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Supporting Teaching Statement Development: A Framework from an Engineering Education Graduate Course

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A teaching philosophy describes an instructor's collection of beliefs, values, and goals regarding teaching and learning. In contrast, a teaching statement is an articulation of how one's teaching philosophy is translated into actionable plans in the classroom. Many engineering instructors, particularly those from the traditional engineering disciplines, are not expected to have a formal training in education, and thus, struggle to develop, articulate, and enact their teaching philosophy and statement. While current engineering education graduate programs embed several opportunities in their curricula for students to develop their teaching philosophy and statement, only a few studies have started reviewing pedagogical approaches that support this development.

This study investigates how a graduate-level engineering education course supports students in developing teaching statements with elements of constructive alignment. Drawing on Biggs' Constructive Alignment as our analytical framework, we analyze three students' progression from their initial teaching philosophies through sequenced reflections on learning objectives, test development, and unit of instruction design, culminating in their final teaching statements. Our central research question asks: *How does the instructional design of a graduate-level elective course in engineering education influence the development of students' teaching statements?*

Using qualitative thematic analysis, we trace how students' understanding of Intended Learning Outcomes (ILOs), Teaching and Learning Activities (TLAs), and Assessment Tasks (ATs) develops across three strategically chosen reflections and how this understanding is expressed in their final teaching statements. The findings yield three major insights: procedural knowledge of constructive alignment emerges most effectively through hands-on design activities rather than theoretical instruction alone; scaffolded engagement with discrete components of alignment prior to holistic integration supports the development of comprehensive understanding; and certain effective instructional practices such as scaffolding and systematic feedback are not immediately intuitive to engineering graduate students and benefit from explicit introduction in coursework.

All three students demonstrated substantial growth, shifting from initial philosophies that articulated broad teaching beliefs without clear operationalization to final statements that incorporated alignment-based reasoning through concrete, evidence-informed strategies. The course's dual use of constructive alignment (i.e., both as course content and structure) played a key role in facilitating this development. For engineering education programs, this study provides evidence for effective approaches to supporting teaching statement development and offers a framework that emphasizes reflection-based pedagogy grounded in constructive alignment principles.

Keywords: educational methods, pedagogy, reflection, teaching philosophy, teaching statement

Introduction

The development of teaching statements represents a critical milestone in the professional preparation of future engineering educators. A teaching statement is "a systematic and critical rationale that focuses on the important components defining effective teaching and learning in a particular discipline and/or institutional context" [1, p. 84]. Teaching statements also serve as reflective documents through which instructors articulate their teaching methods and evaluate the impact of their pedagogical choices [2]. Reviewing multiple guides on how to write effective teaching statements, Kearns and Sullivan [2] found that essential components include articulating learning goals, describing teaching methods and how they support those goals, explaining approaches to assessing student learning, and identifying evidence-based strategies for evaluating teaching effectiveness.

Despite their importance for job applications, tenure and promotion reviews, and ongoing pedagogical development, many graduate students struggle to craft effective teaching statements. Schonwetter et al. reported that "many candidates… have never reflected on what they do when they teach and… have never systematically written about their teaching philosophies and goals," and further noted that candidates often receive little or no guidance from academic advisors because these advisors themselves have not written teaching philosophy statements [1, p. 84]. This lack of preparation is particularly acute in engineering, where doctoral students rarely receive formal training in pedagogy, even though many aspire to academic careers [3]. Although recent initiatives such as graduate teaching fellowships, Preparing Future Faculty programs, and Prospective Professors in Training have begun to address this gap, systematic research examining the effectiveness of these interventions remains limited [4], [5], [6].

Engineering instructors often struggle to bridge the gap between holding general beliefs about teaching and articulating specific, evidence-based pedagogical approaches. Borrego et al. [7] found that the conflicts between beliefs, their articulation and actual teaching and learning practices originate from their lack of confidence on structuring their classes to reflect such beliefs. Without explicit frameworks for thinking about teaching, novice instructors may produce teaching statements that may articulate evidence-based pedagogies without explaining how those values translate into specific instructional decisions. Research on supporting teaching statement development emphasizes that effective preparation requires systematic processes that integrate guidance and feedback, help students produce thoughtful statements, and encourage meaningful reflection on teaching and learning [2], [8]. However, the literature on teaching statement development in engineering education remains sparse, with limited empirical evidence about which instructional approaches effectively support graduate students in moving from abstract teaching philosophies to articulated, evidence-based pedagogical approaches [9].

This study addresses this gap by examining how a graduate-level course in engineering education supports students in developing teaching statements through structured reflection on core instructional design topics. Our central research question asks: *How does the instructional design of a graduate-level elective course in engineering education influence the development of students' teaching statements?* We analyze three students' progression from initial teaching philosophies through structured reflections on learning objectives, assessment design, and unit of instruction design to their final teaching statements, using Biggs' Constructive Alignment as our analytical framework. By examining both common patterns across students and individual variations in how they appropriate alignment concepts, we provide evidence about how reflection-based pedagogy can support engineering graduate students in developing sophisticated teaching statements. The findings offer a replicable framework that engineering education programs might adapt for supporting teaching statement development grounded in evidence-based pedagogical principles.

Theoretical Framework

In this paper, we attempted to utilize Biggs' Constructive Alignment [10], [11] to analyze how teaching beliefs can be translated into instructional practice. Constructive alignment offers a systematic approach to course design in which three components operate coherently: Intended Learning Outcomes (ILOs), which specify what students should be able to do; Teaching and Learning Activities (TLAs), which support students in achieving those outcomes; and Assessment Tasks (ATs), which allow students to demonstrate their learning. The framework integrates constructivist learning theory with the principle of alignment. The former posits that learners actively construct understanding through engagement in meaningful activities while the latter ensures that what students are expected to learn, how they learn it, and how their learning is evaluated function together as an interconnected system [11]. Research consistently demonstrates that courses designed with constructive alignment foster deeper approaches to learning compared to courses in which objectives, activities, and assessments are disconnected [12], [13], [14], [15]. Recent scholarship also highlights the importance of students' perceptions of alignment, noting that when learners perceive coherence across outcomes, activities, and assessments, they are more likely to adopt deep learning strategies [16].

Despite its widespread adoption as a course design framework [15], [17], [18] and its incorporation into quality assurance requirements for educational programs internationally [16], limited research has explored its potential for supporting graduate students in developing teaching statements in an actual course. Constructive alignment holds promise in this context because it provides a concrete structure for translating teaching beliefs into instructional decisions. For instance, rather than merely asserting that teaching should be student-centered or active, a teaching statement informed by constructive alignment would specify what students should achieve (ILOs), describe the activities designed to support that achievement (TLAs), and explain how learning would be evaluated (ATs). Furthermore, when graduate students learn about constructive alignment while simultaneously experiencing it through intentionally aligned course design, they may develop both conceptual understanding of the framework and tacit knowledge of how aligned instruction operates in practice [19]. This dual role of using constructive alignment as both course content and course structure as shown in Figure 1 provides the foundation for the analytical approach adopted in this study.

Course Context

The course examined in this study, "Educational Methods in Engineering," is an elective course designed for graduate students in engineering education. It also enrolls students from traditional engineering disciplines who seek to develop their teaching expertise through the Teaching and

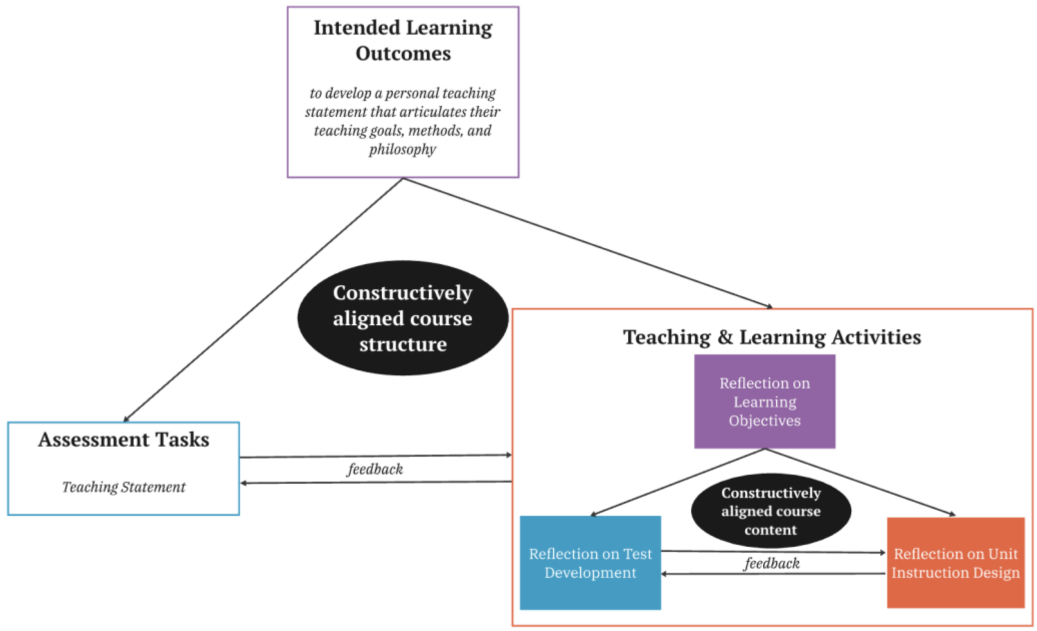

Figure 1. John Bigg's Constructive Alignment as a framework for both course structure and course content

Learning in Engineering graduate certificate program offered by the School of Engineering Education at a large research-intensive Midwestern university in the United States. In Fall 2025, the course enrolled 18 graduate students from engineering education as well as fields such as civil, nuclear, and biomedical engineering. This cohort formed a learning community that spanned multiple engineering departments and brought together diverse perspectives on teaching and learning in undergraduate engineering classrooms.

One of the course's ILOs is for students to develop a personal teaching statement that articulates their teaching goals, methods, and philosophy. To support this outcome, the course integrates several major teaching and learning activities throughout the semester. Students engage with scholarly literature on engineering education, including theories of learning and motivation, principles of instructional design, assessment and rubric development, and evidence-based teaching practices. Throughout the semester, students complete 14 reflections (i.e., 10 weekly reflections based on assigned topics and four reflections corresponding to major course assignments), syllabus writing, test construction, unit instructional design (UID), and classroom observations.

For the purposes of this paper, we focus on three reflections situated at strategic points in the semester, each aligned with a major instructional design concept. Reflection 1, completed before Week 3 on course planning, requires students to consider how clearly articulated learning objectives drive instructional decisions. Reflection 2, completed after the test construction activity, prompts students to examine their experiences while creating different test items with corresponding rubric and solution key. Reflection 3, completed after the UID project, asks students to reflect on the process of designing a complete instructional unit, including the selection of pre-readings, designing a flipped lecture, a lesson plan, active learning activities, and homework, demonstrating alignment across all elements.

The course culminates with the submission of a final teaching statement in which students articulate their teaching goals, describe their methods for achieving those goals, and express the principles and values that guide their practice. This final statement serves as a major assessment task for the course, and students are expected to draw upon the conceptual vocabulary, pedagogical frameworks, and practical insights developed throughout the semester. As such, the teaching statement represents a synthesis of their learning, integrating their initial beliefs, as reflected in their teaching philosophy slide submitted during the first few weeks of the semester, with the pedagogical knowledge and instructional experiences acquired during the course.
From a constructive alignment perspective, the course models the principles it teaches. The intended learning outcome, creating an articulated final teaching statement, is explicitly defined. The teaching and learning activities, including scholarly readings, the test construction and UID projects, and structured reflections, are deliberately selected to support students in achieving this outcome. The final teaching philosophy statement directly assesses students' attainment of the intended learning outcome. This alignment creates coherence in the course's design while also providing students with a concrete example of constructive alignment in practice (see Figure 1).

Research Team

The authors approached this study from a shared constructivist philosophical stance, viewing knowledge as actively constructed through learners' interactions, experiences, and reflections [20]. This epistemological grounding shaped both our interpretation of teaching and learning and our methodological decisions, including the emphasis on analyzing participants' reflections and tracing the development of their teaching philosophies.

The authors also brought diverse professional experiences to the research. The first author is a PhD student in engineering education and served as the teaching assistant for the course, providing close engagement with students' learning processes and artifacts. He has also taken this course with a different cohort; hence, giving him familiarity with the course context. The second author, a professor in engineering education and the primary instructor of the course, contributed deep pedagogical expertise and firsthand experience designing and facilitating student-centered learning environments. The third author is a professor in engineering education, whose scholarly background helped informed the study's theoretical framing and methodological rigor. Both the second and third authors have extensive experience implementing cooperative problem-based learning approaches. They have also expertise in course design rooted in John Bigg's constructive alignment [17], [18].

All authors identify as being from Southeast Asia, a shared cultural background that shapes our perspectives on learning, classroom dynamics, and relational forms of pedagogy. Collectively, our positionalities influence how we understand teaching philosophies as evolving constructs shaped by experience, reflection, and context, all of which aligns with our constructivist orientation.

Methods

This study employs qualitative research design to examine how graduate students' teaching statements develop over the course of a semester. We collected multiple data sources from three students enrolled in the course, including their initial teaching philosophy presentations; three structured reflections on learning objectives, test development, and unit instructional design, respectively; and their final teaching statements.

Our analytical approach was grounded in Biggs' Constructive Alignment framework. We first coded [21] each student's initial teaching philosophy presentation to identify baseline beliefs and to determine whether they demonstrated any early evidence of alignment-oriented thinking. In this stage, we examined connections between teaching beliefs, specific instructional methods, and intended student outcomes. We then analyzed each reflection using constructive alignment as our coding framework, identifying evidence of students' developing understanding of ILOs, TLAs, and ATs.

After coding the reflections, we examined each student's final teaching statement using Biggs' three-part framework. We identified instances where students articulated ILOs for their students, where they described specific TLAs, and where they discussed ATs. Importantly, we also analyzed whether and how students demonstrated alignment thinking by explicitly connecting these three components.

We then conducted a cross-case analysis to identify thematic patterns across the different artifacts of the three students. We examined which codes appeared consistently for all students, which appeared only for some, and which were unique to individuals. This analysis allowed us to distinguish between insights that may have been generated through specific course activities and insights that may relate to individual interpretation and appropriation of course content. Additionally, we traced how alignment-related ideas evolved across documents for each student to understand the development of their thinking over time.

Throughout the analysis, we remained attentive to the dual role of constructive alignment in this course. Specifically, we examined both how the course itself embodied constructive alignment principles in its design and how students developed an understanding of constructive alignment as a pedagogical framework. This dual perspective enabled us to explore not only what students learned, but also how the course's aligned structure facilitated their learning.

Participants

Three participants (n=3) with demographics shown in Table 1 were purposefully selected for this study. Although several students have passed the inclusion criteria (i.e., completed all the required reflections and obtained the highest rating for the final teaching statement), we only selected three to allow us to demonstrate in-depth illustrations of how the course's teaching and

Table 1. Participant Demographics

Participant	Gender	Type of class participation	Major
Student A	M	In-person	Computer and Information Technology
Student B	M	In-person	Nuclear Engineering
Student C	F	Online synchronous	Teaching and Learning in Engineering Certificate Program

learning activities supported the development of their final teaching statements. Consistent with the goals of qualitative research, our intention is not to generalize these findings to all learners, but to offer rich, contextualized insights that may be transferable to other contexts.

Findings

Teaching Philosophy Slide

Student A's teaching philosophy slide centers on three key ideas: learner-centeredness, the development of critical thinking and collaboration skills, and continuous improvement. The first two emphasize the student experience, while the last focuses on Student A's role as an instructor. Given the nature of this requirement, Student A provided only limited details on how these ideas would be operationalized. For example, Student A described significant learning as a product of learner-centeredness.

Student B used the Dunning–Kruger Effect curve (confidence vs. competence) to frame his goal of guiding students toward the "slope of enlightenment". He described learners as diverse in prerequisite knowledge, learning styles, and motivation level. His strategy for addressing this diversity is to incorporate varied teaching methods that balance novelty with level of understanding, with particular emphasis on practical applications.

Student C organized her teaching philosophy using a maximize/minimize framework. She aims to maximize constructive, active, and team-based learning activities; application-based tasks; and a mindset that treats failure as an opportunity to learn. Conversely, she aims to minimize teacher-centered approaches where the teacher is the sole source of knowledge.

*Reflection 1: **Learning objectives** as the cornerstone of active and meaningful learning*

As shown in Table 2, the concept of alignment emerged consistently across the three students' reflections, although with varying emphasis. Student B emphasized that course design must remain aligned with the learning objectives, while Student A extended this alignment thinking to include assessment and classroom activities. Both students recognized the implications of this alignment for mitigating content overload. Although Student C did not explicitly discuss content overload, her remark about "allowing focus to stay where it belongs" suggests a similar intention. This idea is made explicit in Student B's statement:

> [T]raying to be perfect or covering everything is not the goal, and that using available resources and keeping objectives central is the best way to design an effective course.

Among the three, Student B placed the strongest emphasis on "need-to-know" objectives, such as providing students with opportunities to practice and extend their knowledge. Although these ideas relate closely to teaching and learning activities, he underscored that they are grounded in well-written learning objectives and thoughtful course planning.

Student A also described a shift in his perspective on learning objectives—from viewing them merely as an "administrative task" to understanding them as essential in providing course structure. Student C extended this idea by explaining how learning objectives becomes "a target each day for the level of rigor I wanted students to be able to tackle at the end of a unit of study".

Table 2. Summary of cross-case analysis for the students' reflections on learning objectives

Dimension	Student A	Student B	Student C
ILO understanding	LOs are not simply administrative tasks; they provide structure to a course	Keeping LOs central is the best way to design an effective course	LOO demonstrate instructor's intention for each unit of study
Unique insights	LOs should explain both *what* students are expected to do and *why* they are doing it.	LOs must demonstrate balance between course structure and student autonomy	LOs can be used to manage time and focus
Shared insights	LOs should vary in terms of depth of knowledge and levels of thinking		
Alignment thinking	LOs must align with assessment and classroom activities; alignment mitigates content overload	Course design must align with Los; alignment mitigates content overload	Teachers need an in-depth understanding of what students need to know and a plan to get there

She likewise demonstrated a reframing of the teacher's role:

> While I believe that teachers should be focused on delivering content effectively more than writing curriculum and assessment every term, and that I am lucky enough to be teaching in a role this term that allows for exactly that, I also believe that teachers need to have an in-depth understanding of what students are expected to know each day and that they have a personal plan for how to get there.

All three students agreed that learning objectives should vary in terms of depth of knowledge and levels of thinking. Students A and B stressed the importance of structuring learning to help students progress from lower level of remembering to higher level of applying, analyzing, and creating. Student C strongly captured this point, explaining that "DOK [depth of knowledge] does add a dimension that makes sense when you consider not just what students are expected to do, but the depth to which they should have learned the material".

Reflection 2: ***Assessment*** *design becomes stronger through revision and reflection*

The second reflection centers on the test development activity. The students' reflections can be summarized into three major themes: (1) the goals of assessment, (2) assessment as a process, and (3) the qualities of good assessments and rubrics. We expanded these themes in the following narratives and summarized them in Table 3.

Student B emphasized that assessment serves a dual purpose: it is not only a tool for grading but Also, an instrument for teaching. Student A similarly noted that assessment should support deeper understanding by encouraging students "to apply […] rather than just simply recall facts or concepts".

Across the reflections, several insights emerged regarding the qualities of a good assessment. While Student B acknowledged that fairness is difficult to evaluate, he also argued that a good assessment must be fair, challenging, and aligned with learning goals. Student C reinforced the importance of fairness, stating that "a good test should measure what students have had a

Table 3. Summary of cross-case analysis for the students' reflections on test development activity

Dimension	Student A	Student B	Student C
AT understanding	Assessment design, clarity, and feedback work together to support student learning	A good assessment must be fair, challenging, and aligned with learning goals	Fair and transparent assessments can motivate students and help them see what they know and what they still need to work on
Unique insights	Assessment becomes stronger through feedback, revision and reflection	Empathy and perspective-taking in assessment design	Testing as empathy and communication; use of AI tools in designing assessment
Shared insights	*LO Grid shows mix of content and cognitive levels*		
Alignment thinking	LO grid is essential for operationalizing alignment between assessment items, course goals, and cognitive complexity.	A good assessment aligns with the learning goals; assessment as a teaching tool, not just grading;	Good tests match the level of thinking the course has asked students to practice

reasonable chance to learn and should match the level of thinking the course has asked them to practice." She further explained that fair and transparent assessments can motivate students by helping them recognize "what they [already] know and what they still need to work on". For Student C, fairness is also closely tied to the use of a well-designed rubric.

The third theme highlights assessment as an iterative process. All three students recognized the usefulness of the learning objective grid in ensuring appropriate coverage of content and levels of cognitive demand. Student A emphasized that the learning objective grid is essential for operationalizing alignment between assessment items, course goals, and cognitive complexity. He also reflected on the differences involved in writing multiple-choice, short-answer, and long-answer questions. In particular, he noted the challenge of anticipating the various ways students might approach long-answer questions, which increased the difficulty of the task but also prompted deeper reflection when developing the rubric. Student A explained this challenge in detail:

> […] I think that for the long-answer questions, which asked specifically for a context diagram and a system request based on the case study, it was more complex to think of their design. I used examples from the case study to show possible correct answers, but also noted that there could be valid variations, as I realized that grading open-ended questions could be subjective. The rubric that I had for the short and long answers described each level of performance from 'Exemplary' to 'No Evidence', and outlined what evidence would show the understanding in the assessment of the students.

Student B described assessment design using the terms "empathy and perspective-taking", highlighting the importance of anticipating "how students will think through the problems". Building on this idea, Student C framed assessment as an "act of empathy and communication", rather than simply evaluation. She also noted that AI tools helped her generate "several possible solution paths and helped [her] see what different "reasonable" answers might look like […] what kinds of mistakes or alternative methods a real student might use".

A unique aspect of Student A's reflection is his emphasis on feedback as an integral component of test development. For him, feedback can occur through peer review before administering the test and through student feedback afterward.

Reflection 3: *I knew* ***alignment*** *was important but requires attention.*
The following discussion describes the evidence for the three themes under this reflection about UID. The themes are teaching as a decision-making, ensuring alignment, and providing student support. We present a summary of our cross-case analysis in Table 4.

Under the theme of decision-making, Students A and B emphasized the considerable effort required of instructors when designing a unit of instruction. Student A elaborated by describing instructional design as a sequence of coherent, interdependent decisions:

> [S]eeing these parts work together helped me better understand the importance of coherence in instructional design and how each choice shapes the student experience.

This perspective highlights how instructional choices, from choice of instructional materials to classroom activities and assessments, collectively influence learning.

Unsurprisingly, alignment emerged as a dominant theme. Student A provided a detailed account

Table 4. Summary of cross-case analysis for the students' reflections on unit of instruction design

Dimension	Student A	Student B	Student C
TLAs Understanding	UID is a sequence of coherent and interdependent decisions	UID tasks demonstrate the complexity of teaching that seems simple on the surface	UID should demonstrate a clear chain of command: Course Outcomes → Unit Learning Objectives → Instructional Activities → Assessment Tasks.
Unique insights	In active learning, teacher's role shift towards facilitation.	The difficult part is finding the right amount of support to students	Syllabus provides a roadmap for navigating the course
Shared insights	LOs are the non-negotiable anchor; a single session requires huge decision-making		
Alignment thinking	Writing the learning goals before anything else would help guide the rest of the decisions the instructor has to make.	Working through the process of creating and delivering my unit of instruction gave a clearer picture of what real teaching looks like.	Starting with the desired student outcomes or LOs forced a clear alignment across the entire unit

of how pre-readings, flipped lectures, and homework function within a cohesive design. Pre-readings prepare students for active engagement, flipped lectures reinforce key concepts, and homework tasks offer opportunities to apply the ideas discussed during class. Among these components, he identified challenges primarily with the flipped lecture and homework:

> [O]ne challenge that I could note was making sure the flipped lecture actually added real value without simply repeating the pre-readings […] we also found it challenging to decide the right level of complexity for the homework tasks.

Students A and C also reflected on the role of learning objectives as foundational to achieving alignment. Student C referred to learning objectives as “the non-negotiable anchor for every decision in a unit”. Student A similarly recognized that crafting strong learning objectives is the first step toward ensuring synergy among learning goals, instructional materials, and assessments.

Student C further demonstrated her understanding of alignment by articulating how assessment must map directly to practice and instruction:

> I’ve learned that effective assessment, particularly high-stakes exams, should instead align directly with what was practiced in class. Moving forward, my test design will focus on ensuring every test item maps to a specific learning objective, creating questions that are diverse in their levels of thinking and depth of knowledge (e.g., matching Bloom's Taxonomy or Webb's DOK, but not exceeding the cognitive work performed in class), and assessing students on mastery of the material they were explicitly taught and practiced while reserving new, complex tasks for in-class activities or future lessons. This is a practice I will absolutely carry into my future teaching.

The final theme concerns the types of support students need before, during, and after instruction. In their class implementation, Student B described supporting students during open-ended discussions by giving them time and space to think, enabling them to formulate their own conclusions. Student A echoed this belief, noting that active engagement leads to more meaningful learning and that it shifts the teacher’s role toward facilitation:

> […] I believe that the students learn better when they are active and engaged with the content rather than listening passively. I also believe that my role is to be a facilitator who challenges the students, supports them, and creates a welcoming space where real learning can happen.

Student A also underscored the importance of gathering feedback after a unit to determine how students can be better supported moving forward. Additionally, Student C highlighted the syllabus as an essential tool for student success, describing it as “a critical pre-semester task” that provides a roadmap for navigating the course.

Teaching Philosophy Statement

The final teaching statements demonstrated that all three students successfully integrated alignment thinking into their pedagogical approaches, though we can see the variation of the depth of this integration across the three statements.

Student A’s teaching philosophy statement builds upon three central concepts: active learning, inclusive classrooms, and practical application. Across his statement, the elements of constructive alignment appear consistently. For instance, his intended learning outcomes, such as his goal “to support my students in leveraging their skills to become critical thinkers who can analyze complex professional problems, while also becoming effective collaborators who work well and ethically in their teams”, reflect higher-order learning goals. Student A also identifies a range of teaching and learning activities align with his intention “[…] to move beyond memorizing facts and think about the logic and reasons behind technical ideas”. This explicit connection between instructional decisions and desired learning outcomes demonstrates his use of teaching methods that support the achievement of more complex cognitive goals. In terms of assessment, Student A’s statement places strong emphasis on formative assessment through milestone deliverables, peer evaluations, and regular feedback, complemented by summative assessment in the form of projects. Together, his intended outcomes, instructional strategies, and assessment practices provide clear evidence that he is intentionally applying constructive alignment principles in developing his teaching statement.

Student B’s teaching statement integrated alignment thinking through his partnership model. His characterization of “education as a partnership between instructor and student” demonstrated understanding that effective teaching requires coordination between what instructors design and what students do. His emphasis on “balance between rigor and autonomy” and his assertion that “learning begins with personal responsibility” showed sophisticated thinking about how to design teaching activities that support student agency while ensuring learning outcomes are achieved. His statement’s focus on “genuine practice” and his intention that “students must be trained the way they intend to perform” demonstrated alignment thinking. Likewise, this mindset ensures that teaching activities mirror the authentic performances students need to master.

Student C’s teaching statement showed alignment thinking primarily through her systematic attention to outcomes. Her emphasis on skills, active learning, and experiential learning demonstrated clear focus on what students should be able to do. Her commitment to “repeated opportunities” and “scaffolding” showed understanding of how teaching activities must be structured to support learning outcomes. Her attention to “transparency” and “motivation” suggested awareness that students need to understand the alignment between what they are asked to learn and why it matters.

Across all three students, the development from initial philosophy to final statement represented substantial growth specially in operationalizing their beliefs towards specific teaching and learning approaches (see Table 5). Initial philosophies articulated beliefs without operational frameworks. Final statements demonstrated understanding of how to translate their beliefs into aligned instructional systems. Initial philosophies lacked specificity about teaching methods and assessment approaches. Final statements included concrete, named strategies grounded in alignment principles. Initial philosophies offered personal convictions without justification. Final statements provided evidence-based rationales connecting teaching choices to learning outcomes. The course’s emphasis on constructive alignment, experienced through well-designed activities and sequenced reflections on learning objectives, assessments, and UID, successfully supported this developmental progression.

Table 5. Summary of cross-case analysis for the students' reflections on teaching philosophy slide and final teaching statement

Dimension	**Student A**	**Student B**	**Student C**
		Teaching Philosophy Slide	
Core Framework	Learner-centered approach: student-centered, active, and significant learning anchored on commitment to continuous improvement	Dunning-Kruger model; learner diversity	Learning best with multi-modal moments
ILO's articulated	Implicit (critical thinking, collaboration, meaningful practice)	Explicit (get as many students into the slope of enlightenment as possible)	Implicit (maximize synthesis, application, communication)
TLAs mentioned	-	Explicit (Analogies, physical demonstrations, practical applications)	Implicit (less teacher-centered, active learning with a team)
ATs mentioned	-	-	-
Alignment thinking	-	-	-
		Final Teaching Statement	
Organizing Framework	Three pillars: Active Learning, Inclusive Classroom, Practical Application	Partnership and balance model (rigor vs. autonomy, education as partnership, personal responsibility)	Skills-based outcomes (active learning, teamwork, problem-solving, experiential learning)
ILOs Articulated	Critical thinking, teamwork, ethical reasoning, professional competence	Genuine practice, accountability, reveal student strengths	Skills, problem-solving, confidence, teamwork
TLAs mentioned	Scaffolding, milestones, rotating team roles, large language models (LLMs), project-based learning	Genuine practice, training aligned with performance, experiential learning	Active learning, scaffolding, experiential learning, repeated opportunities
ATs mentioned	Regular feedback, continuous learning cycles, peer evaluations, iterative deliverables	Feedback, performance-aligned assessment	Feedback, transparency, motivation-supporting assessment

Unique insights	Teacher as facilitator; inclusive classroom; varied teaching methods	Education as partnership; education should reveal student strengths; learning begins with personal responsibility	Normalize challenges; teaching as responsibility and privilege; repeated opportunities
Shared insights	*Students need to be supported; feedback; active learning; translate knowledge to real world; scaffolding; skills*		
Alignment thinking	Explicit: uses alignment language; justifies each strategy by connection to ILOs	Moderate: frames alignment as partnership; connects practice to performance	Moderate: connects teaching methods to skills outcomes; transparency in assessment

Final Teaching Statement Evaluation

The course instructor evaluated the final teaching statements based on a rubric that highlights four key points: (1) express (and explain the reasons for) your beliefs about teaching and learning; (2) identify your goals for student learning and reasons for those goals in the context of your discipline and today's students; (3) identify specific pedagogical methods that you (plan to) use and explain why these methods are appropriate for your teaching goals, your subject; and (4) present an organized and well-written statement. These evaluation criteria align directly with the components of constructive alignment, as they require students to articulate learning goals, justify teaching methods in relation to those goals, and demonstrate coherence across all elements.

The instructor's evaluation of Student A's final teaching statement highlighted his strong commitment to active learning, inclusion, and practical application, characterizing these elements as both inspiring and student-centered. Student A's emphasis on developing learners into ethical and collaborative problem-solvers was particularly notable. The instructor described Student A as "on [his] way to becoming an outstanding educator who will leave a lasting impact on [his] students," suggesting that his teaching statement successfully demonstrated both pedagogical sophistication and authentic commitment to student learning. Student B's teaching statement was evaluated as articulating a philosophy grounded in discipline, integrity, and accountability. The instructor noted a clear linkage between his personal values and his goals for engineering education. Based on this evaluation, the instructor characterized Student B as "a future educator who is able to instill both skill and character in our future engineers", indicating that his partnership and balance framework resonated as a coherent and values-driven approach to teaching. Student C's statement was evaluated as demonstrating her potential as a "promising and impactful" engineering educator. The instructor noted that Student C clearly articulated guiding principles emphasizing the value of repeated opportunities to practice engineering thinking. The instructor also highlighted her thoughtful integration of structured teamwork practices to intentionally cultivate students' collaboration skills. This evaluation suggests that Student C's skills-based framework has a potential of successfully translating into concrete, implementable teaching strategies.

Discussion

Insight 1: Intended reflections and class activities scaffold constructive alignment

The three reflections analyzed in this paper illustrate how the course scaffolded students' understanding of constructive alignment [11] by guiding them through a sequenced progression: beginning with ILOs, moving to assessment design through the creation of ATs, and culminating in UID, where ILOs, TLAs, and ATs function as an integrated system. This progression was evident across all three students, each of whom demonstrated increasingly sophisticated alignment thinking as they advanced through the reflections.

The first reflection on learning objectives established the conceptual foundation. In their Graduate Student Teaching Fellows program, Daher & Peteranetz [22] argued that the most useful topics according to their students were Bloom's taxonomy, the creation and use of rubrics, and backwards design. We argue that the learning objectives connect all these pedagogical concepts together. Students recognized that ILOs must drive all subsequent instructional decisions [11], [23]. This foundational insight proved essential for the later reflections, as meaningful assessment design and unit construction require a clear grasp of the central role of learning objectives. Moreover, the reflection prompts that encouraged students to connect theoretical readings on learning objectives with their own teaching experiences supported them in understanding the practical implications of this core pedagogical principle.

The test development reflection strengthened students' understanding of alignment by requiring them to confront the challenge of designing assessments that both match learning objectives and target appropriate levels of cognitive complexity. The consistency of codes across all three students suggests that the hands-on nature of the activity, particularly the use of the Test Construction Grid, effectively facilitated deep learning. Students experienced firsthand the difficulty of writing assessment items that extend beyond recall and instead assess higher-level skills such as application, analysis, and evaluation [24]. They discovered that achieving alignment between ILOs and ATs demands careful attention to cognitive levels, deliberate construction of test items, and the development of clear rubrics that communicate expectations [25]. This procedural knowledge of understanding how to construct aligned assessments, rather than merely recognizing their importance, proved critical to their later teaching statements.

The unit instructional design reflection required students to integrate their understanding of ILOs and ATs while incorporating TLAs, thereby deepening their conceptualization of alignment as a holistic system [23]. By designing and implementing a complete unit of instruction in which all components must work together coherently, students encountered the full complexity of achieving constructive alignment. This integrative activity played a crucial role in helping students shift from viewing alignment as a set of discrete components to understanding it as an interconnected system that shapes the entirety of instructional practice [23].

Insight 2: Hands-on experience through test construction and UID develop deeper understanding of constructive alignment

A critical finding of this study concerns the distinction between knowing about constructive alignment and knowing how to achieve it. All three students were likely introduced to the concept of alignment through course readings and class discussions. However, the evidence indicates that their procedural understanding of how to actually design aligned instruction was developed primarily through hands-on design activities rather than through theoretical exposure alone. This is consistent with what Hamdoun [26] reported as one of the constraints of constructive alignment application that some teachers know the principle but don't know how to apply it. In the course, this has been addressed by engaging in the design process, not from reading about constructive alignment alone.

The test development activity was particularly powerful in cultivating procedural knowledge. All three students created tests for real courses and used the Test Construction Grid to map assessment items to learning objectives and levels of cognitive complexity. This structured tool provided valuable scaffolding by making the criteria for alignment explicit. Through the process of writing test items, students discovered how much precision is needed to ensure that ATs genuinely measure ILOs. These insights became part of their practical pedagogical knowledge.

The UID activity expanded this procedural learning by requiring students to make holistic, interdependent instructional decisions. Students selected pre-readings, determined which concepts to address in flipped lectures, designed active learning activities, created homework tasks, and developed rubrics. The most important, yet most difficult component of the task is to ensure that each component is aligned with specific ILOs. This comprehensive design process exposed the complexity involved in achieving alignment across a full instructional unit and illuminated the numerous trade-offs inherent in making instructional decisions [27]. By engaging in this systems-level design task, students moved beyond isolated understanding of alignment components and developed a more integrated, practice-oriented comprehension of constructive alignment. This addresses what Daher & Peteranetz' [22] participants in their study found as a gap in their program (i.e., lack of formal opportunities to teach and get feedback).

Insight 3: The course introduced new concepts and tools that have been evident in the teaching statements

While students retained their individual frameworks, certain pedagogical practices appeared consistently across all three final teaching statements, even though they were absent from their initial teaching philosophies. This pattern suggests that some effective instructional practices are not intuitively obvious to engineering graduate students and therefore benefit from explicit introduction and structured practice through coursework. The most notable examples include scaffolding, systematic feedback, and language emphasizing student support. Unlike what Lee [28] found, students in the course not only became familiar with the pedagogical terminologies, but was able to provide articulation at the level of practice and implementation. This finding also supports the need for instructional development in engineering that covers both content and pedagogical expertise [9], [29].

Scaffolding emerged in the final teaching statements of students, despite neither having referenced it initially. We argue that they developed an understanding of this concept through the UID experience, during which they worked to sequence learning activities in progressive steps that build toward more complex outcomes. This finding suggests that experiential design tasks, especially those requiring instructors to consider how students will advance through learning activities, can help students internalize scaffolding even when they had not previously articulated or applied the concept.

Systematic feedback likewise became a central pedagogical practice for all three students, though their pathways to adopting it differed. This variation indicates that multiple course activities may shape students' understanding of feedback as a pedagogical tool, although the test development activity, especially its peer review process, appears to have been a particularly influential catalyst.

Perhaps the most striking pattern was the emergence of nearly identical language regarding student support across all three final statements. Each student included this idea even though this phrasing was absent from their initial teaching philosophies. This convergence suggests that course activities effectively introduced and reinforced a shared commitment to providing structured support for student learning. The concept aligns naturally with constructive alignment: if instructors expect students to achieve specific ILOs, the TLAs they design must provide the necessary support to reach those outcomes [23]. The course appears to have helped students recognize that student-centered teaching does not equate to allowing students to struggle independently. Instead, it requires intentionally designed support structures that enable all students to meet ambitious learning goals.

Insight 4: Constructive alignment allows students to personalize their understanding of alignment principles.
The instructor's evaluations provide external validation that all three students successfully developed teaching statements meeting professional standards for articulation, coherence, and alignment. The evaluations recognized not only the quality of the statements as documents but also the authentic pedagogical thinking they represented. The instructor's ability to identify each student's distinctive approach suggests that the course successfully supported individual appropriation of alignment principles rather than producing formulaic or homogenized statements. This validation strengthens our claim that reflection-based pedagogy grounded in constructive alignment can support engineering graduate students in developing sophisticated, articulated teaching statements that retain individual voice while demonstrating pedagogical expertise. This supports Hailikari et al. claim that students, especially those who may have unreflective approach to learning, "can be supported in transforming their learning into deeper and reflective processing through constructively aligned teaching" [12, p. 228].

Limitations & Future Work

Several limitations of this study should be acknowledged. First, we did not made assessment of the background of the three students that may influence their prior knowledge on course design. For instance, Student C may have been exposed to other engineering education courses through her Teaching and Learning in Engineering Certificate Program. In some of the reflections, Student A and Student C provide connection to their current and previous teaching experiences which may not be available for Student B. This diversity of backgrounds could provide more depth in the analysis of their artifacts. Second, our analysis focuses on written artifacts which provide insights into students' articulated understanding but may not fully represent their enacted practice. Future research could extend this work by considering other evidences such as semi-structured interviews and classroom observations. Third, our analysis examines development during a single semester, providing a snapshot of students' learning but not revealing longer-term trajectories. Longitudinal research following students across several years could examine how teaching statements evolve with accumulated teaching experience, whether alignment thinking continues to organize pedagogical reasoning in practice, and which aspects of graduate coursework have lasting impact versus which require reinforcement through ongoing professional development.

Despite these limitations, this study provides valuable evidence about how engineering education graduate courses can support students in developing sophisticated, articulated teaching statements grounded in constructive alignment principles. The findings suggest specific design principles such as sequenced reflection on alignment components, hands-on design experiences with structured tools, and course structures that model the principles being taught.

Conclusion

This study investigated how a graduate-level engineering education course supports students in developing teaching statements through structured engagement with constructive alignment. By tracking three students' work across initial teaching philosophies, sequenced reflections, and final statements, we show that a reflection-based pedagogy grounded in Biggs' framework helps students move from broad teaching beliefs to coherent, evidence-based approaches. The intentional design of the course (i.e., using constructive alignment as both content and structure) enabled students to develop increasingly sophisticated understanding of how learning outcomes, activities, and assessments function as an integrated system. Three insights emerged: procedural knowledge of alignment develops most effectively through hands-on design activities; scaffolded reflections that build from component concepts to system-level integration support deeper learning; and effective instructional practices such as scaffolding and feedback require explicit introduction for engineering graduate students. Together, these findings offer a framework for programs seeking to help graduate students construct rigorous, pedagogically grounded teaching statements.

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