2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
Host Sponsor UNC Charlotte
ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION
Paper ID #53670

Engineering students' motivations in creating poems on technical topics: a Self-Determination Theory–based analysis

Miss Golbarg Nazari, University of Florida

Golbarg Nazari's research focuses on AI in education and engineering education, with interests in student motivation, creativity, and human-centered approaches to learning. Her work examines how innovative instructional strategies, including reflective and creative activities, can enhance student engagement, deepen understanding, and promote meaningful learning in engineering education. She received her B.S. degree in Industrial and Systems Engineering from the University of Tehran, Iran, and her M.S. degree in Industrial and Systems Engineering from the University of Florida. She is currently pursuing a Ph.D. in Industrial and Systems Engineering at the University of Florida.

Elayne Colón, University of Florida

Dr. Elayne Colón is a Clinical Professor and Interim Associate Dean for Academic and Student Affairs in the College of Education at the University of Florida. With a background in school psychology, her scholarly interests include accountability and accreditation, the preparation of educators for P-12 settings, and the ways in which we measure learning and impact in higher education.

Prof. Elif Akçalı, University of Florida

Dr. Elif Akçalı is an Associate Professor in the Department of Industrial and Systems Engineering as well as The Michael Durham Professor in Creativity in the Engineering Innovation Institute in the Herbert Wertheim College of Engineering at the University of Florida. She is an industrial engineer, a visual artist, and an explorer of the interplay between thinking and making in the arts and engineering. Her scholarly interests focus on the use of arts-based processes for the development of divergent thinking and critical thinking skills of engineering students.

Engineering Students' Motivations in Creating Poems on Technical Topics: A Self-Determination Theory–Based Analysis

Abstract

Integrating assignments that develop students' creative thinking into engineering curricula remains challenging because such tasks must balance technical rigor with opportunities for autonomy and creative expression. To provide students with the opportunity to think creatively around technical concepts, mathematical models, and solution algorithms, students in an upper-level industrial and systems engineering course focusing on the design and operation of inventory and supply chain systems were asked to work on poem-writing assignments. Specifically, students were required to create two poems that focused on deterministic inventory modeling and stochastic inventory modeling, respectively. After each poem-writing assignment, students were also required to respond to several open-ended questions asking them to (i) describe how and why they picked a particular topic for their poems; (ii) list which course materials and other resources they used to create their poems; (iii) provide an estimate of the amount of time they spent completing their poems, from conception to submission.

Data were collected during the Fall 2022 semester. Among the 26 students enrolled, 21 consented to participate in the study at the end of the semester. The poems written by these students and their responses to reflection prompts were entered as data for the study. The participant responses to reflection prompts were analyzed qualitatively in two steps: First, the students' descriptions of their (i) motivations for choosing a particular topic (i.e., why) and (ii) their individual approaches to complete the poem on the chosen topic (i.e., how) were identified utilizing qualitative content analysis. Next, students' stated "why" and/or "how" rationales were coded using Self-Determination Theory (SDT) to examine four levels of motivational regulation (external, introjected, identified, and intrinsic) across seven primary motivational rationales (ease of completion, personal interest, creative compatibility, important topic, prior knowledge, future assessment, and enhance understanding) that engineering students experienced during poem-writing assignments. Finally, code patterns as well as data on time on task and resource use across two assignments were quantitatively analyzed. The results indicate that, among the primary motivational rationales, Creative Compatibility was the only one that mapped onto multiple SDT regulatory styles (intrinsic motivation, identified regulation, introjected regulation, and external regulation). Overall, student-stated motivations were dominated by more autonomous motivation (intrinsic motivation and identified regulation) than controlled motivation (external and introjected regulation) for these poem-writing assignments. Reports of amotivation and integrated regulation were not observed.

Keywords Self-Determination Theory (SDT), Student Motivation, Autonomous Motivation, Engineering Education, Creativity, Poetry Writing, Inventory Control, Mixed Methods

Introduction

In engineering education, course assignments play a central role in shaping how students engage with technical content and develop disciplinary ways of thinking. Many assignments are designed primarily to support traditional learning goals, such as knowledge construction, critical thinking, and technical problem solving. However, fewer assignments explicitly focus on developing students' creative thinking around technical topics. This distinction matters because creativity-focused assignments often require students to engage differently with course material by reframing concepts, making interpretive choices, and expressing understanding in nontraditional ways. Therefore, instructors must design assignments that not only maintain technical rigor but also create meaningful opportunities for creative thinking and student autonomy.

A central concern for the development of assignments that are aimed at strengthening students' creative thinking skills is student motivation. Unlike conventional assignments that primarily emphasize technical accuracy and convergent problem solving, creativity-based tasks often require higher levels of intrinsic motivation, risk-taking, and active engagement to be successful. When motivation is low, students may adopt superficial, compliance-based approaches, which can undermine the purpose of such activities. Student motivation is a critical factor in educational success because it generates, directs, and sustains the effort needed for learning. Without it, even well-designed courses can lead to low engagement, weaker performance, and student burnout.

Assignments that are aimed at developing creative thinking skills around technical material can help engineering students reframe technical concepts and formulas to communicate them in new ways. Creativity in technical courses can be developed through many modalities (e.g., dioramas, cartoons, stories, role-play, and even dance). However, not all formats are equally feasible or appropriate in typical engineering classrooms. To address this limitation, short and carefully structured poem-writing tasks can easily be used to encourage perspective-taking and conceptual reframing. Poem writing on a technical concept can be implemented as low-stakes, creativity-based activities that complement traditional technical assignments, particularly when the goal is to increase students' personally endorsed engagement with and creativity around technical content. In this study, poem writing on a technical subject is positioned as an accessible format for creativity-supportive learning. However, the central question is not only whether such assignments motivate students, but what kind of motivation they cultivate.

This question can be addressed by considering Self-Determination Theory (SDT) that offers a comprehensive framework for understanding the factors that improve or reduce motivation, learning, and well-being [1,2]. SDT describes a continuum of motivation types based on the degree of internalization, ranging from more controlled forms (e.g., external regulation, introjected regulation) to more autonomous forms (e.g., identified regulation, integrated regulation), as well as intrinsic motivation. Thus, SDT can be utilized to explore not only "how much" motivation students may have but also the quality of their motivation.

A core mechanism in SDT is the satisfaction of three basic psychological needs: autonomy, competence, and relatedness. When these needs are supported, motivation is enhanced [3, 4]. SDT also emphasizes that students' ability to develop high-quality (more autonomous) motivation

depends on the learning environment, because contextual conditions shape whether these needs are supported or frustrated. When students experience adequate support for autonomy, competence, and relatedness, they are more likely to internalize learning goals and engage more meaningfully, which is especially important for tasks involving conceptual understanding and creativity. When these needs are insufficiently supported, students may shift toward more controlled forms of motivation (e.g., responding mainly to external demands) or amotivation (e.g., feeling ineffective or disengaged). This issue is particularly salient in engineering education, where rigid curricular structures, high-stakes assessments, highly technical content, and heavy workloads can constrain opportunities for creativity and frustrate students' basic psychological needs. Therefore, to understand the necessity and potential impact of creativity-based interventions in engineering education, it is important to examine (i) how such interventions shape students' motivational quality and (ii) the conditions under which they support (or fail to support) students' basic psychological need satisfaction. Thus, an SDT-based perspective is useful for informing assignment design and instructional practices that sustain engagement while supporting meaningful learning.

This paper examines the implementation of poem-writing assignments in an upper-level technical undergraduate industrial and systems engineering course as a context for understanding students' motivational orientations and the conditions that support internalization through the lens of SDT's taxonomy of motivation. Specifically, it examines how a non-traditional creativity-based assignment within an engineering curriculum can reveal distinct patterns of student regulation and engagement. Also, a thorough qualitative analysis of the data reveals seven student-described motivational rationales, among which Creative Compatibility emerges as a salient rationale that captures the alignment between the poem-writing task and a student's interests, identity, or preferred way of learning. In this context, the following research questions are considered:

1. To what extent does poem writing on technical topics elicit autonomous versus controlled forms of motivation among engineering students? (RQ1)

2. Is Creative Compatibility a salient rationale associated with more autonomous motivational orientations for the poem-writing assignments, and can it serve as a mechanism for fostering internalization (i.e., movement from controlled toward more autonomous motivation)? (RQ2)

3. To what extent is poem writing on technical topics associated with sustained motivation and behavioral engagement (time on task and resource use) over time? (RQ3)

Related Literature

This study relates to two streams of research in engineering education: the use of SDT principles to enhance engineering education and the incorporation of poem writing into engineering education.

SDT and Engineering Education. SDT has been widely applied in engineering education to understand how course structures and instructional practices shape the quality of students' motivation, including shifts from more controlled (extrinsically motivated) toward more autonomous (intrinsically motivated) forms of motivation. Research indicates that many students experience a motivation "slump" during demanding courses, with movement toward more controlled motivation or amotivation, underscoring the importance of need-supportive learning environments. A growing body of literature applies SDT to engineering education, examining both how curricular and instructional design influences students' motivation and the practical challenges of redesigning engineering courses around SDT principles [5]–[15].

SDT-informed implementations can be useful to increase student autonomy in engineering education. Foundational work in high-stakes STEM contexts showed that instructor-provided autonomy support predicts increases in students' competence, interest, and autonomous self-regulation over the semester, and that autonomy support can be especially important for students who initially lack autonomous motivation [5]. Later, a narrative study examined motivational change during a "low-cost intrinsic motivation course conversion" and highlighted three mechanisms that supported shifts toward intrinsic motivation: individual choice, interpersonal relationships, and constructive failure [6]. Similarly, a sophomore-level engineering course was redesigned by (i) replacing a traditional exam with autonomy-scaffolded, student-selected design projects and (ii) providing choices in homework. Student interviews revealed that while autonomy was emphasized in the design, relatedness emerged as a particularly salient need, and a perceived lack of connection with teaching staff shifted motivation toward more extrinsic factors [7].

SDT can be used to study motivational mechanisms in various engineering contexts. For example, Organismic Integration Theory, a sub-theory of SDT, was used to identify distinct instances of motivational regulation through qualitative analysis, suggesting that while external rewards may initiate participation, sustained engagement in innovation is better supported by student ownership and personal goal alignment [8]. SDT has also been used to examine the motivation of engineering graduate teaching assistants (GTAs), linking factors such as training, appointment structure, students, and teaching colleagues to autonomy, competence, and relatedness needs [9]. Longitudinal work further suggests that motivation is dynamic and sensitive to activity type: repeated measures across time points indicated that although need satisfaction and a supportive classroom climate were associated with autonomous motivation, intrinsic motivation decreased during more theoretical assignments before rebounding during hands-on design challenges [10]. In addition, an evaluation of an SDT-informed community support program aimed at retaining women in engineering technology found strengthened relatedness, continued vulnerability in autonomy due to gendered team roles, and improved two-year persistence [11].

SDT implementations in engineering education can be complex at scale. A large-scale course redesign study (1,886 engineering students) used stepwise regression to show that students' evaluation of the course assignment predicted perceived competence, which in turn predicted intrinsic motivation and course enjoyment; the study recommended simplifying course structures to support competence before introducing additional changes [12]. This approach was guided by a hierarchical model of motivation that explains how motivation operates across levels and

contexts and has been used to interpret motivational processes in educational settings and course redesigns [13]. Person-centered SDT work also highlights heterogeneity in motivational trajectories: cluster analysis identified multiple needs-based profiles and showed that motivation can diverge over time across profiles [14]. Most recently, a multi-year study in a second-year electrical engineering context combined qualitative coding with the Situational Motivation Scale and found competence to be the strongest motivating need, with need satisfaction linked to intrinsic motivation/identified regulation and low need satisfaction linked to amotivation/external regulation [15].

Poetry Writing and Engineering Education. Although the integration of poetry into engineering curricula may initially appear to be an unconventional approach, a small but growing body of literature demonstrates its efficacy as a pedagogical tool for fostering creativity, communication skills, and conceptual understanding [16, 17, 18, 19, 20, 21, 22, 23]. Building on this broader literature, an exploratory study incorporated "I am" poems into an industrial and systems engineering course, where students personified technical concepts (e.g., "I am ABC Analysis"), encouraging imaginative reframing and the translation of complex technical ideas into plain language [24]. A subsequent study then examined how poetry writing can enhance students' conceptual understanding of mathematical models and inventory-management approaches by analyzing students' poems and related responses, showing that technical poetry can also surface conceptual misunderstandings and gaps in understanding [25]. In parallel, another study analyzed student perceptions of technical poem writing and identified dominant reflection themes such as creativity, understanding, problem-solving, and communication, along with substantial perceived career relevance and alignment with professional skills (e.g., communication and design-oriented thinking) [17]. More recently, a follow-up study analyzed students' reflection prompts to examine how engineering students approached technical poetry as a creative task, including their topic-selection rationales, creative processes, and how these were related to effort and technical accuracy [26].

Together, these studies suggest that poem-writing assignments can complement traditional analytical training while supporting creativity-based learning outcomes valued in engineering education. Furthermore, to better understand the quality of students' motivation for engaging in such assignments, this study uses SDT to examine students' motivational rationales associated with poem-writing assignments in technical contexts.

Data Collection

Course. Study data were collected in a 3-credit-hour junior/senior level undergraduate industrial and systems engineering course on inventory and supply chain systems. The course focuses on the modeling and analysis of inventory, logistics, and supply chain problems encountered in practice. Foundational deterministic (i.e., economic order quantity and its extensions) and stochastic (i.e., newsvendor and (q,r) policy as well as their various extensions) models for inventory management establish a basis for the students to study complex logistics as well as supply chain problems using these foundational models. The course is designed to emphasize both procedural and conceptual learning. That is, students are expected to demonstrate both (i) an ability to formulate and solve

problems and (ii) an understanding of the principles of and connections between concepts that relate to inventory and supply chain systems. A component of the course that facilitates conceptual learning is a set of poem-writing assignments in the course.

***Poem-Writing Assignments*.** Poetry is one of the foundational forms of literary art that uses imagery, rhythm, and figurative language to communicate deep emotions, complex thoughts, and human experiences. Writing a poem encourages a more careful observation, a more comprehensive investigation of the subject matter, and, hence, helps develop a deeper understanding of the subject matter. Although poem writing is generally a complex task that benefits from substantial training and experience, in this study it was used solely as a tool for learning. To minimize the literary demands placed on students, a highly structured form requiring little prior training—the 'I am' poem (see Appendix A)—was selected.

Students were required to complete three poem-writing assignments in the course. First, students were asked to produce an "I am" poem about themselves. Next, students were required to select a topic related to one of the deterministic inventory models (e.g., economic order quantity, unit inventory holding cost, or assumptions of the EOQ model) and craft an "I am" poem from the perspective of this topic (see Appendix B for a student-written poem from the standpoint of the EOQ model). Finally, students were asked to pick a topic related to one of the stochastic inventory models (e.g., newsvendor model, (q,r) policy, or unit cost of backlogging) and write one more poem from the point of view of this topic (see Appendix B for a student-written poem through the lens of the unit overage cost). Following the submission of the two poems on technical topics, students were also asked to complete a brief survey capturing their (i) rationale for topic choice and approach (open-ended "why/how" prompts), (ii) estimated time on task (self-reported minutes/hours), and (iii) resource use (open-ended material descriptions). Open-ended prompts were used to elicit both motivational rationales (e.g., interest, perceived value, and perceived ease) and process information (e.g., how students gathered information and constructed poem lines). While "why/how" prompts were designed to explore the nature of behavioral engagement, time and resource questions were included to operationalize behavioral engagement in ways appropriate to a creative learning task.

***Grading*.** As poem-writing tasks and post-assignment surveys were all required components of the course, they were graded by the course instructor. Poem submissions were graded out of 10, and each submission received a full mark, unless there were structural (e.g., poem lines or stanzas missing) or linguistic (e.g., spelling mistakes) issues. Each poem submission accounted for 1 point toward the final grade in the course. Survey responses were graded out of 10 also, and each submission received a full mark, unless there were missing responses or responses were too short. Each survey submission also accounted for 1 point toward the final grade. At the end of the semester, the students were asked for their consent to include their poems and survey responses in the study data. The students were asked to submit signed (i.e., giving consent) or unsigned (i.e., not giving consent) forms, and were given 1 bonus point toward their final grade if they submitted the consent form.

Student Feedback. Poems 2 and 3 were due about 5 days before the first and second term exams, respectively, so that the instructor had enough time to read all the poems and give brief individual

feedback to each student. The instructor also compiled a list of most repeated mistakes that indicated conceptual misunderstandings to provide some additional collective feedback to the entire class before the exam.

Faculty Workload. When the data for this study were collected, the instructor used the student-written poems on technical topics for a rough overall assessment of conceptual understanding of key topics. Accordingly, grading was lenient and feedback was holistic for the poem as a whole, while still being individualized for each student (see Appendix B for sample instructor feedback). It took less than a minute to read (and enter the grade for) the first poem per student. Hence, it could be estimated that grading the first poem-writing assignment took less than 30 minutes. The time needed for reading and typing up individualized feedback for the poems on technical topics was longer. While a well-constructed and technical-error-free poem needed around 2-3 minutes to read and type the individualized feedback for the student, a poorly constructed poem that has multiple technical errors took around 5-6 minutes. During grading, the instructor also copied and pasted some of the most problematic poem lines to a slide presentation to be used later to facilitate the collective feedback discussion in class. Hence, it could be estimated that the grading of the second and third poem-writing assignments took about 90 to 120 minutes each.

Study Data. The data collection and analysis methods for this study were approved by the Institutional Review Board (IRB) at the (suppressed to preserve anonymity) as exempt (Protocol Number: suppressed to preserve anonymity). Among the 26 students enrolled in the course in the Fall 2022 semester, 21 consented to participate in the study at the end of the semester. Their poems as well as their responses to survey questions were entered as data for the study. The poems and survey responses of the other 5 students were read by the instructor for grading at the time, but they were excluded from this study.

Data Analysis

We used a mixed-methods analytic approach that combined qualitative coding with quantitative summaries. Open-ended ‘why/how’ responses were coded using SDT regulatory styles and primary motivational labels, while we quantitatively summarized the resulting patterns, along with time on task and material use data.

Task Time. For time on task, students reported an estimated completion time in minutes or hours. All estimates were converted to minutes for analysis. When students reported ranges (e.g., “1–2 hours”), the midpoint of the range was used as the *estimated time on task* for descriptive and inferential analyses.

Resource Materials. Students described the resource materials (e.g., lecture slides, personal notes, course documents, public websites) they consulted in creating their poems. Responses were qualitatively analyzed, different types were identified, and the number of distinct resource types identified by the participant was standardized into a materials count variable.

Topic Choice and Approach Data. Student responses to the open-ended "why/how" prompts were segmented into meaning units. Each meaning unit received two codes: (i) an SDT regulatory style reflecting the type of motivation expressed, and (ii) a primary motivational rationale capturing the

student's main reason for topic selection or writing approach. The primary motivational labels were adopted from Atherton and Akçalı's prior analysis of technical poem-writing assignments [26]. In the current study, both the primary motivational rationales and the SDT regulatory styles were coded by two researchers (EAk, GN). After independent coding, the coders discussed coding decisions and resolved discrepancies through consensus. Coded segments were then aggregated by assignment iteration (P2 and P3), and cross-tabulations were used to examine how motivational rationales mapped onto SDT regulatory styles across tasks.

Coding framework (what was coded): Each meaning unit received two codes: (1) an SDT regulatory style to classify the type of motivation reflected in the response and (2) one primary motivational label capturing the student's main rationale.

Coding procedure (how coding was conducted): We segmented each response into meaning units and dual-coded each unit using this framework. Then we aggregated coded segments by assignment iteration (P2 and P3) and summarized frequencies using cross-tabulations to examine how motivational labels mapped onto SDT regulatory styles across tasks.

Coding 1: SDT Regulatory Style. To interpret students' stated reasons for engaging in the assignment, we used SDT's taxonomy of motivation, which organizes motivation along a relative autonomy continuum (Fig. 1). Following Ryan and Deci's definitions, we briefly define each motivation category used in our analysis and provide representative example statements to illustrate how each category would appear in students' explanations:

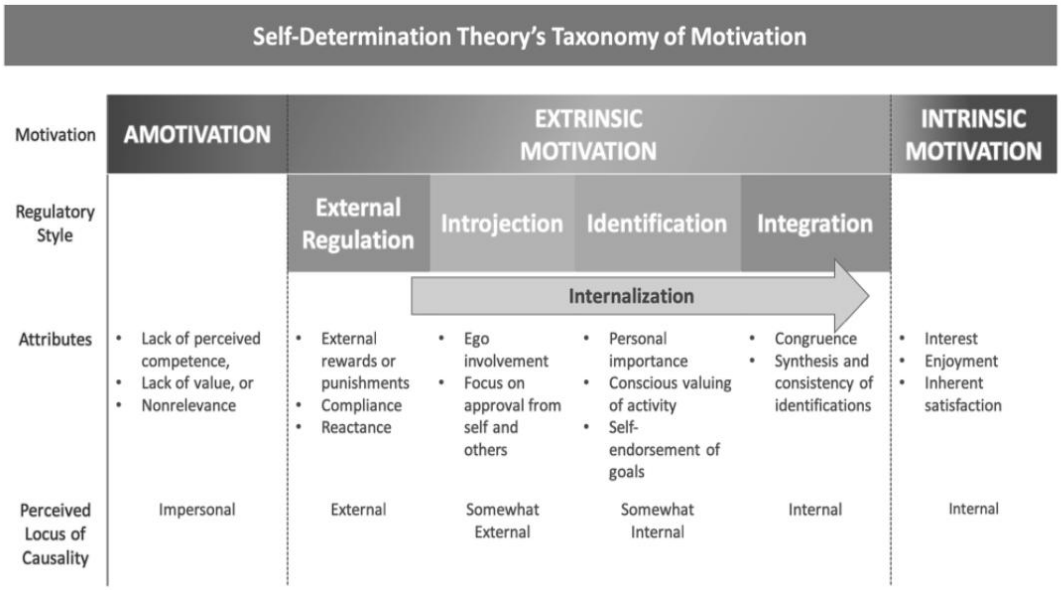

Figure 1. Self-Determination Theory's Taxonomy of Motivation (adapted from [4]).

- Amotivation. *Amotivation* refers to a lack of intention or reason to act. It can result from a lack of perceived competence to perform an activity or from a lack of value or interest, and it is a strong negative predictor of engagement, learning, and achievement. In the context

of this study, no amotivated rationales were observed in the coded responses since all the students who consented to participate in the study submitted both poems and responded to the surveys.

- Extrinsic motivation (EX). *Extrinsic motivation* is a heterogeneous category of motives that concerns behaviors performed for reasons or separable outcomes rather than the activity's inherent interest or enjoyment. These instrumental motivations can vary widely in content and degree of internalization, ranging from external regulation (rewards/punishments), through introjected regulation (ego pressure), to identified regulation (personally valued outcomes) and integrated regulation (aligned with one's identity).
    - External regulation (EX-EX). *External regulation* refers to behavior driven by externally imposed rewards and punishments; it is typically experienced as controlled and non-autonomous. In the context of this study, rewards include tangible or social benefits (e.g., grades, points, praise, credit), and punishments include losses or penalties (e.g., grade loss, point deductions, negative feedback, late penalties, failing a course). These contingencies may prompt risk-minimizing choices (e.g., selecting easy or straightforward topics, choosing topics that are fresh in mind, or adhering closely to course materials).
    - Introjected regulation (EX-INJ). *Introjected regulation* is a partially internalized form of extrinsic motivation in which behavior is driven by internal pressures, such as maintaining self-worth or avoiding anxiety, shame, or guilt. In academic contexts, it often reflects ego involvement, where self-esteem is contingent on outcomes; thus, the regulation is internally controlling but still non-autonomous. These cues differ from pure grade-seeking (external regulation) and from valuing learning (identified regulation) because the primary driver is self-worth or approval pressure rather than grades or personally endorsed value.
    - Identified regulation (EX-ID). In *identified regulation*, individuals consciously identify with, or personally endorse, the value of an activity and thus experience a relatively high degree of volition or willingness to act. In the context of this study, identified regulation may appear as selecting or shaping a topic to deepen understanding, solidify key course concepts, ensure accuracy/clarity, or because the topic is important or relevant to one's goals or real-world practice. Here, the work is undertaken to achieve a valued educational outcome rather than to obtain points.
    - Integrated regulation (EX-INT). *Integrated regulation* is the most autonomous form of extrinsic motivation, in which individuals not only identify with the value of an activity but also integrate it with other core interests and values. In the context of this study, integrated regulation did not appear.
- Intrinsic motivation (IN). *Intrinsic motivation* is defined as engaging in activities "for their own sake," in the absence of external impetus, for their inherent interest and enjoyment. It involves engaging in an activity because the activity itself is interesting and satisfying. Intrinsically motivated individuals are interested in what they are doing, display curiosity, explore novel stimuli, and work to master optimal challenges that are typically experienced as volitional and absorbing and are supported by feelings of autonomy and competence. In

this study, personal interest/curiosity refers to students selecting a topic because it is inherently interesting and engaging to explore, with attention driven by curiosity rather than grades or efficiency.

For qualitative coding, meaning units in participant responses were identified, and each meaning unit was mapped to at least one of the regulatory styles IN, EX-EX, EX-INJ, EX-ID, and EX-INT.

Coding 2: Primary Motivational Label. The study data were qualitatively analyzed in a previous study and labels that represented the functional "why" of topic choice and writing approach in a poem-writing assignment were conceptualized [26]. In what follows, the descriptions of these labels are reviewed briefly and these labels are mapped to SDT regulatory styles:

- Ease of Completion: This label indicates that students selected a topic to minimize time, effort, or cognitive load when completing the poem-writing task. Typical cues include references to the topic being "easy," "straightforward," "fitting assignment constraints efficiently," or having enough material to make the poem easier to complete. Ease of Completion always reflects externally regulated motives when the emphasis is on finishing the task with minimal burden.
- Creative Compatibility: This label indicates that the selected technical topic "fits" the structure of the poem, enabling effective use of poetic voice, personification, structure, rhyme, flow, or imagery. Students may describe the topic by being easy to "turn into" an "I am" poem, or requiring additional creative work (e.g., improving rhyme schemes). Creative Compatibility spans multiple SDT forms depending on the response: it can reflect intrinsic enjoyment of creative craft, identified regulation when the poem form is valued as a tool for organizing or exploring concepts, external regulation when fit is framed as task efficiency, and introjected regulation when driven by self-imposed quality standards (e.g., 'make it sound right,' 'best it could be').
- Important (topic-wise): This label captures that selected topics are foundational, central, or high impact in the course content or in real-world practice. Students may describe the concept as "important," "a foundation/basis," "quintessential," or essential for understanding subsequent topics. When students emphasize the value or significance of mastering the concept (rather than a grade), Important typically aligns with identified regulation.
- Prior Knowledge. This label reflects existing familiarity, competence, or confidence with the topic before writing the poem. Linguistic indicators include "I knew it well," "most familiar," "best understanding," "strong foundation," "comfortable," or references to extensive prior exposure through lectures, practice problems, or previous review. Prior Knowledge maps to identified regulation when students endorse choosing a topic that matches current competence.
- Future Assessment. This label captures the recent evaluation or anticipation (e.g., quizzes, exams, grades), including repairing weak performance, rehearsing material, or prioritizing content expected to be assessed. Typical cues include direct references to exams/quizzes/tests, studying, "will be on the exam," "did poorly," or preparing for upcoming assessment. Future Assessment corresponds to external regulation when framed as grade- or test-driven compliance.

Table 1. Codable linguistic indicators and illustrative student excerpts in the context of poem writing on technical material in an undergraduate engineering course.

Primary Motivational rationales	SDT Regulatory Style	Codable Linguistic Indicators	An Illustrative Example for Each Primary Motivational Pair and SDT Regulatory Style Pair
Ease of Completion	EX-EX	1) Direct explicit "easy / easier / simple" language 2) Enough material / lots of content causes lower risk of running out of lines/ideas or a task-completion strategy. 3) Prompt fit / requirement fit (easy to meet the assignment constraints) 4) Scope control / manageable reduces cognitive load and effort.	"I decided to write about the ABC analysis because I found it easier to do the poem based on it since it has clearly 3 class items categories and a bunch of valuable information that is easy to implement on a poem."
Personal Interest	IN	1) Personal Interest / enjoy / fun / passionate / attention curious / like	"I also thought the EOQ model was interesting."
Creative Compatibility	EX-EX	1) Form-fit / structure / rhyme / sound / flow cues supports creative execution in an easier way	"made it easier for me to think of good lines to create the poem."
	EX-INJ	2) Quality-pressure language / self-imposed standard	"I wish I would have spent more time to get more creative with the lines in my poem and to also revise it."
	EX-ID	3) Creative craft / word-choice that uses as a valued tool to explore / organize / learn.	"Writing creatively about a topic you do not know much about forces you to look at the material in a different way which ultimately helps you understand a topic."
	IN	4) Enjoyment / interest / inspiration / like poem writing that allows for creative expression.	"Overall, I would say I enjoyed this assignment because it steps back from calculations and allows us to just think about the model."
Important	EX-ID	1) Foundational / core / basis language 2) Explicit importance 3) Important in the course content 4) Real-world impact / applicability / relevance 5) Validity (conceptual necessity)	"I chose the EOQ assumptions as they are the foundation of the model but also it is important to understand that they are just assumptions, and not necessarily true. Therefore it is very important to remember that in the real world, these do not necessarily hold true."
Prior Knowledge	EX-ID	1) Direct familiarity / statements 2) Confidence / comfort language 3) Prior study / review before / class coverage	"I already had a strong foundation into the basics of the EOQ model and its assumptions. In addition, I thought we learned about the EOQ model more in depth throughout the lectures. Thus, I was able to pull inspiration from more slides and I had a stronger foundation of the EOQ model."
Future Assessment	EX-EX	1) Direct exam/quiz/test references 2) Performance repair / weakness after assessment 3) Grade/reward language	"After choosing it as my topic, it helped me study for the exam we just took as it strengthened my weak knowledge about the model prior to this assignment."
Enhance Understanding	EX-ID	1) Direct "learn/understand more/better" statements 2) Explicit lack of understanding / weakness cues 3) Learning framed as the purpose of the activity	"This would force me to take a deeper look at it. It would also make me try to better understand the model so that I can put it into everyday terminology."

- Enhance Understanding. This label expresses intent to deepen comprehension through the poem-writing process. Students may indicate confusion or low confidence, a desire to "understand better," "learn more," "take a deeper look," or "grasp the concept," or report that writing the poem increased familiarity or corrected misunderstandings. Enhance Understanding aligns with identified regulation when students frame learning as a valued outcome of the activity.
- Personal Interest. This label captures fun, enjoyment, curiosity, or perceived inherent interest in the topic (e.g., "interesting," "I liked it," "intriguing," "enjoyed it," "took my attention," "funny"). Personal Interest directly reflects intrinsic motivation when students describe engagement driven by pleasure or curiosity.

Table 1 demonstrates how the primary motivational labels [26] (in Column 1) can be mapped to SDT regulatory styles (in Column 2) utilizing the codable linguistic indicators (in Column 3). Also, Table 1 provides a demonstrative example from study data for each motivational primary rationale and SDT regulatory style pair.

Results

Observation 1. Table 2 maps the SDT regulatory styles to primary motivational rationales. A careful examination of Table 2 reveals the following: Across both Poem 2 (P2) and Poem 3 (P3) responses, Creative Compatibility is the only primary motivational label that mapped across multiple SDT regulatory styles (i.e., IN [intrinsic], EX-ID [identification], EX-INJ [introjection], and EX-EX [external] cues). This suggests that poem–topic fit is a flexible rationale that can be enacted for different reasons: as enjoyment of the creative act (IN), or as a valued strategy for organizing/expressing technical ideas (EX-ID), or as a constraint-management or quality-pressure framing (EX-EX/EX-INJ). In other words, Creative Compatibility does not reliably indicate a single motivational orientation but instead appears to function as a broad "entry point" through which students with different motivational profiles can engage the poem-writing task, whereas other labels appeared with just one SDT regulatory style. For example, while the Personal Interest label is aligned only with IN, the Ease of Completion and Future Assessment labels are aligned with EX-EX. Furthermore, Important, Prior Knowledge, and Enhance Understanding labels are all aligned with EX-ID.

In other words, some SDT regulatory styles appeared under multiple primary rationales. For instance, EX-EX (i.e., external regulation) appeared under three different primary rationales, namely Ease of Completion, Future Assessment, and some Creative Compatibility, because students described "task completion" external pressures in multiple ways. The external pressures noted are associated with [i] minimizing effort/time ("easy/straightforward/enough material"); [ii] meeting evaluation demands (e.g., "for the quiz/exam"); and [iii] selecting poem–topic pairings that reduced production difficulty (e.g., "works well for this type of poem / easier to convey in a poem"). A similar observation can also be made for EX-ID (i.e., identified regulation), which appeared under four different primary motivational labels, namely, Enhance Understanding, Important, Prior Knowledge, and some Creative Compatibility segments, because students described self-endorsed value in multiple forms. The self-endorsed values stated relate to [i] using the poem as a purposeful strategy to deepen comprehension (e.g., "learn it better," "grasp the

concept"); [ii] prioritizing foundational or consequential content ("e.g., imperative," "important to understand moving forward"); [iii] selecting topics that leveraged existing competence to support productive engagement (e.g., "I knew it best," "strong foundation"); and [iv] treating poem–topic fit as a valued means to organize, translate, or communicate technical ideas effectively (e.g., choosing a structure/voice that helped them express the concept clearly).

Table 2. Presence/absence cross-tabulation of SDT regulatory styles and primary motivational rationales observed in both assignments P2 and P3.

	Ease of Completion	Personal Interest	Creative Compatibility	Important	Prior Knowledge	Future Assessment	Enhance Understanding
EX-EX	X		X			X	
EX-ID			X	X	X		X
EX-INJ			X				
IN		X	X				

– An "X" indicates that at least one coded meaning unit appeared in that label–regulation pairing in both P2 and P3. Blank cells indicate that no coded meaning units were observed for that pairing. Assignment-specific frequencies are reported separately in Tables 3 and 4.

Across assignments P2 and P3, we observed the same overall code mapping between primary labels and SDT regulatory styles (Table 2), with detailed frequencies reported in Tables 3 and 4, respectively. This consistency suggests that students' motivations in poem-writing tasks are not captured by a single SDT style alone; instead, Creative Compatibility can be enacted through different regulatory framings, while all other primary motivational labels reliably signal more controlled versus more autonomous motivational orientations.

Observation 2. Tables 3 and 4 depict the cross-tabulated frequencies to show how often each label–regulation pairing occurred for assignments P2 and P3, respectively. Overall, across both poem iterations, identified regulation (EX–ID) was the most prevalent regulatory style, suggesting that students most often framed their rationales in terms of personally endorsed value (e.g., learning importance, strengthening understanding, leveraging familiarity). However, the distribution of SDT regulatory styles shifted toward more controlled framing from P2 to P3. Specifically, intrinsic motivation (IN) decreased (11 to 6), while externally regulated rationales (EX–EX) increased (7 to 16), indicating that students more frequently emphasized task completion efficiency and meeting course constraints in the later poem (e.g., selecting topics that were "easy," had "enough material," or fit the poem format) rather than enjoyment or curiosity-driven engagement.

Moreover, in Table 5, autonomous motivation remained predominant in both poems but decreased from P2 to P3 (41/53 ≈ 77% to 33/52 ≈ 64%), whereas controlled motivation increased (12/53 ≈ 23% to 19/52 ≈ 36%). One contextual explanation is a shift from exploratory engagement toward a more strategic, assessment-based approach later in the semester, potentially driven by the increased grade value of the later assignment, the greater difficulty of the topics, and the cumulative workload and time pressures typical of the end of the semester.

Table 3. Cross-tabulation of SDT-coded regulatory styles and primary motivational labels for assignment P2.

	Ease of Completion	Personal Interest	Creative Compatibility	Important	Prior Knowledge	Future Assessment	Enhance Understanding	Total
EX-EX	5		1			1		7
EX-ID			2	9	8		11	30
EX-INJ			5					5
IN		6	5					11

Table 4. Cross-tabulation of SDT-coded regulatory styles and primary motivational labels for assignment P3.

	Ease of Completion	Personal Interest	Creative Compatibility	Important	Prior Knowledge	Future Assessment	Enhance Understanding	Total
EX-EX	10		4			2		16
EX-ID			4	5	9		9	27
EX-INJ			3					3
IN		3	3					6

Observation 3. A careful examination of Table 5 indicates that students' rationales were predominantly autonomously regulated across both poems, rather than controlled, illustrating that students framed poem writing in terms of self-endorsed value and/or interest/enjoyment.

Table 5. Comparison of autonomous and controlled motivation.

	Autonomous motivation (intrinsic motivation [IN] and identified [EX-ID] regulation)	Controlled motivation (external [EX-EX] and introjected [EX-INJ] regulation)
P2	11 + 30 = 41	7 + 5 = 12
P3	6 + 27 = 33	16 + 3 = 19
Total	74	31

Observation 4. Table 6 shows that the total number of reported resources decreased from P2 to P3 (40 to 33). One interpretation is that students engaged in less exploratory information seeking in the later poem, potentially reflecting reduced autonomous engagement (e.g., less curiosity-driven online research) and greater reliance on instructor-provided materials, a pattern consistent with more controlled, 'safe' resource selection when grades or exams are salient. This corresponds to a shift from exploratory engagement to consolidation. Alternatively, it may indicate that students became more fluent with the assignment and more confident in the content, and, hence, may have needed fewer supplementary resources.

Table 6. Frequency of resource materials used by participants for assignments P2 and P3.

	Lecture Notes	Slide Decks	Class discussion	Personal notes	Previous Assignment	Online Research	Total
P2	6	18	3	2	3	8	40
P3	7	19	1	3	0	3	33

Observation 5. Table 7 shows that the average estimated time on task was lower in P3 than P2, suggesting a modest decline in reported engagement over time.

Table 7. Descriptive statistics for estimated time on task for assignments P2 and P3.

	Mean	Standard Deviation
P2	72.14	43.54
P3	63.29	41.25

Observation 6. Table 8 depicts the results of a paired-samples *t*-test to assess whether students' estimated time on task changed from assignment P2 to assignment P3. On average, the estimated student time on task decreased from P2 to P3, with a mean paired difference of 8.86 minutes (P2 > P3). However, this difference was not statistically significant, likely due to limited paired responses (small *n*) and substantial variability in self-reported time estimates. Another reason could be increased familiarity with the "I am" poem format by the third iteration.

Table 8. Paired-samples *t*-test results for estimated time spent completing assignments P2 vs. P3.

	Mean difference	*t*	*p* (two-tailed)	Cohen's *d*_z
Estimated Time on Task	8.86	1.26	0.23	0.27

Findings

RQ1. To what extent does poem writing on technical topics elicit autonomous versus controlled forms of motivation among engineering students? To explore this research question, students' rationales were analyzed to identify whether they framed the poem-writing assignments primarily through enjoyment and self-endorsed value (i.e., autonomous motivation) versus compliance, efficiency, or performance pressure (i.e., controlled motivation). These distinctions were operationalized by using SDT-based coding and by triangulating them with patterns in time on task and resource use data. As shown in Tables 3 through 5, autonomous motivation predominated overall, although controlled motivation increased from P2 to P3.

RQ2. Is "Creative Compatibility" a salient rationale associated with more autonomous motivational orientations for the poem-writing assignments, and can it serve as a mechanism for fostering internalization (i.e., movement from controlled toward more autonomous motivation)? The results in Tables 1 and 2 indicate that, across both poem-writing iterations, Creative Compatibility was the only primary motivational label that occurred under the wide range

of SDT regulatory styles—from intrinsic motivation through identified regulation to introjected regulation and external regulation. This distinctive "full-range" pattern suggests that Creative Compatibility functions as a flexible rationale that can be enacted for different reasons: [i] as enjoyment of the creative act (intrinsic motivation [IN]); [ii] as a self-endorsed strategy to organize and communicate course concepts (identified regulation [EX-ID]); [iii] as a quality-driven internal pressure (introjected regulation [EX-INJ]), or [iv] as an efficiency/constraint-management strategy (external regulation [EX-EX]). Because students enter with different motivational orientations, this primary label may be particularly informative and inclusive.

Accordingly, Creative Compatibility can be interpreted as a potential pathway toward internalization in poem-writing tasks: the same perceived fit between topic and the structure of the poem may initially support participation for controlled reasons (e.g., making the task easier) while also enabling more autonomous engagement when students frame the creative fit as personally meaningful or learning-oriented.

RQ3. To what extent is poem writing on a technical topic associated with sustained motivation and behavioral engagement (time on task and resource use) over time? To investigate whether motivational patterns (i.e., observed SDT regulatory styles) and behavioral engagement indicators (i.e., time on task and resource use) were sustained across iterations of P2 and P3 over time, first, SDT regulatory style codes were compared using frequency summaries, cross-tabulation, and summary tables (Tables 2 and 5). Next, behavioral engagement using students' self-reported time on task-and resource use were analyzed. For time on task, a paired comparison of estimated time on task between P2 and P3 for students with matched responses (Tables 7 and 8) was conducted. For resource use, total counts and the composition of resource types (e.g., lecture slides, personal notes, online sources) were compared across P2 and P3 (Table 6). Together, these descriptive patterns are suggestive of a modest decline in engagement from P2 to P3. The paired comparison of estimated time on task did not reach statistical significance (Table 8), and the changes in resource composition and SDT regulatory styles are reported as descriptive rather than inferential. Nevertheless, the directional pattern — a drop in mean time on task, fewer total resources consulted, and an increase in externally regulated rationales — is consistent with a shift from exploration toward consolidation in the later assignment. This pattern should be interpreted cautiously given the small paired sample, and a stronger inferential test of sustained engagement is left to future work with a larger sample.

Limitations

***Sample size and generalizability*.** The survey responses were collected from only one course and a limited number of paired observations across P2 and P3. In particular, the RQ3 analysis of sustained engagement should be read as descriptive rather than inferential; the directional pattern is suggestive but underpowered for a confirmatory test.

***Self-reported engagement measures*.** The data were self-reported and may contain recall error, rounding, or differences in interpretation (e.g., whether "time" includes brainstorming, drafting, or revising). In addition, the number of resources used does not necessarily capture depth or quality of use (e.g., careful study of one lecture vs. shallow reviewing of one assignment).

Coding scope and reliability. Primary motivational labels and SDT regulatory styles were applied to brief excerpts in survey responses rather than extended interviews, which may limit nuance (e.g., some SDT regulatory styles may appear under multiple primary labels within a single response). In addition, although both coding schemes — the primary motivational labels (developed in [26]) and the SDT regulatory styles (in the current study) — were coded independently by two researchers, with disagreements resolved through discussion until consensus was reached. This consensus-coding approach is consistent with established practice in qualitative content analysis. As an additional check, future work could complement consensus coding with a formal interrater reliability statistic on a held-out subset of segments.

Context effects across assignments. Changes in time on task and resource use between assignments P2 and P3 may reflect several contextual factors including increased familiarity with the "I am" poem format, proximity to assessment deadlines, shifting workload across the semester, instructor effects in how the assignment and topics were explained, and differences in topic difficulty.

Implications for Engineering Education

The findings of this study have several implications for engineering education practice. First, poem-writing assignments on technical concepts using "I am" poem structure can be used as a low-stakes, creativity-based activity that complements traditional analytical assignments in engineering courses. Instructors can use this type of assignment to help students engage with technical content in a more personally meaningful way that supports sense-making while still reinforcing conceptual understanding and communication skill development. This matters because students' rationales were more often framed in autonomous terms (especially identified regulation), indicating that many students experienced the assignment as a meaningful way to work with course concepts rather than only as a compliance task.

Second, increasing creative thinking around technical content also matters because it encourages students to reframe formulas and concepts, explain ideas in new ways, and develop the flexible sensemaking skills needed for engineering problem solving. In this study, the role of Creative Compatibility is especially important because this rationale appeared across a broad range of SDT regulatory styles, meaning that students with different motivational starting points can still find a productive way to do the task when the poetic form feels compatible with the topic or with their preferred way of expressing understanding. This suggests that instructors may not need every student to be intrinsically motivated at the outset; instead, assignments can be designed to create multiple access points that support movement toward more self-endorsed engagement.

Concluding Remarks and Future Directions

This study examined industrial and systems engineering students' motivational rationales for a technical poem-writing assignment through an SDT lens and linked these rationales to behavioral engagement indicators (estimated time on task and resource use) across two iterations (P2 and P3) of poem-writing assignments. Overall, students most often framed the activity in autonomous terms—primarily through identified regulation and, to a lesser extent, intrinsic motivation—

suggesting that many students perceived the poem-writing task as a meaningful or worthwhile way to engage with technical course concepts. At the same time, controlled motivation (especially external regulation) became more prevalent in the later iteration (i.e., P3), alongside modest reductions in time on task and total resource use, consistent with a shift toward more efficiency and constraint-oriented participation over time.

A key contribution of the current study is to characterize how Creative Compatibility, previously identified as a topic-selection rationale [26], maps onto SDT regulatory styles across both iterations of poem-writing assignments, which was the only primary motivational label that spanned a broad SDT regulatory style range—from intrinsic enjoyment of the creative task to identified value (creative form as a useful tool for organizing or expressing technical content), and in some cases to externally-regulated, completion-oriented framings. This broad-spectrum pattern indicates that Creative Compatibility may serve as an inclusive entry point in poem-writing tasks: students with different motivational starting points can still experience poem–topic fit and this may create opportunities for more autonomous engagement when students frame that fit as personally meaningful or learning-supportive.

Several future research directions could strengthen and extend this research on poem writing on technical topics in upper-level engineering courses. First, using larger and more diverse course contexts (e.g., different institutions, different engineering majors, and different course levels) would improve generalizability and help identify when creativity-based interventions are most effective. Second, future studies should use stronger engagement and evaluation measures—such as learning outcomes (quiz/exam performance) and interviews—to better assess how poem-writing assignments influence motivation and learning.

Acknowledgements

This work has been supported by the United States National Science Foundation under Grant Number 2215133. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References

[1] E. L. Deci and R. M. Ryan, *Intrinsic Motivation and Self-Determination in Human Behavior*. New York, NY, USA: Plenum, 1985.

[2] R. M. Ryan and E. L. Deci, "Intrinsic and extrinsic motivations: Classic definitions and new directions," *Contemporary Educational Psychology*, vol. 25, pp. 54–67, 2000.

[3] C. P. Niemiec and R. M. Ryan, "Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice," *Theory and Research in Education*, vol. 7, no. 2, pp. 133–144, 2009.

[4] R. M. Ryan and E. L. Deci, "Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions," *Contemporary Educational Psychology*, vol. 61, Art. no. 101860, 2020.

[5] A. E. Black and E. L. Deci, "The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective," *Science Education*, vol. 84, no. 6, pp. 740–756, 2000.

[6] K. F. Trenshaw, G. L. Herman, K. A. Green, and D. E. Goldberg, "Fostering motivation as a class objective in a large engineering class for second-year students: A narrative approach," *International Journal of Engineering Education*, vol. 30, no. 4, pp. 837–847, 2014.

[7] K. F. Trenshaw, R. A. Revelo, K. A. Earl, and G. L. Herman, "Using Self-Determination Theory principles to promote engineering students' intrinsic motivation to learn," *International Journal of Engineering Education*, vol. 32, no. 3(A), pp. 1194–1207, 2016.

[8] N. D. Fila and Ş. Purzer, "Using self-determination theory to understand engineering student motivation during innovation projects," in *Proc. 2017 IEEE Frontiers in Education Conference (FIE)*, 2017, pp. 1–8.

[9] R. L. Kajfez and H. M. Matusovich, "Competence, autonomy, and relatedness as motivators of graduate teaching assistants," *Journal of Engineering Education*, vol. 106, no. 2, pp. 245–272, 2017.

[10] J. D. Stolk, J. Jacobs, C. Girard, and L. Pudvan, "Learners' needs satisfaction, classroom climate, and situational motivations: Evaluating self-determination theory in an engineering context," in *Proc. 2018 IEEE Frontiers in Education Conference (FIE)*. IEEE, 2018, pp. 1–5.

[11] E. M. Dell, Y. Verhoeven, J. W. Christman, and R. D. Garrick, "Using Self-Determination Theory to build communities of support to aid in the retention of women in engineering," *European Journal of Engineering Education*, vol. 43, no. 3, pp. 344–359, 2018.

[12] G. Bombaerts and A. Spahn, "Simplify! using self-determination theory to prioritise the redesign of an ethics and history of technology course," *European Journal of Engineering Education*, vol. 46, no. 2, pp. 210–226, 2021.

[13] R. J. Vallerand, "Toward a hierarchical model of intrinsic and extrinsic motivation," in *Advances in Experimental Social Psychology*, vol. 29, pp. 271–360. Academic Press, 1997.

[14] G. Bombaerts and B. Vaessen, "Motivational dynamics in basic needs profiles: Toward a person-centered motivation approach in engineering education," *Journal of Engineering Education*, vol. 111, no. 2, pp. 357–375, 2022.

[15] J. Cawkwell, R. M. Paul, and Y. Jazayeri, "Self-determination theory applied to a second-year engineering classroom," in *Proc. 2024 Canadian Engineering Education Association Conference (CEEA-ACÉG24)*, Paper 27, 2024.

[16] H. L. Millan, "Poetry in engineering education," *Journal of Engineering Education*, vol. 85, no. 2, pp. 157–162, 1996.

[17] E. Akçalı, J. Williams, R. Burress, A. Aguila, and M. Buraglia, "In their own words: Student perceptions of technical poetry writing in discipline-specific undergraduate engineering courses: Opportunities and challenges," *INFORMS Transactions on Education*, vol. 24, no. 2, pp. 136–151, 2024.

[18] N. J. Mourtos, "Portfolio assessment in aerodynamics," *Journal of Engineering Education*, vol. 88, pp. 223–229, 1999.

[19] C. J. Gunn, "Engineers as poets: The need for poetry contests in colleges of engineering," in *Proc. 2003 American Society for Engineering Education (ASEE) Annual Conference and Exposition*. ASEE, Washington, DC, USA, 2003.

[20] A. D. Christy, "Renaissance learning and poetry contests in biological and agricultural engineering," in *Proc. 2004 American Society for Engineering Education (ASEE) Annual Conference and Exposition*. ASEE, Washington, DC, USA, 2004.

[21] J. A. Graf and A. D. Christy, "Assessing perceptions of education: A case for increased interdisciplinarity," *ASABE Meeting Presentation*, Paper No. 068001. ASABE, St. Joseph, MI, USA, 2006.

[22] A. D. Christy and J. A. Graf, "Departmental to inter-collegiate engineering poetry contests," in *Proc. 2005 American Society for Engineering Education (ASEE) Annual Conference and Exposition*. ASEE, Washington, DC, USA, 2005.

[23] A. D. Christy, M. E. Owens, and M. J. Faure, "Student portfolios, business communications, engineering poetry contests, and grading multiple drafts of technical writing documents," *ASABE Meeting Presentation*, Paper No. 078001. ASABE, St. Joseph, MI, USA, 2007.

[24] E. Akçalı, M. Buraglia, A. Essenfeld, and J. Williams, "Poetry writing in engineering education: Preliminary results and insights from an exploratory study," in *Proc. 2021 ASEE Virtual Annual Conference and Exposition*, 2021.

[25] E. Akçalı, S. Gatechaw Belay, E. Colón, and J. Williams, "Poetry writing to enhance conceptual understanding of mathematical models and approaches for inventory management," in *Proc. 2023 ASEE Annual Conference & Exposition Proceedings*, 2023.

[26] E. Atherton and E. Akçalı, "Poetry writing as a creative task to enhance student learning," in *2024 ASEE Annual Conference & Exposition Proceedings*, 2024.

Appendix A. “I am” Poem Template

Table A. The verbs and the prompts for the lines of an “I am” poem.

Stanza	Lines
1	I am *(two special characteristics)* I wonder *(something you are actually curious about)* I hear *(an imaginary sound)* I see *(an imaginary sight)* I want *(an actual desire)*
2	I am *(the first line of the poem restated)* I pretend *(something you pretend to do)* I feel *(a feeling about something imaginary)* I touch *(an imaginary touch)* I worry *(something that really bothers you)* I cry *(something that makes you very sad)*
3	I am *(the first line of the poem repeated)* I understand *(something you know is true)* I say *(something you believe in)* I dream *(something you actually dream about)* I try *(something you make an effort to do)* I hope *(something you actually hope for)* I am *(the first line of the poem repeated)*

Appendix B. Sample Student Work and Instructor Feedback

Table B.I. Two student-written poems submitted by participants 314 and 320 for poem-writing assignment 2 focusing on deterministic inventory modeling and poem-writing assignment 3 focusing on stochastic inventory modeling, respectively.

Poem	Participant	Topic	Student-written Poem
P2	314	Economic Order Quantity Model	I am the simplest and most fundamental I wonder about the trade-off between fixed costs and variable costs. I hear continuous inventory level reviews I see an infinite horizon I want the optimal trade-off I am the simplest and most fundamental I pretend to just be an equation I feel unsurprised that annual ordering and inventory holding costs are equal I touch the purchasing cost, ordering cost, and inventory holding cost I worry that the entire order quantity can be delivered at the same time I cry when there are shortages I am the simplest and most fundamental I understand how to minimize costs I say two significant digits after the decimal point I dream that my assumptions represent reality I try to minimize inventory cost I hope lead time remains certain I am the simplest and most fundamental I am the Economic Order Quantity (EOQ) Model
P3	320	Overage Cost	I am interested on the perishability of your items I wonder if your products can be sold in the next period I hear that the critical ratio gets smaller if I do too I see that I differ depending on the context I want to help you find the critical ratio I am warning you that ordering too much might increase your total cost I pretend to like my counterpart underage cost I feel that salvage revenue is important to me sometimes I touch multiple period analysis with both backlogging and lost sales I worry about leftovers at the end of the period I cry if unsatisfied demand is lost I am interested on the perishability of your items I understand that underage has more impact than me on the critical ratio I say “excess over shortage” I dream that I can help to optimize your profit I try to help you find what ratio to look for in the z-table I hope you will optimize your order quantity I am interested on the perishability of your items I am the overage cost

Table B.II. Instructor feedback provided for two student-written poems submitted by participants 314 and 320 for poem-writing assignment 2 focusing on deterministic inventory modeling and poem-writing assignment 3 focusing on stochastic inventory modeling, respectively.

Poem	Participant	Topic	Instructor Feedback
P2	314	Economic Order Quantity (EOQ) Model	This is a strong poem overall. - I worry that the entire order quantity can be delivered at the same time Should this read can NOT be delivered? - There are a few "weak" lines perhaps that could have been made more precise. I understand how to minimize costs: Which cost? I try to minimize inventory cost: Do you really? Or do you try to minimize sum of all inventory related cost? If you think about it,one of these lines in their current form are somewhat redundant or repetitive. This could have been prevented if these lines had a bit more detail to make them more specific. But like I said, it is a strong poem.
P3	320	Overage Cost	This is brilliant. The focus on overage cost is a refreshing perspective. I say "excess over shortage"...made me laugh! I think the first two stanzas are very good but some of the lines in the third are not specific to the overage cost. But it is very original.