	0%	0%
	7 (LearnStrat)	98.9%	1.1%	0%	0%	0%

Table 5 shows the percentage of syllabi that contained student activities related to each ABET outcome at each level for Lecture/Lab courses. For Lecture/Lab courses, there were high indications of course activities aligned with Significant Learning - Technical (ABET 1, 46.1%

medium and high, and ABET 6, 57.7% medium and high), and moderate indications of activities aligned with Significant Learning - Professional (ABET 3, 38.5% medium and high). Teamwork opportunities were available in the majority of courses but at low levels (ABET 5, 50%). Opportunities for development of learning strategies (ABET 7, 100% no evidence), and ethics (ABET 4, 100% no evidence) were again noticeably absent.

Table 5. Level percents by student outcome for combination lecture & lab courses (*n* = 26)

Typology Dimension	ABET Outcome	No Evidence	Declared but no Evidence	Low	Medium	High
Significant Learning - Technical	1 (ProbSolv)	3.8%	0%	50%	11.5%	34.6%
	2 (Design)	76.9%	7.7%	7.7%	7.7%	0%
	6 (Exp/Data)	7.7%	0%	34.6%	15.4%	42.3%
Significant Learning - Professional	3 (Comm)	61.5%	0%	0%	7.7%	30.8%
	4 (Ethics)	100%	0%	0%	0%	0%
	5 (Team/Lead)	38.5%	11.5%	50%	0%	0%
	7 (LearnStrat)	100%	0%	0%	0%	0%

Table 6. Level percents by student outcome for capstone courses (*n* = 12 syllabi)

Typology Dimension	ABET Outcome	No Evidence	Declared but no Evidence	Low	Medium	High
Significant Learning - Technical	1 (ProbSolv)	83.3%	0%	0%	16.7%	0%
	2 (Design)	0%	0%	0%	0%	100%
	6 (Exp/Data)	100%	0%	0%	0%	0%
Significant Learning - Professional	3 (Comm)	0%	0%	25%	75%	0%
	4 (Ethics)	0%	100%	0%	0%	0%
	5 (Team/Lead)	0%	0%	0%	0%	100%
	7 (LearnStrat)	100%	0%	0%	0%	0%

Table 6 shows the percentage of syllabi that contained student activities related to each ABET outcome at each level for Capstone courses. For courses labeled as Capstone, there were low indications of course activities aligned with Significant Learning - Technical (ABET 1, 83.3% no evidence, and ABET 6, 100% no evidence), and high indications of activities aligned with Significant Learning - Professional (ABET 5, 100% high, and ABET 3, 75% medium). Teamwork (ABET 5) and design (ABET 2) opportunities were universally represented at the highest possible level. Ethics (ABET 4) was included in all courses at the lowest level (100% declared but no evidence).

Across Semester Analysis

The level to which ABET student outcomes were indicated in syllabi also changed by semester for each course type. Table 7 shows the average level of each ABET student outcome for each semester of data collection. There may be some indications that the shift to remote instruction due to COVID-19 in Spring 2020 had some impact on Significant Learning – Professional for communication and teamwork (ABET 3 and 5, respectively) in lecture courses. The instrument is perhaps picking up some efforts in the Spring 2021 and Spring 2022 semesters by the department to integrate design into the curriculum. Ethics (ABET 4) was not present in lecture course syllabi until the Fall 2020 semester, and when included, was only present in a single course for the remainder of the data collection period. Overall, Significant Learning –Technical, specifically problem solving (ABET 1) does not show change over time.

Table 7. Average ABET outcome levels across semesters for lecture courses

Semester	ABET Outcomes						
	Significant Learning - Technical			Significant Learning - Professional			
	1 (ProbSolv)	2 (Design)	6 (Exp/Data)	3 (Comm)	4 (Ethics)	5 (Team/Lead)	7 (LearnStrat)
Fa19 (*n* = 16)	4	0.4	0	0.3	0	0.3	0
Sp20 (*n* = 14)	4	0.5	0	0.4	0	0.2	0
COVID (*n* = 8)	4	0.4	0	0.1	0	0.1	0
Fa20 (*n* = 12)	4	0.2	0	0.2	0.1	0.3	0
Sp21 (*n* = 13)	3.9	0.8	0	0.3	0.1	0.4	0
Fa21 (*n* = 15)	4	0.5	0	0.1	0.1	0.5	0
Sp22 (*n* = 12)	4	0.9	0	0.2	0.1	0.4	0

Table 8 displays the average level of each ABET student outcome for each semester of data collection for Lecture/Lab courses. Ethics (ABET 4) is notably absent from all course syllabi across all semesters. The shift from the fully remote COVID semester to the hybrid Fall 2020 semester saw the most change for Significant Learning - Professional. Communication and teamwork both decreased in Lecture/Lab courses (ABET 3 and 5, respectively) in the Fall 2020 semester, with both outcomes completely disappearing from course syllabi. Significant Learning

– Technical, specifically design (ABET 2), saw a decrease during Fall 2020 and Spring 2021 before increasing in Fall 2021.

Table 8. ABET outcome levels across semesters for lecture/lab courses

Semester	ABET Outcomes						
	Significant Learning - Technical			Significant Learning - Professional			
	1 (ProbSolv)	2 (Design)	6 (Exp/Data)	3 (Comm)	4 (Ethics)	5 (Team/Lead)	7 (LearnStrat)
Fa19 (*n* = 5)	2.4	0.8	3	1.6	0	1.2	0
Sp20 (*n* = 4)	2.8	0	3.3	2	0	1.5	0
COVID (*n* = 3)	2.3	0.7	3.3	2.7	0	1.7	0
Fa20 (*n* = 2)	3	0	2.5	0	0	0	0
Sp21 (*n* = 2)	3	0	3	1.5	0	1.5	0
Fa21 (*n* = 4)	2.8	0.8	2.3	1	0	1.3	0
Sp22 (*n* = 6)	3	0.5	2.7	1.7	0	0.7	0

Table 9 shows the average level of each ABET student outcome for Capstone courses across each semester of data collection. Levels for Significant Learning – Technical, specifically design (ABET 2), and Significant Learning – Professional ABET student outcomes for ethics, teamwork, experimentation, and learning strategies were consistent for all semesters (ABET 4, 5, 6, and 7, respectively). Design (ABET 1) levels peaked in Spring 2020 (1.5) with no change due to the pandemic. However, these levels returned to zero in the Fall 2020 semester. Communication (ABET 3) levels also saw a change post-remote learning, with an increase starting in Fall 2020 (from 2.5 to 3).

Table 9. ABET outcome levels across semesters for capstone courses

Semester	ABET Outcomes						
	Significant Learning - Technical			**Significant Learning - Professional**			
	1 (ProbSolv)	**2 (Design)**	**6 (Exp/Data)**	**3 (Comm)**	**4 (Ethics)**	**5 (Team/Lead)**	**7 (LearnStrat)**
Fa19 (*n* = 2)	0	4	0	2.5	1	4	0
Sp20 (*n* = 2)	1.5	4	0	2.5	1	4	0
COVID (*n* = 2)	1.5	4	0	2.5	1	4	0
Fa20 (*n* = 2)	0	4	0	3	1	4	0
Sp21 (*n* = 1)	0	4	0	3	1	4	0
Fa21 (*n* = 21	0	4	0	3	1	4	0
Sp22 (*n* = 1)	0	4	0	3	1	4	0

Discussion

The Course Change Typology was able to identify differences in syllabi by course type along the dimensions of Significant Learning – Technical and Significant Learning – Professional. Within the dimension of Significant Learning – Technical, the ABET student outcome emphasis was as expected for course type. Lecture courses focused predominantly on problem solving and technical content (ABET 1) and was expected for this course type. Lecture/Lab courses focused on experimentation and data (ABET 6) while still having a strong focus on problem solving and technical content (ABET 1) and was expected for this course type [13]. Capstone courses focused on ABET 2. Within the dimension of Significant Learning – Professional, Lecture courses contributed relatively little to the ABET outcomes. Lecture/Lab courses contribute to communication (ABET 3) and Teamwork (ABET 5). Capstone contributed to communication (ABET 3), ethics (ABET 4), and teamwork (ABET 5). This emphasis on Significant Learning - Professional aligns closely with the desired outcomes for capstone courses [14], [15].

The Course Change Typology was also able to detect changes in the level to which ABET student outcomes were addressed and how the level changed over time. The sensitivity of the Course Change Typology was further exemplified through the COVID-19 event where course changes were made more frequently than a typical semester as the situation evolved. Changes in ABET level over time indicated the impact COVID-19 had on Significant Learning -Technical (ABET 2) and Significant Learning – Professional (ABET 3 and 5) in lecture courses. This was not unexpected, as many instructors experienced struggles with implementing design, communication, and teamwork activities in a remote space [16], [17]. Lecture/lab courses saw the most changes due to the disruption. The decrease in Significant Learning – Technical, specifically design (ABET 2) and experimentation (ABET 6), and a decrease in Significant Learning – Professional, specifically communication (ABET 3) and teamwork (ABET 5), indicate that the Course Change Typology was sensitive enough to detect changes. ABET levels in Capstone courses saw very little change across semesters due to the pandemic. This consistency could be due to several factors (experience teaching the course, ease of moving content online, external instructor support, etc.) and requires more research to identify a specific cause.

The extremely low indication of Significant Learning – Professional in terms of learning strategies (ABET 7) across all course types and across time illuminates an opportunity for providing faculty development in this area.

Limitations

Several limitations to the study exist. First, it should be noted that instructors were not always explicit in the ABET outcomes that the course was addressing – this often required the researchers to search through the syllabi to find this information. Second, the study focused on a single department at a single university. Applying the Course Change Typology to a broader set of data would further assist in demonstrating its sensitivity and robustness. Finally, only a single teaching artifact was analyzed. To ensure the sensitivity of the Course Change Typology to detect change, additional teaching artifacts need to be considered.

Conclusion and Future Work

This work focused on examining the sensitivity of an instrument for detecting and measuring course change using teaching artifacts, in this case syllabi, for the purpose of providing evidence of change in the use of a WATPS. The results from this work have shown that the Course Change Typology is useful in uncovering details about the dimensions of Significant Learning – Technical and Significant Learning – Professional. Sensitivity was demonstrated between course types and across semesters in which there was a known change to instruction (i.e., COVID-19). Further application of the typology will enable the detection of other teaching practices and strategies from a course syllabus, providing a more complete picture of course change.

In addition, future work will also entail applying the typology to a wider variety of course artifacts including LMS data. Expanding the analysis of artifacts beyond course syllabi will allow for detection of other practices and strategies that can be difficult to detect from syllabi, particularly if instructors have relatively minimalist or stagnant syllabi. Future work will also expand the application of the Course Change Typology beyond a single department at a single university to best meet the needs of a wide variety of colleges, departments, and instructors.

The development of the Course Change Typology was the first aim in a multi-step project. Future work will explore personal characteristics of instructor adaptability to allow for the development of rich descriptions of course change in terms of instructor adaptability. Collection and analysis of self-reported instructor data from two instruments, the *Cognitive, Behavioral, and Emotional Adaptability Model* (CBEAM) [18] and the *Individual Adaptability Theory* (I-ADAPT) [19] will serve as the next aim in this project. Ultimately, connecting course change to adaptability will allow for the creation of a means for colleges, departments, and professional faculty developers to strategically support individual instructor's teaching development.

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