

Course Development in a First Year Engineering Program: The Interplay of Autonomy, Peer Relationships, and Content*

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While much is known about the student experience in large first year engineering programs, little is known about the experiences of the faculty engaged in teaching and course development. To begin closing this gap, we conducted a collective autoethnography to understand the faculty experience in executing course development in a large first year engineering program. Grounded in Self-Determination Theory, we focused on faculty motivation and addressed the research question: How does the interplay between faculty autonomy, course content, and departmental collegiality affect the course development process in a large first year engineering program? Individually, the participants reflected on a series of questions and then we engaged in collective data analysis. Our results show that autonomy plays an important but complex role in course development. Faculty who engaged in course development work on behalf of a larger team of instructors identified faculty autonomy as an important outcome of the course development work, i.e., they wanted faculty members to have room to teach in their own individually meaningful ways. At the same time, course developers confirmed that specifying common course subject content was a necessity in a common first year engineering course taught by multiple instructors. They recognized that this specificity curbed individual autonomy, resulting in a need for course developers to balance autonomy while maintaining collegiality when making content choices. Achieving balance is particularly challenging when collegiality is a departmental value that is enacted though not always articulated. Our findings advance the current knowledge base on faculty experiences in first year engineering programs and offer a number of practical implications.

Keywords: faculty development; faculty motivation; autoethnography

1. Background

Large first year engineering programs are common in engineering education. These programs are designed to help with the transition from high school to a university engineering program and to introduce students to their major [1]. In institutions featuring large cohorts of students (often ranging in the thousands each semester), students are typically divided into many different sections led by multiple instructors. Under such circumstances, it is often difficult to ensure the content and quality of instruction across the entire faculty without resorting to strictly conformal course materials (e.g., prescribed lectures, common exams, etc.). Furthermore, in the more foundational engineering courses, there is not an accepted or preferred collection of recommended course content, nor indeed of course style and teaching practices [2–4]. Some institutions focus foundational engineering courses on more physical and technical fundamentals (e.g., introduction to programming), while others steer their curriculum to focus on professional skills development, holistic issues, problem solving, and responsible ethical consideration of context. Hence, these

courses evolve over time to better adapt to engineering programs and other stakeholders' needs. However, little is known about these first year programs course updates and redesign processes.

While much is known about the student experience in such programs [1, 5–8] little is known about the experiences of the people in charge of teaching and course development in such programs, i.e., faculty members. It is important to understand the faculty members' experience in order to promote job satisfaction and to reduce turn-over in instructors. Faculty motivation is particularly important to understand, because it promotes student motivation and learning [9]. Furthermore, usually faculty members are the ones in charge of keeping large first-year engineering programs up to date to provide a good first-year engineering experience. We conducted a collective autoethnography to understand the faculty experience in executing course development in a large first year engineering program. Specifically, we posed the research question: How does the interplay between faculty autonomy, course content, and departmental collegiality affect the course development process in a large first year engineering program? In answering this ques-

tion, we focus on faculty experiences in the course development process and do not present the student perspective nor do we offer definitive suggestions on what content such courses should include.

1.1 Definitions

We consider it important to provide definitions of several key concepts in the context of this research, so readers can understand our context and perspectives. In this work, we consider *course content* to be the concepts on which the course focuses. Examples of common course content include input and output methods in MATLAB, methods for adding structure to ill-structured problems, identifying stakeholders, and exploring ethical dilemmas. A related term is *course materials*, which are the learning and assessment activities themselves such as assignments, rubrics, lecture slides, exams, etc.

In self-determination theory [10, 11], autonomy is broadly defined as having choice and agency in acting. In the context of our study, *autonomy* refers to the freedom for instructional faculty to administer and execute common course material as best matches their teaching style, previous experiences, and background. For example, autonomy in teacher choices can be fostered by having some generalized assessment rubric line items that are required for all instructors, while leaving the particulars of the assessment format (presentation, take-home project, etc.) in the purview of the individual instructor. In this paper, we are not referring to autonomy experienced by the instructional development team themselves; though important, that is beyond the scope of this work.

Within the academic community the term collegiality has multiple definitions, so it is important to be clear on how we are using this term. Bess [12] created an influential framework distinguishing between behavioral, cultural, and structural collegiality. In that framework, behavioral collegiality is about individual relationships, cultural collegiality is about shared values, and structural collegiality is about shared governance. Kligyte and Barry [13] and Kligyte [14, 15] argued that the term collegiality has complex and sometimes contradictory usage and interpretation, and was in need of further exploration. In the course of that exploration, they expanded on Bess's [12] framework to differentiate collegiality as either governance structure, behavioral norm, intellectual affinity, or culture. Kligyte [15] went on to classify and map collegial practices, finding a complex set of logics under the heading of collegiality. Clearly there is still overlap in how collegiality and its subsets are understood in the academy, making them difficult to operationalize, as we ourselves observed in the process of this

autoethnography. In our reflections, coding, and conversations we found that we were mostly using an encompassing and inclusive definition of *collegiality* that referred to the department's perceived overall spirit of interconnectedness, collaboration, and positivity as it relates to peer relationships and a shared culture, but at times were using it in more specific ways, variously consistent with the definitions in Kligyte's work. In our analysis and results, we have applied this collegiality framework as we discuss our examples for clarity. However, we note that the cultural usage of the term is most consistent with our focus throughout this paper.

Finally, we use the term *faculty* throughout this paper to refer to the people teaching the course. Faculty is used as an umbrella term because the authors and the broader group with whom they engaged during the course development process have a variety of different titles and ranks including: instructor, professor of practice, tenured/tenure track, and occasionally graduate students.

2. Situation in Current Literature

We have situated the current analysis within self-determination theory (SDT) as developed by Deci and Ryan [10, 11]. SDT describes motivation on a spectrum associated with the degree to which the motivation is externally or internally regulated. According to Ryan and Deci [16], at the broadest level there are three categories of motivation: (1) amotivation, a complete lack of motivation; (2) extrinsic motivation, external forces are promoting actions and behaviors; and (3) intrinsic motivation which encompasses "behaviors done in the absence of external impetus that are inherently interesting and enjoyable." [17, p. 134]. These three can be seen as a continuum, as extrinsic motivation includes four types of motivation that range from less to more autonomous or internally regulated (Fig. 1). In intrinsic motivation, behaviors are internally regulated such that they come from the self rather than from external forces, i.e., they are the most autonomous. Intrinsic motivation is considered an optimal state of functioning for cognitive and social development [10, 11].

Research across a variety of contexts has shown that people thrive with more autonomous motivation [18], making it important for organizations, such as academic departments, to consider conditions that foster autonomous motivation. Within educational settings, autonomous motivation is not only important to teachers' well-being but also to student motivation and outcomes (e.g., [19]). Our literature review revealed that much more research has focused on K-12 learning environments than college settings. Although we acknowledge that the

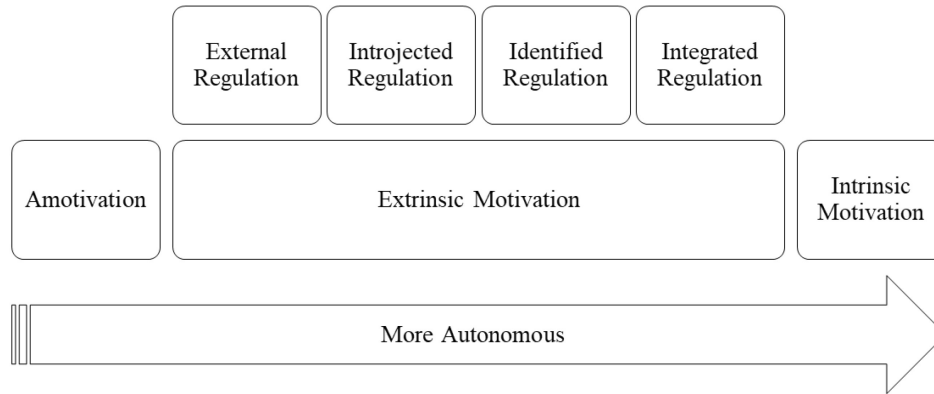


Fig. 1. Illustration of the motivation spectrum relating motivation types with increasing autonomy.

literature is not void of studies in college settings (e.g., [20, 21]), we argue that K-12 based literature meaningfully informs our study to the degree that it demonstrates the basic tenets of SDT regardless of any focus on specific student age-related developmental experiences. Hence, we draw on literature from K-16.

Importantly, autonomy does not mean working alone but rather having choice and empowerment within an environment. In an educational setting, the environment includes supervisors, peers, students and others with whom teachers are socially interacting. For example, research shows direct relationships between leadership and teacher experiences. Eyal and Roth [22] showed that teachers perceived principals' leadership styles as directly related to teacher burnout, with teachers' autonomous motivation serving as a mediator. Specifically, transformational leadership was associated with less burnout as mediated by having more autonomous motivation. Niemiec and Ryan [17] argue that student's autonomy can be supported by "maximizing student's perceptions of having a voice and choice in those academic activities in which they are engaged." [17, p. 139]. Within the tenants of SDT, it is reasonable to assume the same for teachers meaning that their autonomous motivation can be supported by maximizing their choices in teaching. In fact research shows that autonomously motivated university instructors were more autonomy-supportive in teaching, that being free to make pedagogical choices was negatively associated with external motivation towards teaching, and that factors such as large classes and high teaching loads reduced feelings of autonomy [23].

School leadership and teacher autonomy directly impact student outcomes. Eyal and Roth argue that the choices and actions of school leadership create a school climate and environment that supports not only student learning directly but also supports

teacher motivation [22]. From other research it is clear that teacher motivation directly influences student motivation. For example, research has shown that teachers who felt controlled by external pressures were less autonomy-supportive towards students [24] and more controlling [25]. Positive student learning outcomes are associated with autonomy-supportive environments (e.g., [19, 26, 27]).

While autonomous motivation of teachers is important to themselves and to their students, autonomy must be meaningfully supported. Within SDT, this support is often referred to as degree of structure. Reeve [19] defines structure as "giving students clear expectations, optimal challenges, and timely and informative feedback as they attempt to make progress in living up to those expectations and challenges." [19, p. 193]. Again, although defined from a student perspective, the meaning would be the same for faculty in an organization: providing clear expectations, optimal challenges and timely and informative feedback remain important. Reeve [19] argues that the relationship between autonomy and structure is curvilinear such that too little structure can thwart autonomy because the lack of expectations and feedback can feel overwhelming, making it difficult to function. At the opposite extreme, too much structure thwarts autonomy by taking too much control from the individual. Thus, there is an optimal amount of structure needed to support autonomy. If we consider faculty as learners, we can draw on literature that describes optimal learning environments for students to inform our thinking. Such literature is rich with studies on the balance between autonomy-support and autonomy-control. However, little research exists that actually transforms student-based literature to faculty. Thus, there is a need for further research that interrogates autonomous motivation and support structures.

3. Course and Development Context

The authors of this work were tasked with undertaking course redesign for a two-course sequence, Foundations of Engineering I and II, in an introductory first-year general engineering program. All students wishing to enter engineering degree programs at our large research-focused school must complete these two courses. Understanding the course development experience requires an introduction to the purpose, structure, and current configuration of the courses, as well as course administration, and the general course development philosophy.

3.1 Course Purpose

The purpose of the Foundations of Engineering courses is to welcome all incoming engineering students, to instill a sense of belonging and identification with engineering to support long-term persistence toward a degree, to introduce them to the engineering discipline, to help them select their engineering major from among more than 14 options, and to provide foundational academic, technical, and professional knowledge and skills needed to succeed in that major. The two-credit courses each serve more than 2,000 students per year. To accomplish our goals, the sequence includes team-based and individual activities, assignments, and projects that place students in situations to design and scope ethical and holistic solutions to ill-structured engineering problems using a common set of fundamental engineering tools that are applicable across a wide range of majors, including basic computer programming and computer-aided design (CAD).

3.2 Course Structure and Current Configuration

Foundations of Engineering I and II are taught in approximately 35 sections led by more than a dozen faculty consisting of a mix of instructors, professors of practice, research faculty, and occasionally graduate students. As students do not select a specific engineering major until the end of the second semester, there is a mix of major interests in each class section. Prior to Spring 2019 each section had 30-36 students with one faculty member or graduate student teaching the class, and undergraduate grader support. When the section size was increased to 72, graduate teaching assistant (GTA) support was added for each section. In both models, the number of sections taught by each individual instructor ranged from one to five, depending on other job responsibilities. The total number of people teaching the two-course sequence each year also varies but is often more than a dozen.

In the current configuration, Foundations of

Engineering I is a three-module suite comprising Exploring Engineering Opportunities, Data and Modeling, and Unpacking Ill-Structured Problems. Each module features multiple smaller assignments designed as scaffolding for two major assessments – one individual-based, and one team-based. Foundations of Engineering II is centered on a semester-long team project and is divided into two design iterations, each featuring a single design/build/test phase. During the first iteration, student technical learning focuses heavily on computer aided design (CAD). During the second iteration, students work with instructors to determine and develop additional technical skills necessary to complete the project. The course development work described herein led to these current iterations of the courses.

Our instructional faculty generally operate in a collaborative manner wherein course materials and techniques are discussed and shared openly between faculty. Faculty are encouraged to participate in an iterative and ongoing course fine-tuning process through internal scholarship at departmental colloquia. Furthermore, most faculty work closely with each other during the course of the semester.

As a result, each course has a shared library of course materials curated digitally wherein all teaching faculty have full edit access. The curated materials include common syllabus templates, rough semester timelines, and in-class activities. Each course module includes a guide for the instructor dictating which components should remain relatively unchanged, and which components have been crafted so as to provide space for instructor self-expression (autonomy). These materials are updated continually.

3.3 Course Administration

The course sequence has been taught using several models of instruction over the years, ranging from an approach where all instructors teach from the same material using the same assignments (low autonomy in a highly structured environment) to one where each individual instructor has nearly complete control over what and how they teach throughout the semester (high autonomy in an environment with little structure).

Each of these approaches had unique advantages and disadvantages for faculty, though both could be problematic from an autonomous motivation perspective. Too much control is demotivating, but too much autonomy is overwhelming [19]. Optimal autonomy support includes freedom with a supportive structure. Providing autonomy with structure was therefore desired by departmental leadership. This resulted in plans to create a degree of consistency throughout the first-year engineering pro-

gram while still allowing for instructors to take ownership over how, and to some extent, what was taught in the classroom while maintaining the courses as relevant and engaging for students.

3.4 Course Development Philosophy

As a department, we recognize that course development is an iterative process that will exist as long as the program does. We consider continuous reflection about the purpose and experience of our courses to be crucial to successful course development, and have maintained this as a part of departmental discussions for many years. However, these discussions provided context for the redesign, rather than being an objective of the redesign. The objectives for the course redesign were (1) to realign the student and faculty time requirements to the course considering its revised credit load (2 credits each semester), (2) to establish clear requirements for development of course projects and deliverables, and (3) to develop a set of common assessment criteria for exams, projects, and summative assignments.

Our team worked to achieve these objectives by developing a framework that encouraged faculty consistency with autonomy. Much of the redevelopment work focused on structural redesign to streamline the course layout, changes to the course content, and curating a body of shared teaching resources to support consistent instruction and to scaffold autonomous execution. We reworked the courses such that we could ensure a consistent student experience through relatively similar content across the large student cohort each semester, while still providing mechanisms for autonomy in course execution and administration. Therefore, the team refined and developed templates for course content, materials, and assessment and project requirements for both semesters of the two-semester sequence. The outcome of the effort was a collection of sample lecture slide decks, templates for assignment prompts and rubrics, and support materials in the form of tools to assist with grading, sample in-class activities, and suggested course timelines. This was done iteratively over several semesters, with varying team members providing multiple perspectives. These materials allow instructors to teach from a common course structure and general scope for content and course assessment, while providing instructors with the opportunity to individualize their sections of the course.

4. Research Methods

We designed our study as an autoethnography - a qualitative research method that promotes self-

inquiry in a critical way that involves narrative inquiry [28]. Autoethnography in its most simplified definition is the study of the self. It is a unique research perspective where the researchers are the subjects of study while having the flexibility to position themselves in relation to the phenomenon of study in ways that are otherwise off-limits in traditional research approaches [28]. According to Hughes [29] “the call to craft, translate, share and study personal narratives as critically reflexive self-stories has gained traction in recent years” [29, p. 154], particularly in education fields. We considered this an appropriate method to share our combined experiences and our critical reflective process of course redevelopment. Our overall study was originally grounded in and guided by the Model of Teacher Growth [30] as described elsewhere [31]. However, the current analysis draws on SDT to make additional meaning of our findings.

Autoethnography is a research approach that blends the personal reflection of autobiographical writing with the examination of cultural relations, values, and beliefs that are part of ethnographies [32]. In contrast to social science research that has traditionally incorporated and recognized personal accounts [33], autoethnography is more intentional in this regard. Duarte [34] describes the function of autoethnography: “As a reflexive genre of writing autoethnography situates the self within the context of a culture, sub-culture or group, and studies one’s experience along with that of other members of the group” [34, p. 2]. Consistent with this function, the authors of this paper wrote autobiographical reflections on their course development experiences and collectively analyzed them to yield collaborative findings. Hence, we consider our study to be framed in co-constructed narratives and with an analytic autoethnography approach as described by Hughes and Pennington [28]. Therefore, our reflections followed an analytic autoethnography approach [28, 35], which is more focused on rational scholarly endeavors, as opposed to the evocative autoethnography approach more focused on emotions related to the phenomenon [32]. Co-constructed narratives illustrate how different researchers collaboratively experience a phenomenon. In this approach, each author writes their own experience and then shares with the larger group who typically reacts to the narratives, reflecting on relationships to their own understanding of what they themselves experienced and highlighting and reflecting on the possible explanations for contradictions [36, 37].

4.1 Participant Profiles & Positionality Statements

The five participants in this study (Table 1) include three professors of practice, a tenured faculty

Table 1. Description of participants backgrounds

Name	Years Teaching in Course Sequence	Course development role/responsibility	Background
Ben	3	First-semester segment development team.	4 years industry experience, 2 years at current school as Instructor, 1 year as Associate Professor of Practice.
Holly	5+	Original course developer years ago, current program administrator.	12 years combined consulting and industry experience, 11 years total at current school though not always teaching in this course sequence, 5.5 years experience in departmental administration.
Homero	3	First and second semester segment development teams.	6 years industry experience, 15 years in academia, 5 years experience in university administration, 1 year at current school as Associate Professor of Practice, 2 years at current school as Assistant Professor.
Matt	3	First and second semester segment development teams.	8 years industry experience, 3 years total at current school as Assistant Professor of Practice.
David	2	Second-semester segment development team.	8 years industry experience, 2 years at current school – 1 year as instructor, 1 year as Associate Professor of Practice.

member who has administrative responsibility for the first-year program, and a tenure-track faculty member who was previously a professor of practice in the same department. A professor of practice is defined as someone who has industry experience, and whose academic role is characterized by a predominantly teaching nature. The five participants also include some demographic diversity. This combination of author roles and purposes gives us a multi-faceted view that allows us to incorporate a broader range of cultures, values, and beliefs than if the whole team served in the same capacity and brought the same experiences. However, we do not make direct comparisons based on our demographic similarities and differences (including not but limited to race, ethnicity, gender, rank, etc.). Instead, through our positionality statements, we recognize our individual beliefs on background characteristics that mattered to each of us in our self-representations in this work. As part of our autoethnographic process, we followed Anderson's [35] proposed characteristics of analytic autoethnography: (1) the authors are members of the group they are researching; (2) they engage in analytic reflexivity; (3) they are visible in their narratives; and (4) they engage in dialogue with other informants beyond "the self" [35, p. 378]. Consistent with autoethnographic approaches, the research team emerged as one with a common set of research questions and interests which we decided to collaboratively explore. Therefore, unlike some other modes of research, there was not a call for participants or formal response rate.

4.1.1 Ben Positionality Statement

I am an engineering educator in a teaching-focused position, and have been with the department in that capacity for three years. I have always valued education, and come from a well-educated family,

with various master's degrees and doctorates among my parents and grandparents. I am the first in my family to have a job focused on course instruction in higher education, but I have still spent my entire life hearing about the academy and scientific inquiry. That comes with a lot of embedded knowledge and privilege, things I once took for granted which may be completely new to first years, and important to their success. Recognizing this has led me to try to include opportunities for examination of why things are designed as they are in my development work, to help students understand the context of the work (which also connects well with our engineering design lessons). I also come from an interdisciplinary background, with a STEM interdisciplinary undergraduate degree, master's degrees in Civil Engineering and Entomology, and a PhD in Environmental Design and Planning (housed in the Department of Building Construction). My exposure to sometimes very different teaching methods in different fields, and joining programs as both a disciplinary insider and outsider has taught me to value course design that allows students to bring their own authentic selves to the classroom, and help them to frame their work in the context of their personal interests and ambitions.

4.1.2 Homero Positionality Statement

I am an engineering educator with 15 years of experience interacting with undergraduate engineering students. I have worked most of my academic career to improve the way students learn engineering concepts by making sure they are engaged, and their personal experiences are valued in the classroom. I am originally from Venezuela where I worked for 11 years as a Faculty member at a public technical University where I had to teach students coming from very difficult socioeconomic backgrounds. Here in the United States, I also have worked on a predominant white institution and

interacted and experienced how students from traditionally marginalized populations have barriers to become engineers. I have had those experiences in mind when going through course redesign processes and I have intentionally tried to be aware of how to develop more inclusive experiences while at the same time considering how my experiences in industry and as a recruiter had a voice in the process. I consider it really important to develop interventions that are not only inclusive but that will also prepare all students to be competent when joining the workforce. I also have experience redesigning courses, and entire engineering programs. When doing this work, I was very aware about how my previous course redesign experiences were in a very different cultural context, so I was intentional on making sure the U.S. culture was present when structuring my recommendations.

4.1.3 David Positionality Statement

I am a Professor of Practice, and I am relatively new to teaching. I spent nearly a decade in small business research, working not only as a Principal Investigator on multiple projects, but also as Director of Research and Development. My views on teaching and on curriculum and course design arise largely from my experiences in working with entry level engineers at all levels – from interviewing for hiring through project management, and finally through termination from the organization. I structure my teaching style to engage students and to attempt to develop a respectful and collaborative mentoring relationship. I am continually working to try to instill some of the professional skills in the students that I was looking for when hiring new engineers – internal motivation, time management, confidence, and humility.

4.1.4 Holly Positionality Statement

I am an engineering education researcher and educator. The pathway that brought me to higher education includes alternating between school and work such that I am in my third career. After earning a BS in Chemical Engineering, I worked as a consulting engineer. I then returned to school to earn a master's degree in Materials Science before taking a job in a manufacturing environment. I returned to school to earn a PhD in Engineering Education before joining the faculty at Virginia Tech. My research specialty includes using motivation frameworks to understand the degree and career choice pathways of engineering students. My views on teaching and learning draw heavily on all of the experiences that brought me to where I am today and focus on helping students feel empowered in their learning and career pathways. My views on leadership are essentially the same. I

am a strong advocate for women in engineering in terms of learning and leadership.

4.1.5 Matt Positionality Statement

I have worked as a Professor of Practice for the past three years after approximately a decade of working as a practicing engineer. I earned my BS and MS degrees from Virginia Tech in Civil Engineering, and subsequently worked for a private civil engineering company, with a specialization in land planning/development and stormwater management. Following positive teaching experiences as a Graduate Teaching Assistant and periodic pro-bono teaching work while I was practicing as an engineer, I joined the Engineering Education department at Virginia Tech as a full-time instructional faculty member. I was born, raised, and had the vast majority of my work experience in Virginia. In my teaching and course development, while I try to reflect on my own experiences, I also recognize that my own view is limited. It is my goal to create an environment that intentionally makes room for and builds upon the valuable experiences of the many others who have different backgrounds and perspectives than I do.

4.2 Data Collection and Analysis

We developed a series of questions informed by the Model of Teacher Growth [30]. This model was useful in guiding the activity because it focuses specifically on teachers and how growth and change happen specifically in educational settings. It is a comprehensive model that addresses four areas including: the personal domain, which encompasses teacher's knowledge, beliefs and attitudes; the external domain, which considers sources of stimulus or information outside of the teacher; the domain of practice, where there is experimentation in teaching; and the domain of consequence which includes salient outcomes. While discrete and distinguishable from each other, the categories themselves are broad and leave room for open reflection that is not bound by rigid construct definitions.

The participants individually reflected on the questions in the protocol (Appendix A). Our reflective practice resulted in a ~4000-word written document for each person. In addition to pragmatic questions about what worked well and what did not, we used the framework and associated guiding questions to make invisible or behind-the-scenes considerations visible to ourselves and then to each other. Originally, we did not have a specific question about students but realized after a first analysis session that such a question was needed to help us consolidate student-related reflections. This is because we realized we had only recorded partial thoughts related to students scattered throughout

the questions on each domain; bringing them together allowed our thoughts to coalesce. It is important to note that Holly reflected on similar questions, which were modified to account for her administrative role and perspective. It should be noted that her reflection came after the first pass of collaborative analysis, though before final analysis. It became evident that her lens in an administrative role was needed to understand and analyze the process as well as provide richer context for the course development process.

In our analysis, all authors reviewed the individual reflections and then met as a group to discuss them. As an initial way to gather our thoughts, we started by listing the concrete and pragmatic recommendations each participant made for suggestions to others on how to engage in course development. We connected these ideas back to the personal experiences noted in other areas of the reflection that prompted them. The notes from this session were translated to the textual story and Holly's reflective positionality was added to yield our first interpretation [31].

Recognizing the depth and breadth of data, we set out to expand our analysis. We engaged in several rounds of open-coding and data visualizations drawing on the four domains of our original framework (personal, external, practice, and consequence).

After several rounds of analysis, we identified ideas (codes and definitions in Table 2) that cut across the domains and realized that our emerging results were well-aligned with SDT [10], hence we used this framework to interpret and make meaning from our data through our coding process. For example, we defined ownership/empowerment as autonomy as described by SDT. Although this is a direct alignment, other codes in combination related to foundational ideas in SDT. For example,

acceptance of other personal domains and *beliefs about what is appropriate* are part of course content expectations as well as part of SDT's description of structures in tension with autonomy.

Throughout the entire analysis process, each participant continued to review the reflections, identify aspects of their story in alignment to the collective story, and engage in regular conversation about the narrative we co-constructed herein.

4.3 Measures of Quality

Walther, Sochacka, and Kellam [38] suggest that researchers should consider research quality in terms of making the data and handling the data. In making the data, the research team followed approaches consistent with autoethnography, specifically Anderson [35]. Each person individually and critically reflected on their experiences and documented these reflections as narrative responses to a set of prompts. In terms of handling the data, the research team used a protocol informed by theory in order to focus these reflections so they could be collectively and collaboratively evaluated. We worked collaboratively on the analysis to develop the results giving participants a chance to respond to the analysis process and findings as they emerged. The study secured ethical clearance from the Institutional Review Board (IRB).

Similarly, Patton [39] explains that when judging the quality of autoethnography it is important to describe how the work affects the authors intellectually and emotionally. Since the focus of this work was on course redevelopment that benefited the program where the majority of us teach, we had several sessions to reflect on how this work was informing not only our teaching and scholarly practices but also our general perceptions of the first-year engineering program. Patton [39] also

Table 2. Codebook with codes and definitions

Code	Definition
Acceptance of other personal domains	This code refers to the recognition that other people have beliefs about the course which need to be worked with/around.
Value opinions within department	This code encompasses the belief/understanding that other faculty members' opinions are valuable and need to be considered when developing course changes.
Humility	Although not directly stated as a value, this code was indicated through statements and highlighted moments where the course developers were humble about their experiences.
Collegiality	Collegiality refers to both an official interconnectedness and an unofficial spirit of cooperation between faculty teaching the courses under development, and the behavioral norms and the governance model of our course development team that are a consequence of that culture.
Openness to change	This code refers to instances where change was described as something people would accept and that considered all the possible issues emerging from implementing change.
Recognition of iterative process	This code explained how the course redesign process was not linear, but rather was a complicated and sometimes messy process that required several iterations and multiple trials and errors.
Ownership/empowerment	This code refers to the presence, development, or fostering of internal motivation and association of the course participants and developers with the process and material.
Beliefs about what is appropriate	Aspects based on belief rather than evidence, evidence may not exist yet or may require too much time to find.

emphasizes the importance of understanding how the work can lead to actions. Since Holly is in charge of the first-year program, we also have had emerging conversations from this research on how the proposed changes have been implemented and perceived by the larger community in the department and by the students taking the revamped courses. Furthermore, we have discussed how this research could impact similar redesign experiences at other institutions.

4.4 Limitations

A strength of the work is the interconnectedness of the team and our varying perspectives. However, this is also a limitation of this work in two ways. First, Holly has administrative responsibility for the course sequence within the department. While this role was known when the collaboration emerged and we started the project, it may still have impacted participants' desire to reflect freely and openly specifically regarding challenges associated with work assigned by the administrator. Second, all of the authors have previously taught and expect to continue teaching these courses together, which could potentially impact what they chose to share in their reflections.

Our work has value in describing the experiences of faculty engaging in course development and our ability to make recommendations to others in how to provide a productive and positive experience for faculty. However, our work is limited in that we cannot tie the course development work directly to student experiences at this time. We did not intentionally gather any data from students and their experience, losing an opportunity to bring a more complete and rounder story. Furthermore, we focused on our experience with course development, but did not assess the success of the course development and materials. In this paper we focus on our process. Future work could consider additional reflective activities and participants to specifically elicit the degree to which this may have been a challenge.

Finally, our results are not all-inclusive as the makeup of our participants is limited. We have different backgrounds and diverse experiences and perspectives in some ways but not others. Our results present our views on the process but do not include perceptions of other instructors with more diverse backgrounds. Regardless, we believe we captured elements of our experience that can be meaningful to others.

5. Results

Our data suggest that autonomy plays an important but complex role in course development. Our

results show that faculty who engaged in course development work on behalf of a larger team of instructors identified faculty autonomy as an important outcome of the course development work, i.e., they wanted faculty members to have room to teach in their own individually meaningful ways. This goal was supported by departmental administration. At the same time, course developers confirmed that specifying common course subject content was a necessity in a common first year engineering course taught by multiple instructors. They recognized that this specificity curbed individual autonomy, resulting in a need for course developers to balance autonomy while maintaining collegiality when making content choices. Achieving balance is particularly challenging when collegiality is a departmental value that is enacted though not always articulated. One way to represent our results is using the analogy of a large ship, whose forward motion represents the continued progress of the course (Fig. 2). On either side, the ship is subjected to opposing loads, one representing the amount of autonomy given to individual course instructors, and another representing the level of consistency in course content across the entire program.

The departmental culture of collegiality is balanced on the ship; if either instructor autonomy or consistent content are out of balance, the collegiality and ease of forward progress for the course are compromised. That is, collaboration and sense of community may be disincentivized or even incompatible with systems out of balance, and this can tip the ship even further to the side. When the forces balance (i.e., the boat is level), tensions are reduced, and forward progress is easier. The use of a large ship as an analogy also recognizes the difficulty in implementing immediate changes in the course due

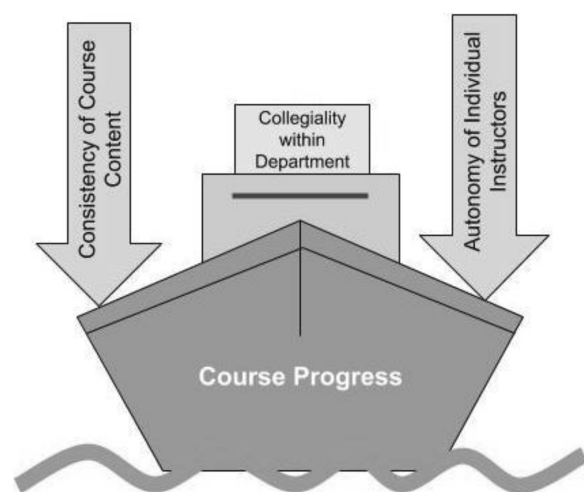


Fig. 2. Illustration of an analogy of course redevelopment as a large ship balancing loads of autonomy and consistency.

to inertia from the large number of students and internal and external stakeholders who are affected by course development decisions, as is likely the case at many larger institutions. Hence, having this balance is really important because it helps with fulfilling every instructor's teaching voice, meeting departmental requirements for consistency in a large first-year engineering program, and maintaining a collegiate culture based on respect of individual contributions.

5.1 Faculty Autonomy as a Course Development Outcome

Faculty autonomy is prioritized as a critical outcome of course development work in our context and therefore an important force in the forward motion of course progress. For example, in her administrative capacity, Holly said: "... the autonomy lets faculty teach authentically and bring themselves to the course and classroom." Matt also expressed this idea in describing his approach to course development:

"I have also always firmly believed that people should have the opportunity for ownership of their own jobs to do their best, even if this means letting them make mistakes. I think this is why I was pushing for a degree of autonomy more so than some others in the department. I know this comes with its own challenges, but I wouldn't want to stay in this kind of job long-term if somebody told me exactly what and how I needed to do it. I certainly didn't feel comfortable telling people how they could do their jobs best either, especially given my relatively limited teaching experience when I undertook this process." ~Matt

In these statements, Holly and Matt specifically pointed to autonomy as important to the success of the course development process. Others expressed similar ideas, even if they did not explicitly use the word autonomy. Ben elaborated on his thought process as to how providing faculty autonomy could, in the right setting, further improve the course as a whole:

"We tried to set things up so that these people were able to make decisions and changes as much as they wanted while still maintaining some consistency in student experience and outcomes. We also thought about writing things to actually encourage this behavior, and thus generate and innovate. We started assignment blocks with 'what needs to stay the same; what can change' statements, so the first thing that instructors read was an invitation to bring fresh ideas and energy." ~Ben

Ben went on to reflect on how having autonomy not only could generate new ideas among faculty, but create a classroom environment that benefits the faculty and student experience by allowing faculty to engage with areas about which they are passionate:

"Personally, I find my classroom sessions go a lot better and the students are a lot happier when I am enjoying the topic. Creating organization and laid out materials with built-in flexibility allows us to find angles that excite us with every topic, and lean in to them in class." ~Ben

There was also a recognition that the students have perceptions about an individual faculty member's autonomy in designing a course. This was seen in end-of-semester teaching evaluations, where some students attributed parts of the class they were critical about to a perceived lack of autonomy.

"I've had several similar comments on SPOT [Student Perceptions of Teaching survey] evaluations in my first year, when students said that I should be given more latitude to change the course. I'm not sure if that was just an idea that sounded good and circulated in the student body, or came out of us using the departmentally suggested strategy of telling complaining students that certain unpopular standardized things were required by the higher-ups. I now think more about how the course design influences how students will see the first-year program in general, and not just the instructor." ~Ben

5.2 Consistency of Course Content

Consistency of course content emerged from our analysis as a counter-force to autonomy in course development progress. Although there is a perceived need for consistency there is not a consensus across individuals on what that content should be, which puts consistency and autonomy in opposition. As exemplified in this statement from David, varied content is partially a function of the people that have worked on course development over time.

"As a consequence of design by committee, the course had experienced content creep over the past several years. As each instructor introduced a new topic or assignment along the way, the required effort for the students was closer to that of a three- or four-credit course." ~David

At the same time, the course developers recognize that the challenge of establishing content is not just a function of the people involved but also associated with the function of the program itself in orienting first year students pursuing a variety of majors:

"One of the large challenges with developing the courses has to do with the subject material itself. It's often hard to define what an engineering "fundamental" is, especially in a meaningful way that crosses multiple disciplines. Because of that, there are a lot of different ways that people approach this; some trend more towards the concrete and technical, others to the philosophical. I don't believe there's necessarily a right or wrong way to approach this (although I do have my preferences)" ~Matt

Despite higher level questions on what should be taught, Matt also owns that he has preferences,

which highlights the need to balance consistency with autonomy in order to provide for continued forward momentum in the ship metaphor described above.

5.3 *Maintaining Collegiality in Course Development*

Course developers described preserving the various aspects of collegiality as an important part of the course development process, hence its position in balance on the ship in our metaphor. Nearly all of the autoethnographies reference collegiality in some way, often noting that this type of positive, collaborative, and supportive culture is not perceived to be common in other departments:

“The Engineering Education department operates in a manner that is somewhat more collegiate than many other departments. The department has a shared library of lectures, assignments, and general course materials that are essentially available for all faculty to use.” ~David

There is an assumption that many other departments are more competitive, or negative. We hear stories from our own colleagues about other departments where, for example, materials developed by one person for a course are not shared with other people that teach the course. For us, a collegiality was an administrative expectation even if not directly articulated. Holly pointed out that, as a leader in the department, she intentionally tried to build a team that would foster collegiality through intellectual affinity:

“However, at any given point in time my goal is to have a team of people who are: respected by their peers with regard to course development work, ‘moderates’ with regard to status quo and change meaning that they embrace change but with some caution towards consequences, collegial, willing to explore the unknown and ask questions, and excited about doing the work.” ~Holly

The course developers often mentioned collegial behavioral norms in the department. Positivity and support for other faculty members are appreciated, encouraged, and required. The department head often states support for this behavior during meetings. It seems to pervade the department, and has been referenced in many small meetings attended by the authors, including several of our discussions about the reflections. Our collaborative and collegial environment was to our eyes a very important aspect of the success of our development efforts, and strongly supported the success of the collegial structure of the development team:

“Another part that worked well in the process was the team that I was working with. I really think that at the different points in time that I was working on a reform of each of the courses, the team was ideal and we could

understand each other well. I argue that this is partially because we all had industry experience and we all really care about teaching.” ~Homero

“Choose the right team to do the work and then trust and respect the people doing the work. This includes people who are knowledgeable and dependable but also people whom others trust and respect. In our Department that meant choosing people that the folks doing heavy teaching (instructors and professors of practice) and people with less first-year teaching load but more research-based educational knowledge (tenured/tenure-track research faculty in engineering education). Once the team is in place, trust and respect them to do the work.” ~Holly

5.4 *The Intersection of Autonomy, Collegiality and Consistent Content*

It is at the intersection of autonomy, collegiality, and content that the notion of forces and careful balance arises. We give people the opportunity to have ownership of what they do, and they develop materials because of it. However, this can also mean that when people are heavily invested in those materials, they may be reluctant to change. There is some defensiveness and conflict that can arise which challenges maintaining collegial behavior:

“As can be expected with a group of highly qualified instructors with different backgrounds, there are some variations in people’s philosophies as to what we should teach and how we should do it.” ~Matt

“This is a bunch of educators, some with very strong and sometimes conflicting opinions about how things should be done in the classroom.” ~Ben

“We were somewhat concerned with faculty reactions. Ours is a generally supportive and positive bunch, but people do have some ownership of materials, and longstanding habits and preferences. There are also differing perspectives on what should be included in our courses. As we worked through materials, we frequently had discussions about possible points of friction.” ~Ben

Trying to maintain a balance is hard on course developers. Our development reflections indicated concern in awareness of this, and clear efforts to be supportive and accepting of the value of the different interpretations of the course:

“I think in terms of the process (big picture thinking right here) one thing that in my opinion doesn’t work is to try to make everyone teaching the course happy. I feel like some people might be very particular on the things they like about the class so there is this constant feeling of I’m going to make someone mad if I make this change. That took a lot of energy and time on my end and I don’t think it was productive or helpful. I think if I were to make a process like this again I will try to get buy-in from the administration and care less about hurting people’s feelings. If something is good for students and their learning, that should be enough and people will adapt in the long term.” ~Homero

“The interpersonal factors were probably the most

stressful things to think about when we were pulling together the courses.” ~Matt

Perhaps complicating rather than simplifying the question of content, the administration left the developers to resolve issues of content:

“Because content is a central decision in course development, beliefs on content are important. I care less about exactly what we teach and more about the inspiration it creates for students. Not being attached to specific content helps me support building a collective vision that is malleable enough to change with changing students and teachers in our program.” ~Holly

Though supportive of autonomy, not being clear on content expectations can create other challenges, particularly in balancing collegiality. In past iterations of the course structure, the department had enacted different systems that ranged from a time with nearly full autonomy to a period with nearly fully consistent course content; each of these were perceived by some faculty members to weaken the collegial culture of the teaching team. In the case of full autonomy, some faculty went with their own work, rebuilt the entire course from scratch, and did not collaborate. In the case of full consistency, faculty did not feel empowered to participate and collaborate to improve the course.

6. Discussion

Understanding the process of course development from the perspective of participants in charge of such work provides a better understanding of the importance of relationships between autonomy, peer relationships (collegiality), and content. With regard to research, we expand the SDT literature by using a different approach to data collection (i.e. autoethnography) in a unique context (i.e. first-year engineering course development). Our study also provides a unique lens on how autonomy in any academic process can increase motivation regarding the phenomena. We argue that understanding our teaching self or “persona” and being able to bring our teaching voice is an important pedagogical strategy that motivates instructors because their authenticity is recognized as something valuable in the classroom. Similarly, our results suggest the importance of balancing autonomy with some consistency in terms of providing a similar experience in terms of content for the students going through the first-year program. With regard to practice, this study provides researchers in engineering education with information to advance the understanding of course redesign processes in general, and a better understanding of how to use reflective processes along the way as a research opportunity to further explore these processes.

6.1 *Interpreting our Findings within Current Literature*

Our results show that a group of course developers experience the course development process as finding balance between faculty autonomy and the consistency in course content with collegiality, serving as a perhaps uncomfortable but necessary balance. When aligned with theory, our findings show that autonomy and consistency are related in a way that requires balance for optimal functioning and motivation. In this case, autonomy comes from having enough guidance such that all instructors can provide an experience for students that prepares them to choose and enroll in an engineering major, but not so much consistency that every detail, e.g., assignments, lectures, timelines, pedagogical strategies, etc., are fully controlled and do not allow faculty autonomy. Our finding on the need to balance autonomy and consistency (often called structure in SDT literature) is well-documented within the literature: specifically with regard to leadership and faculty (e.g., [22]) and faculty and students (e.g., [19]). With regard to collegiality, research with SDT also confirms the importance of satisfying basic human needs for relatedness with others [18], a term akin to collegiality. People have a need for autonomy but also for relatedness and it is important for healthy work environments to support both.

Our research adds to current literature the perspective of faculty working with each other as peers in an environment with significant freedoms (i.e. there is not one established set of content for first year programs like there is for other engineering course such as statics) but also constraints not under their control (i.e. the course developers are peers with and are not in a position of authority over other faculty that will use the developed course materials). This is a particularly important perspective in engineering education as there are many large first year engineering programs that are taught by a team and considering this interplay could support a positive experience by promoting autonomous types of motivation (Fig. 1).

Our research also makes contributions to autoethnographic research methods by showing the significant benefits of collaborative reflection on the research approach. Narratives evolve and change when using different lenses, and can be adapted to a common story by a process of continuous rigorous reflection and discussion [30, 40]. We recognized the importance of our interactions with each other and with the data and were able to identify how those processes increased the trustworthiness of our findings [40]. Furthermore, as part of the process we were able to identify how the

process of collaboration increased the depth of our own reflective processes. Initially, we thought writing our reflections individually was enough to obtain meaningful data, however, when reading our reflections in isolation we realized the story was not complete. Only by going through an iterative process of discussions and further reflection were we able to achieve the data saturation that provided us with our complete findings.

6.2 Practical Implications and Suggestions for Keeping the Ship Balanced

Drawing on our findings as well as the interactive and reflecting strengths of our autoethnographic approach, we have a series of recommendations for keeping the metaphorical ship balanced. We acknowledge that our advice is firmly grounded in our particular team and context, we believe these ideas and suggestions are useful to share as they are adaptable to other institutions and course development endeavors. An important finding from our research is that finding a balance between consistency and autonomy that supports collegiality is an important outcome in our large first year engineering program context where many people are involved. We also found that development is an iterative process that may be messy. To support successful work, we have made a series of suggestions including the need to consider stakeholder perspectives.

It is important to start with an open mind and an open acknowledgment that a course and a team can and should undergo continual improvement. While there might be incorrect methods for course redesign, there are multiple “correct” methods. Similarly, there are multiple “correct” finished products. Participating in the course design allows faculty to learn different techniques for course development and to reflect on their own course development. Understanding the methods used by colleagues can allow faculty to feel more confident in their own course implementation style, and can further bolster autonomy and motivation. Furthermore, we recognize this is an ongoing process and the process itself is as important as the final product.

Throughout the development and teaching phases, collegiality may be supported by disrupting the silos and segregation of collegiality as an intellectual affinity (separating tenure/non-tenure faculty, research philosophies, etc.), and also by allowing for the success of collegiality as part of the organizational structure. This is especially important when there is collaboration and co-teaching in such heterogeneous teams as ours. Similarly, we felt our willingness to compromise was essential. Those within the development process were relying on compromise from peers. If other instructors were

not willing to relinquish a certain degree of autonomy in order to balance course content, our centralized redesign would not have been feasible.

In order to manage the balance, we found it critical to consider the lens of those involved in delivering the course materials and to include representatives from those stakeholder groups during the redesign. Our instructional faculty consists of research professors, teaching professors, instructors, and graduate teaching assistants. The degree of autonomy inherent in each of these roles varies significantly, as does the required teaching load for the different roles. Different degrees of teaching responsibility can have a huge impact on what is done, and what kinds of changes to materials can be made. Our loads ranged from 1 to 5 sections, and we noted that someone teaching one section is more able to focus on things like detailed instructor feedback on writing assignments, whereas someone teaching five sections might not be able to give that kind of feedback and attention, and might instead play up student peer review, simplified writing assignments, or development of tools to streamline class grading and administration.

Having the development team work through a reflective process helped us to understand the philosophy of each other and of the departmental administration. This also impacted our perceptions of what is needed for each other, and for the students. For instance, the creation of space for instructors to bring their own selves to the classroom has increased in importance in our mind, and we are more confident now both in finding ways to do so, and in our colleagues’ ability to take advantage of this. We also felt that it informed our sense of place within the department, strengthening our kinship, investment, and sense of belonging as members of the community.

These discussions and analysis were of benefit when COVID-19 forced a transition to fully online courses, and the additional course design changes that this required. Collectively, we believe that the findings of this paper translated well to designing activities for student teams. In particular, we were concerned with maintaining a sense of connection in the students with their teams, the courses, and the university, while allowing enough flexibility (autonomy) in completing the course objectives to accommodate their varied access and availability as they moved on and off campus, or dealt with health and family issues. At the same time, we were all wrestling with our own reactions to the pandemic and needed to connect with our students in ways that were authentic to each individual. Having some structured common “rules” but also having autonomy let us meet course design, instructional and student needs during a difficult time.

Finally, we recommend that course developers spend substantial effort to create “big picture” guidelines for what course content should include in situations like ours, where there is not necessarily widespread agreement in the field for what should or shouldn’t be taught. While we did find through our discussions and reflections that having clearer definitions of the course and parameters for course content would be helpful, we did not dedicate much time to talking about the specific course content itself.

7. Conclusions and Future Work

In reflecting on our course development work through this autoethnography, we found that all of the course developers strove to balance the consistency of course content with enabling autonomy of the instructors who teach the class. One of the driving factors for this was to maintain the sense of collegiality that is an important part of the department’s culture. The metaphor of a ship that could become off-kilter if either consistency or autonomy become too out of alignment was helpful for us to visualize the process, and can be seen as aligning with understandings of teacher motivation as described by self-determination theory.

This autoethnography project began because we all enjoyed working together on course development, and wanted a structured opportunity to reflect on the process together. We thought an autoethnography would be an interesting, engaging, and valuable way to document these reflections. Reflection on the process of course redevelopment served as a means to reinforce our own metacognition. In essence, the autoethnographic process cemented our understanding of the redevelopment process, and provided a strong foundation for ongoing course refinement. We consider the process of going through an autoethnography while doing our work a very impactful process because it pushes us to continuously reflect. We realized how important our emerging themes

are in our work of course development because everyone had similar thoughts, however, if the research process would not have been included, we probably would never have had conversations about it. We do not suggest that every course development process goes through an autoethnographic approach, however, we consider self-reflection and team discussions key to understanding the important aspects of the process.

This work explores the experience and perceptions of a course development team engaged throughout a course development process. However, as acknowledged in our limitations, we are missing the experiences of students and faculty who were not on the course development team. Expanding the scope of analysis to include student perceptions as well as additional faculty perceptions could help further inform the work. Specifically, our future work could include an evaluation of the course redesign materials and implementation from the perspectives of students, the rest of the instructional team, and faculty in the engineering disciplines into which students transfer after completing the first year program. This evaluation could be further enriched by including programs in other institutions. As we pursue this, we would also seek to identify and formalize mechanisms for continuous feedback from these stakeholder groups in support of on-going continual improvement. Developing these feedback mechanisms and their context will enable us to not only improve our own program, but could be made transferable to other large programs.

Finally, we encourage course developers, instructional designers, and anyone in charge of transforming and improving engineering curricula to consider sharing their experiences and use engineering education research to shape their processes, not only can it provide more rigor to improve current practices but also it can help the engineering education community to understand the implementation of best practices.

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Appendix A: Autoethnography Reflection Guide

Each project team member will write a reflection addressing the following questions:

Reflection on pragmatic aspects of course development:

How did you approach course development? What worked and what did not work in your approach? How do you know?

What are the principal changes that you made in the course? What worked? What did not work? How do you know?

What were some of the principal challenges that you encountered in course development? How did you address these challenges?

What recommendations would you make to others embarking on a similar process?

Deeper Reflection on the Experience:

Where and how in this process did personal beliefs (yours or others) come into play (including previous personal experiences)?

What departmental and university factors contributed to course development decisions (positive and negative)?

What external factors associated with a broader context contributed to course development decisions (positive and negative)?

What, if any, experimentation was involved (either prior to or during the semester)?

What salient outcomes were considered for students, faculty and other stakeholders?

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