Improving STEM Classroom Culture: Discourse Analysis

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***Abstract*— Every classroom constructs its own culture through the interactions of all participants, students and instructors. This culture, often covert or invisible, has a direct impact on students' opportunities to learn. Therefore, it is critical that instructors understand their classrooms' interaction patterns and their effect on student learning. We suggest that discourse analysis may serve as a tool to enhance instructors' understanding of their classrooms and to serve as an intervention particularly useful for junior faculty as they are beginning their teaching career. To this end, this paper (1) describes the theoretical foundation of discourse analysis and (2) demonstrates its application, effectiveness, and applicability in STEM classrooms, particularly at the introductory level, the time when students make their first steps in negotiating 'academic literacies'.**

Keywords*— *discourse analysis; qualitative methodology; academic literacies; first-year engineering courses

I. INTRODUCTION

In the last few years, an increasing number of scholars have called upon the engineering education research community to expand the predominant quantitative and positivist paradigm to include a broader and more diverse range of epistemologies, theories, and methodologies [1]-[8]. Broadening engineering education scholarship will allow access to a larger spectrum of possible research questions and ensuing understandings about ways engineering is taught and learned. By including a range of research perspectives, the engineering education research community may delve deeper into the fundamental questions about engineering students' learning experiences and extend the current discourse about student learning from a purely cognitive enterprise to a socially constructed endeavor [8, and the literature cited therein].

This paper presents discourse analysis method as a way of exploring the question of students' learning experiences situated in various socio-cultural contexts. We maintain that discourse analysis, albeit underutilized to date in engineering education research, allows for understanding classroom culture as it is being created through the interactions between all participants, students and instructors. Specifically, the focus on the classroom use of language provides a lens to understand students' learning opportunities [8]-[14].

To this end, we situate our discussion in the research on 'academic literacies' while also co-opting this term to embrace ideas that go beyond the traditionally defined boundaries of the engineering education research field. Epistemologically, literacies are considered social practices, in which students negotiate, often conflicting, academic and experiential discourses [8],[14],[15]. Literature on the subject maintains that it is through this process of negotiation that students work towards finding their professional identities [8]. We propose, however, that the term 'academic literacies' need to encompass students' understanding of 'the rules of the game' in each classroom context, i.e., the micro-actions and micro-discourses embedded in each classroom's activities that serve as opportunities to learn [2]. We argue that in the absence of knowing 'how to play each classroom's game,' students do not take advantage of opportunities to learn, preventing them from further learning particular academic discourse needed for realization of professional identities.

Thus, in this paper we draw on the work of Courtney Cazden (2001) to describe the academic literacies developed in classrooms by focusing on micro-actions and variations in discourse features [10]. As such, in addition to describing qualitative features of the classroom discourse that form the cognitive basis of students' professional development, we employ quantitative methods to measure the ability of all students to gain access to learning. By using this mixed-methods framework, we demonstrate how the effectiveness of comprehending communication may be measured through the ability of all participants, at any given moment, to actively share in the co-creation of classroom culture and for students "to know what they are talking about and feel confident that all the parties involved refer to the same things when using the same words" [16].

In Cazden's framework, the classroom culture is created by all participants through actions such as obtaining speaking turns, gaining the floor, active listening, pacing and sequencing, classroom routines, etcetera [10]. We demonstrate how these actions, which serve as a source of quantitative data, along with qualitative observations can be used to generate a holistic picture of the classroom's culture. Specifically, we do so in the context of introductory mathematics courses, which serve either as a gateway to a technical degree or a requirement for a non-technical one. In all cases investigated, the courses are situated at the critical time in students' overall development as they are making their first steps in negotiating 'academic literacies' [14],[15]. Therefore, understanding the cultures of those specific classrooms becomes of particular importance. Moreover, we illustrate how discourse analysis method may be used as an early intervention for junior faculty as they are beginning to shape their pedagogical identities and skills.

We conclude with a description of how discourse analysis method allows for identifying what students have better opportunities to succeed in the specific classroom cultures investigated and how faculty perceive their post-intervention evolution with an emphasis on the ways in which they can then take concrete steps to make overt the classroom culture, otherwise invisible to students, and reshape it to expand learning opportunities for all participants.

II. Discourse Analysis Method

A. Methods

We investigated three introductory mathematics classrooms at three different undergraduate institutions: one at an engineering school, another at a liberal arts college, and the third at a business school. All classrooms were led by an early-career instructor (either in his second or fourth semester of teaching). Three classroom meetings of each course were videotaped and one videotaped session from each was chosen for transcription and further analysis [17, and the literature cited therein]. Analysis began with the creation of broad categories typical of discourse analysis studies: the number of interactions initiated by the instructor and students, the amount, "density," and quality of instructor's and students' discourse, etc. This was achieved by breaking transcribed discourses into message units, interaction units, and instructional units (defined below). Multiple passes through the data allowed for enumerating and qualifying various items of interest (e.g., quantity and quality of faculty feedback, type of questions, etc.), which revealed specific interaction patterns. To summarize our findings for each classroom, we used three representations: graphical visualization of the numerical data; short narratives describing a typical student's experience; and a 'taxonomic map' of the classroom's culture. These representations allowed a holistic understanding of each classroom's unique culture and, moreover, identification of these cultures' aspects that students ought to have understood to take full advantage of learning opportunities.

B. Nomenclature

In what follows, we present the discourse analysis terminology used throughout the paper.

Interaction units are defined as "turn-taking" between classroom participants [2]. For example, the following episode contains three interaction units. For visual identification, interaction units are separated by horizontal lines:

Instructor: *First, tell me the type of curve it is. It has a name, right? We know that?*
Student: *Parabola.*
Instructor: *It's a parabola.*

Instructor: *And it opens up or down?*
Student: *Up.*
Instructor: *Up.*

Instructor: *So, the coefficient of the x squared term is positive or negative?*
Student: *Positive.*
Instructor: *Positive.*

In this episode, the instructor begins each interaction, the student then responds, and the instructor follows up with feedback. This is a typical example of what is called the IRF pattern (Initiation-Response-Feedback). Many interactions, however, do not fall into such a neat arrangement. For example, an instructor may ask a student a series of questions to elicit a desired response. A turn-taking may then be considered to be "complete" either after each student's response, or after the instructor moves on to a new line of questioning or to a different student altogether. The way interaction units are identified is subject to the information sought in specific classroom discourse.

A message unit is defined as "the smallest unit of meaning." In practice, this can be interpreted as the smallest portion of speech that evokes a complete image or thought. For example, in the previous example, message units, delineated by slashes, may be defined in the following way:

First tell me / the type of curve it is. / It has a name, / right? / We know that?

Finally, the largest unit of analysis identified in discourse analysis is that of an instructional unit. An instructional unit is usually defined as a change of interaction pattern and/or of content. For example, in a class session that has three instructional units, a teacher may start by lecturing, then allow time for group work, followed by the group report-outs. In this example, the lesson moves in a very linear way and the instructional units, sometimes known as lesson phases, are clear to all participants. Other classrooms may follow a different pattern. For example, an instructor may choose to shift from topic to topic based on student feedback or spiral around a central class theme; yet other classrooms may have loose instructional units whose transitions are obscured by frequent, off-topic interruptions.

To some extent, identification of interaction, message, and instructional units is subject to the specific analytical practices used by an analyst. The robustness of the results lies in the analytical consistency and high inter-coder reliability.

C. Analytical Representation

The results of the analysis may be represented in several different ways. Used together, these representations allow for a comprehensive in-depth description of quantitative and qualitative results. For example, data can simply be represented in terms of raw numbers of interaction, message, and instructional units. Alternatively, a series of bar charts or other graphical representations may be used to capture major patterns in classroom discourse. A short narrative of what an analyzed class might look like from a student's perspective may serve as yet another illustration of classroom discourse.

This particular portrayal of data usually supplements quantitative results and allows for a detailed description of qualitative findings. Finally, a taxonomic map allows for a visual depiction of the classroom culture with ensuing understandings about a type of student that might thrive in a given classroom environment. A taxonomic map can also be used to understand the processes necessary to support students' success in each classroom culture and serve as an intervention for instructors' professional development.

In this particular study, the taxonomic map incorporated both quantitative and qualitative features along with some open questions. This allowed us to use the taxonomy to generate a conversation with the instructors about their classroom culture and the processes they follow to co-create interactive contexts in their classrooms. In our dialogue with participating instructors, we were able to identify important aspects of each classroom that students need to understand in order to successfully take advantage of learning opportunities.

Ultimately, discourse analysis has several benefits when used in the appropriate context. Breaking down a classroom's discourse into countable units allows an analyst to quantifiably answer questions about the procedures and processes that govern classroom interaction. Those objective results can reveal an overall picture of the classroom's culture, and various methods of data interpretation may be used to help the instructors understand that culture from many angles so that they can overtly communicate their unique interaction "rules" to students.

III. Our Study

To give context for our results we first offer a description of the format and content of each of the three classes analyzed. Next, we present the results of the study by first explaining emerging catgories for all three classrooms and sharing an illustration and interpretation of one taxonomic map. We also include a cross-class comparative analysis of our findings for each classroom and present them as models-in-use, i.e., examples, but not generalizations, of similar classes.

A. Abbreviated Class Narratives

All three mathematics classes investigated were introductory in nature and prerequisite either for attainment of a major or as a distribution requirement. As well, early-career faculty, all men, taught all three classes. Set in the context of different institutions, however, each class had its own unique structure, pattern of interactions, and overall discourse. Below are much abbreviated narratives about each observed class.

At the *engineering school*, the classroom was significantly larger than the other two with 72 students and an approximate ratio of 50/50 men to women. This class ran 100 minutes and was held in an auditorium, with a single large white board at the front of the room. The distinctive feature of this class was that three mathematics instructors were always present in the room. For each lesson, one of the instructors was designated as a "main lecturer," while others chimed in to either clarify an answer to a question or to expand on the material presented. The lesson analyzed for this study was presented by the most junior instructor in his fourth semester of teaching at the school. The lesson took the form of an interactive lecture that began with a discussion and clarification of the course format and expectations, quickly transitioning to the presentation of the main topic, differential equations. Guided by students' questions, the instructor briefly reviewed and clarified content presented in previous lessons and homework assignments. When students had no further questions, the instructor moved to introducing new content: linearization, phase plots, and phase planes. The instructor frequently solicited and entertained students' questions, often taking him away from the lesson's focus. However, he quickly realigned himself with the class agenda while still responding to students. (His colleagues occasionally spoke up as well.) On several occasions, students' questions were only briefly or partially answered under the premise that the full answers would be included in later portions of the lecture. The interactive nature of the lesson was established by frequent exchanges between instructor(s)' lecture and student questions/comments. These exchanges were either instructor-to-individual student or instructor-to-student group. There were no student-to-student interactions during the lesson, that is, we did not observe any partner- and/or small-group work. Throughout the entire lecture, the instructor allowed for no deviations away from the main lesson's content.

The *liberal arts college* classroom was the smallest of the classes observed with only 14 students, all women. The lesson ran 75 minutes and took place in a room that had individual desks arranged in two rows, all facing a "smart" interactive white board. The instructor was in his second semester of teaching at the college. The content of the analyzed lesson included convergence of power series. The instructor taught the lesson in a traditional lecture format. There was some individual and pair work. The instructor began the class with a review of a quiz taken by students during the previous class session. He then moved into sharing the results of a student feedback survey regarding the course. The instructor then transitioned into the day's lesson by stating the lesson goal, representing functions as power series, and recapping what the class had learned about the topic up to that point. He gave an example of a function the class was familiar with, and asked questions beyond the students' knowledge to justify the importance of what was to come during the lesson. Although the instructor frequently solicited questions, they were usually met with silence; yet, for simple questions that required (dis)agreement, students seemed to respond through nodding of their heads or other non-verbal cues. During a short period of individual work, the instructor asked students to solve a problem on their own. As students did so, the instructor checked individual student progress and answered questions, making sure to stop by each desk. At the end of this individual seatwork, the instructor brought the students back together and stepped through the problem with the entire class. The instructor concluded the lesson by solving an additional example problem. The interaction during the presentation of

both sample problems consisted of lecture interspersed with instructor's questions, infrequently followed by students' answers. Throughout the entire lesson, the instructor's focus remained on presenting the relevant material allowing for no social language and little teacher-student interactions.

Similarly to the classroom in *liberal arts college*, the class in *business school* was relatively small, 17 students, with a male to female ratio of 12:5. The class was 80 minutes and was held in a classroom arranged in two semicircular arcs centered on a series of white boards at the front. A new faculty member, in his second semester, taught the class. Similarly to the lesson in liberal arts school, the class took a form of a lecture with a group work component. The lesson began by the instructor reviewing a recent quiz with a detailed presentation of each problem on the board. The lecture then moved to a discussion of a simple and compound interest. At each step, the instructor made a point to differentiate between an asset's present and future values based on certain interest rates and initial investments. Following the presentation of the new concepts, the instructor asked the class to work on a problem in small groups. During this mini-session of problem-solving, the instructor walked around the classroom answering students' individual questions. The instructor did not solicit questions from student groups; rather, he spoke only to the groups that had specific questions. In the final few minutes of class, the instructor quickly presented the process of solving the problem at hand and demonstrated the correct solution. Students in this course frequently interrupted both the instructor and one another. These interruptions ranged from questions about problems that had already been discussed earlier in the lesson to questions about grading. Some students' questions were unrelated to the course and were of a personal or social nature. These interruptions required the instructor to suspend the flow of the lesson, go back to previously presented material and/or discuss content tangential to the lesson's objectives.

B. Comparison of Variables

After multiple passes through the data coding the *quantity and quality* of each set of units (interaction, message, and instructional) from the transcribed classroom discourses, we arrived at ten emerging categories. These categories were: (i) overall interaction units (both initiated by the instructor and students); (ii) overall message units (both those of the instructor and student); (iii) questions asked by instructor; (iv) instructor feedback; (v) student name use; (vi) instructor use of "I" vs. "We"; (vii) social content vs. pedagogical content; (viii) interruptions; (ix) student participation (i.e., "density" of student message units); and (x) theoretical vs. "real life" application content. The above categories served as a basis for ensuing quantitative and qualitative analyses within and across the classes. Below we describe most prominent categories as a way to understand social interactions of the classrooms studied.

1) Number of interaction/message units

In what follows we report quantitative data and analyses; statistical methods are not used in reporting our analytical findings as data demonstrated refers to specific units counted in one class at each school. Fig. 1 compares the number of interaction and message units per instructional hour initiated by the instructor with those started by students in each class. With only 80 interaction units/hr commenced by the liberal arts instructor in comparison to 124 and 135 in the engineering and business lessons, respectively, this seems to be the least "interactive" class. The number of interaction units/hr initiated by the students in each class, with only 16 in the liberal arts college in comparison to 23 and 83 in the engineering and business schools, respectively, supports the description of least "interactive" class as well.

When paired with the message units "density" data (the number of message units per instructional hour), however, the following picture emerged. With the 1749 instructor's vs. 134 students' message units/hr, the lesson in the liberal arts college remained the least "interactive" of the three. The corresponding numbers in the engineering and business school lessons were 1507 vs. 361 and 1974 vs. 449, respectively. This indicates that the low density of interactions in the liberal arts school does not correspond to a decreased number of message units, i.e., the density of the information shared by this instructor was quite significant, in fact, even larger than that at the engineering school. What this implies, however, which is what we qualitatively observed as well, is that the liberal arts classroom had the least student participation, solicited or otherwise. This qualitative observation bears out in the quantitative finding that only 7.1% of all message units in this class came from the students.

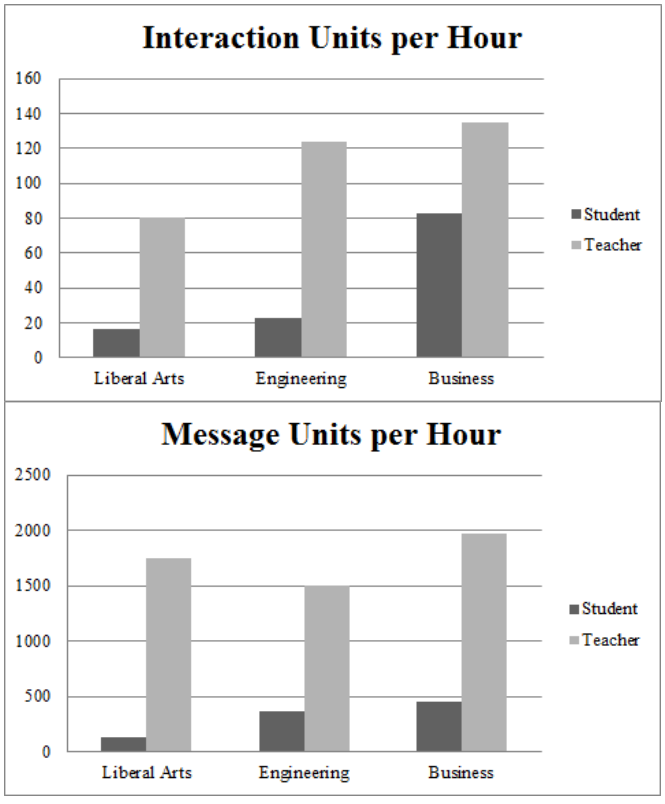

Fig.1. Number of interaction and message units per instructional hour initiated by the instructor and students in each class.

In the business and engineering courses, 81.5% vs. 80.7% of all message units were faculty discourse. This implies a high students' participation rate, which was both observed qualitatively in the two classes and bears out in the quantitative findings, i.e., 18.5% and 19.3% of all message units in these classes, respectively, come from the students.

2) Student vs. teacher initiated interaction units

In comparison to the classrooms at the liberal arts and the engineering colleges, the classroom at the business school boasted the largest density of both interaction and message units initiated by the instructor and the students. In fact, students initiated 38.1% of all interactions in this classroom. This is in comparison to 16.7% in the liberal arts and 15.6% in the engineering lessons, respectively. By this measure, the business school class was the most interactive of the three in terms of the student initiations. Measured by the instructor's message unit density, the overall information shared by the instructor in this class was comparable to that of the instructor at the engineering school.

The classroom "interactivity" may be also measured by the participation rate, i.e., the number of students participating in the classroom discourse. From this perspective, the lesson in the liberal arts college remains to be the least "interactive" with only 20% of students engaging in the overall classroom discussion (3 out of 14). On the other hand, using these quantitative data, the lesson at the business school continues to be the most interactive with 70% student engagement (12 out of 17), and the class at the engineering school having intermediate level of student participation at 38% (27 students out of 72).

3) Interruptions

Classroom "interactivity" measured simply by the interaction unit density, whether initiated by the instructor or the students, or by the students' participation rate, however, is a poor measure of what goes on in the classroom. This is because interaction units initiated by the students are not the same qualitatively. The quality of contribution to the classroom discourse differs greatly from classroom to classroom and from student to student. For example, the lesson at the business school had the highest number of student-initiated interaction units, but most were categorized as interruptions. An example of such interruptions, indicated by dashed horizontal line, is demonstrated below:

Instructor: *Okay. / So, i equals prt. / I'm going to leave it here. / And we're going to move on to compound interest. / Because/ this is, this is a pretty, / a pretty straightforward idea. /*

_ _

Student Larry: Professor, /what did you do for RIM? /

Instructor: *Um, we'll talk about it after class, / because/ we have to get through a lot. / But/ not much. /*

Student Elsa: What? /

Instructor: *I worked for Blackberry/ – the, the company that makes Blackberry phones. / Um, but/ I only worked there a semester during grad school. /*

At 30 such interruptions per hour, or one interruption every two minutes, the quality of this lesson's "interactivity" is pedagogically questionable. The quantitative data, taken with the qualitative observation, indicate that the class seemed to have developed a culture wherein students had learned that interruptions are acceptable. Some students had come to understand they would receive a response, either from faculty or a fellow student, notwithstanding the time, content, and suitability of the questions.

In comparison, interruptions were either small in number (6 per hour) or non-existent at the engineering and liberal arts schools, respectively. Combining these data with the qualitative observations, we find that these two lessons were highly focused on the subject matter with the emerging culture of the speaking rights belonging to the instructors who nevertheless welcomed students' content-centered input.

4) Questions

In terms of the questions asked in each classroom, the instructors presented a differing number of inquiries (85 in the engineering school, 75 in the liberal arts, and 143 in the business school classes). The instructor in the liberal arts school asked 85% of all questions during the class session, while the percentage of all the questions asked by the instructors at the engineering and business schools were, respectively 65% and 63%. These quantitative findings combined with the qualitative observations of the three classrooms indicate an interesting set of cultural paradigms.

In addition there were interesting qualitative differences observed in the type and format of the questions. The instructor in the liberal arts school tended to ask multiple questions before receiving an answer – sometimes as many as four questions were asked in sequence before a student responded. The students seemed to expect multiple questions, each increasing in focus in terms of content solicited. To ensure "the correct" response, therefore, a student may have developed a strategy of waiting until the last question to better understand what the instructor wanted to hear:

Instructor:

So, / what we see/ here in black/ is the actual curve 1 over 1 minus x./ Right…/and it makes sense, / because/ it seems like / it has an asymptote at x equals 1./ Um, so it seems like/ it's the right curve./

Instructor: *So, / can anyone tell me/ what they think this thing /in red is?* ***[4 sec silence]*** */ Any ideas?* ***[4/5 sec silence]*** */ First tell me / the type of curve it is./ It has a name, /right?/ We know that?/*

Class: *Parabola./*
Instructor: *It's a parabola./*

At the engineering school, the quality of questions asked seemed to indicate high instructor expectations in terms of both students' preparation for the class and the instructor-student dialogue for constructing new understandings:

Instructor: *So, let's try to figure out /what is the behavior /around the equilibria/ in this system of equations. / Is there anything we have to do /preliminary to that investigation?* ***[1 sec]*** */*
Student B: *Find the equilibria. /*
Instructor: *We definitely need /to find the equilibria / so systems of equations. / This is an example /of a system of equations. / And let's find the equilibria.* ***[6 sec]*** */*

Instructor: *Okay. / So, how do we/ go about doing that? /*
Student M: *Set x-dot equal to zero / and y-dot equal to zero? /*
Instructor: *Yeah. / So, if I'm at equilibrium, / and I'm not moving, /neither x nor y could be moving/ at equilibrium. / So, I have to solve / now / two equations and two unknowns. /*

The predominant culture of high density of interaction units and multiple student interruptions at the business school seems to indicate that students in this context needed to ask and respond quickly before another student interrupted the flow of the discourse.

5) Instructors' use of students' name

Interestingly, quantitative measure of students' class participation is correlated with quantitative measure describing the number of students called by name. At the liberal arts college, with the lowest number of students and the lowest percentage of student participation, no student was called by name. In contrast, at the engineering school, the instructor used the names of 10 students of the 27 participating; the instructor at the business school called all 12 participating students by name. We may attempt to infer an unspoken message that students in each of the three classes may have received as a result of either being called by name or not. Remaining nameless, may decrease the responsibility for participation in the class, while being called out prevents one's ability "to disappear," i.e., a student must be present and participating in such an environment.

6) Feedback

Differences in quantity and quality of feedback message units were also significant. In fact, in the business school, students received instructor feedback 216 times (i.e., 27 times every 10 minutes) compared to only 54 and 90 feedback responses at the liberal arts and engineering schools (i.e., 7 and 9 times every 10 minutes), respectively. In the engineering classrooms, feedback messages were more numerous but brief in quality (e.g., "*Yeah!*" or "*Yes!*" or "*Absolutely!*") in comparison to the class in the liberal arts school, while in the business classroom, the feedback was personal and positive (e.g., "*It gets…yeah, / right. / Wow. / I can't believe you just, / you just, uh, understood that. / It's um… /*").

7) Type of Content

One of the most interesting categories was the number of message units dealing with the type of content in the three classes. In the liberal arts college, the class contained mostly message units coded as mathematical theory (e.g., "*This function has the same slope at 0,/ the same y value at 0 /and what else?/*"), while at the engineering school most message units contained visualization-related content (e.g., "*Who has, / who has a Matlab window open? / It's just 2 by 2, / but/ we're that lazy. / What are the eigenvalues and eigenvectors? /*"). Yet, in the class at the business school, most message units were based on real life applications (e.g., "*The next year, / we're going to get interest/ on our original investment/ and interest on the interest. /*"). What is significant in this finding is that each class reflected the values and missions of the three institutions.

8) Taxonomic Maps

Discourse analysis allowed us to look at the three mathematics lessons by de-constructing them into distinctive coding variables and then restructuring the variables to uncover the hidden interaction of each context.

A taxonomy is map of the identified patterns that constitutes the "rules of the game" for each class. An example of such map is presented in Fig. 2. This map summarizes various quantitative and qualitative findings while placing them in the context of students' experiences. In addition to the summary, such a map prompts a participating instructor to think about the questions related to classroom culture (e.g., "Who creates classroom culture and how?") and ensuing student experiences. Empty blocks are left specifically for the participating instructors to fill in during and following the debriefing session with the researchers.

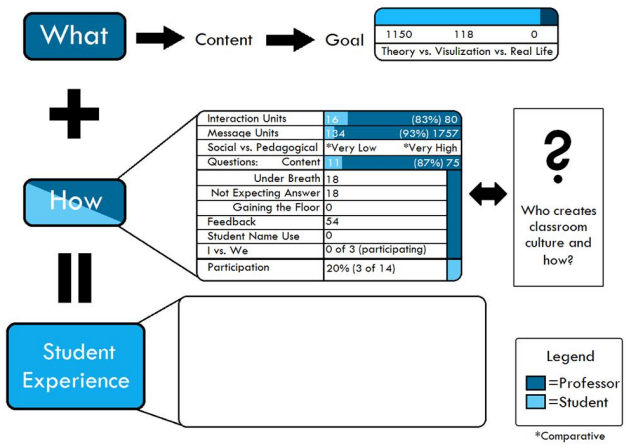

Fig.2. An example taxonomic map.

The liberal arts classroom was one in which students' responsibility for the classroom interaction was minimal and the instructor was in control of the lesson. In sharp contrast, in the business school, students participated actively, however, much of the participation was in the form of interruptions changing the topic. In the engineering classroom, students were expected to co-construct the classroom content and culture. Each classroom had constructed its own distinct culture through the interaction of instructor(s), students, group dynamic, and text Students who were able to understand the culture and live within its rules, gained more learning opportunities.

Although not in the scope of this paper, we also investigated the patterns of pedagogical units (change of topic) of each instructor and the variation of interaction types within pedagogical units. This topic will be discussed in our future work.

IV. Concluding Remarks

To complete the research-to-practice circle, our methods and results were shared with participating instructors during a follow-up meeting the subsequent semester to determine the research and program's efficacy. The main question discussed during these meetings was about a type of student that may thrive in each class and how the instructors may actively work to change the classroom culture to benefit all students. We also helped instructors identify 'academic literacies' that students must develop in their classrooms in order to succeed. Two instructors found that their classroom discourse changed drastically due to their participation in the research. The third instructor felt his participation in the program confirmed what he had already known about his classroom discourse.

One semester after the program completion, participating instructors were presented with an opportunity to reflect on the efficacy of the program and its effect on their teaching. The two instructors, who originally found the program beneficial to their teaching, remained positive about their participation and found that their teaching improved dramatically:

> *Discourse analysis helped me see exactly how my lessons were falling short of my intended learning outcomes for them. I've since used the results of the analysis to better pace my lessons, improve the time I wait for student responses to questions, and adjust my lesson outlines to better foreshadow upcoming new material.*
>
> - Instructor from Liberal Arts School

While the original study design did not include a longitudinal piece, in the future we intend to conduct follow-up interviews with participating faculty over a course of several semesters post-program to allow for a rigorous analysis of the impact and efficacy of the discourse analysis "intervention" on participants' classroom teaching.

Our findings indicate that discourse analysis, a rigorous yet straightforward method of researching classroom interaction, may be used by any educator who wants to uncover, understand, and shape their classroom's culture to offer all students the most effective opportunities to learn .

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