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Work in progress: Guidelines on Developing Writing Prompts and Exploring How Its Quality Predicts Outcomes in a YouTube Role Model Intervention

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Work-In Progress: Guidelines on Developing Writing Prompts and Exploring How its Quality Predicts Outcomes in a YouTube Role Model Intervention

***Abstract*—Interventions targeting undergraduate students' motivational beliefs have shown promise for increasing persistence and retention within the engineering major. However, few studies have systematically investigated the writing component in these interventions—a key component of helping students internalize the message. To understand how students are engaging with and internalizing the intervention material, more research is needed on how to evaluate the quality of engagement in these types of motivational interventions and how its quality predicts changes in motivational beliefs. This paper aims to: (a) outline the process for creating writing prompts; (b) provide guidelines for effectively coding these prompts to understand how students are differentially engaging with the intervention; and (c) evaluate the extent to which the quality of writing prompt completion is associated with changes in motivational beliefs in a YouTube role model intervention for community college engineering students. Results provide guidelines for effectively developing and coding writing prompts that target a wide range of motivational beliefs. Further, findings show that there were no statistically significant associations between the quality of writing prompts and any of the post-motivational beliefs. Implications for developing more effective interventions by analyzing students' writing prompt responses are discussed.**

***Keywords*—community college students, engineering, role model intervention, writing prompts**

I. INTRODUCTION

Attrition in engineering remains high, with approximately half of the engineering majors leaving the field before graduating [1]. To address this problem, interventions targeting students' motivational beliefs have shown promise for increasing persistence and retention in STEM [2]. A critical component of the motivation interventions is asking students to complete writing prompts because doing so allows the student to internalize the message [3]. For example, utility-value interventions have been shown to promote students' interest and performance in the course [4, 5]. Utility-value interventions aim to target students' task value [*Do I want to do this?*; 7] of utility (i.e., wanting to do a task because it is useful) by asking them to make connections between the course content they are learning to their personal lives to increase motivation [4, 5]. Students are asked to respond to a writing prompt where they make personal connections to course content, thereby increasing the perceived usefulness of that content for students [5]. Another type of motivation intervention using role models has been shown to promote students' belongingness [7]. Role model interventions target students' belonging by exposing them to a role model like them who normalizes the challenges that students may face [7, 8]. In role model interventions, students respond to writing prompts where they discuss how the role model's experience mirrors their own, thereby increasing feelings of belongingness [9]. Both utility-value and role model interventions seek to improve students' motivation and could be effective in decreasing attrition in engineering.

Although writing prompts have been utilized to evaluate students' engagement in the intervention, much prior work has largely focused on the academic outcomes associated with the intervention [2, 5]. Few studies have directly outlined the process of coding students' writing prompts, which is important for understanding students' cognitive and motivational processes after being directly exposed to the intervention. Even further, of those intervention research that has begun to provide guidelines for developing and coding students' writing prompts, they tend to only target a few motivational beliefs, such as utility and intrinsic value [e.g., 10, 11]. More work is needed in providing clear guidelines for coding students' writing prompts in interventions that target a wide spectrum of motivational beliefs because it is important for evaluating how students are connecting to the role model, and the cognitive and motivational processes related to this exposure. Not only are coding guidelines needed, but also more work is needed on how students' writing prompt responses are associated with changes in their motivational beliefs. This research is particularly important for understanding how engineering community college students can be supported with a motivational intervention. The content of students' writing responses can provide insight into the motivational processes underlying engineering students' experiences, which can be utilized to develop more effective motivational interventions.

II. LITERATURE REVIEW

A. Theoretical Framework

Students' writing prompts were developed under Situated Expectancy-Value Theory [SEVT; 6]. According to SEVT, students' expectancies for success and subjective task values are

the primary motivational beliefs underpinning their academic choices and performance [6]. Students' expectancies for success are their beliefs about whether they can complete a certain task [6]. Students' subjective task values are their beliefs regarding why they are engaging in a particular task, and are divided into four components: utility value (i.e., usefulness of a task for reaching a goal), intrinsic value (i.e., inherent interest or pleasure that one derives from engaging in a task), attainment value (i.e., importance of engaging in a particular task for one's identity), and cost [i.e., what one has to give up to engage in a task; 6]. Prior interventions framed under this theory have targeted different facets of students' expectancies and subjective task values [e.g., 4], and have been shown to be effective in improving students' motivational beliefs [2]. Therefore, the present study utilizes SEVT to develop writing prompts designed to target a range of motivational beliefs that other interventions have not previously targeted together.

B. Writing Prompts in Interventions

Writing prompts have played a key role in promoting students' motivational beliefs the intervention aims to target [5, 7, 12]. In utility-value interventions, students write short essays about how their course content connects to their own lives or that of their friends or family, in order to increase their utility value [4, 5]. Students' writing prompt responses are generally coded for the absence or presence of utility value as well as the number of utility value connections made to the course [4]. Using these two scores, an index score of utility-value is created. Although this index score allows scholars to examine the extent to which writing prompt task completion predicts intervention outcomes, the quality of scoring responses is missing. Both quantity and quality in writing responses are important because a student who can point out how their course content is useful for their life in various ways, but with fewer details might engage with the intervention differently compared to a student who provides a lot of details on how the course content is useful to their life, but with less utility value examples. More work is needed to capture the extent to which aspects of quantity and quality in students' writing responses predict changes in motivational beliefs.

In growth mindset interventions, students generally read articles on how their ability can be improved with effort (i.e., is not seen as inherent talent) and then wrote about how this type of mindset can apply to their own life [12, 13]. For example, in Fink et al. [12], chemistry undergraduate students completed reflections describing how the growth mindset articles could be useful for their upcoming exams. Students' responses were qualitatively coded to identify themes, with results highlighting the strategies that students had developed as a result of the intervention [12]. This type of qualitative coding is important because it allows us to understand how students incorporated the intervention's message into their personal lives. However, there is limited research that explains the extent to which these responses are directly related to improvement in their motivational beliefs.

Additionally, role model interventions have been shown to be effective in improving students' motivational beliefs [7, 14]. These interventions leverage role models—individuals whose success is perceived as desirable, relevant, and attainable by others [8]. In role model interventions, students are asked to write how they identified with the role model they were

exposed to, either in terms of feeling like them, relating to them, or wanting to achieve their success [9]. Students' responses are coded for how often they mentioned shared characteristics with the role model that they were exposed to [9]. This coding scheme allows researchers to determine the frequency with that students mention certain characteristics across intervention versus control groups but lacks how quality in responses might play a vital role in intervention outcomes. Few studies within role model interventions have used students' writing prompts to predict changes in their motivational beliefs. This association can be particularly useful for understanding whether students with greater engagement in their writing prompts experience greater benefits from the intervention.

C. Current Study

In the current study, we provided guidelines and examined the following research questions on writing prompts:

1. How are writing prompts for a role model YouTube intervention developed?
2. How are students' writing responses for a role model YouTube intervention coded?
3. To what extent is the quality of writing prompt task completion related to the change in motivation beliefs?

III. METHODOLOGY

A. Participants

Participants in the intervention (N = 179) were students enrolled in introductory engineering courses at a community college (see Table 1).

TABLE 1
STUDENT DEMOGRAPHICS

	n	%
Gender		
Male	116	64.8
Female	60	33.5
Decline to state	3	1.67
Race/ethnicity		
Asian	70	39.1
White	60	33.5
Hispanic	34	19
Two or more races	8	4.47
Black or African American	3	2.23
Decline to state	4	2.23

B. Procedures

Figure 1 shows the procedure of the intervention. First, the study sign-up information document was uploaded to Canvas by the professor from each course the intervention was implemented in. Students were able to sign up for the study during the first two weeks of their course. Students who were interested in participating for extra credit were directed to Qualtrics to consent. Students then completed a pre-survey on their engineering attitudes and motivational beliefs on Qualtrics. In another Qualtrics survey, students were asked to choose from one of the six successfully transferred engineering students (or YouTubers) they wanted to watch. They were provided with a picture, biography, and video titles with descriptions of each YouTuber. On this same Qualtrics survey, students were provided a link directing them to watch their first video on YouTube based on their YouTuber choice. Each video was five to ten minutes. Video topics were chosen by the transfer engineering students themselves and included: personal background (*n* = five videos), study tips (*n* = five videos), engineering opportunities (*n* = three videos), remote learning (*n* = three videos), transferring experience (*n* = two videos), and adapting to the quarter system (*n* = two videos). Once students finished watching the video, they returned to Qualtrics to complete the corresponding writing prompt for the video. Students watched YouTube videos and responded to their corresponding writing prompts three more times every two weeks throughout the academic semester. At the end, in another Qualtrics survey, students completed a post-survey on their engineering attitudes and motivational beliefs.

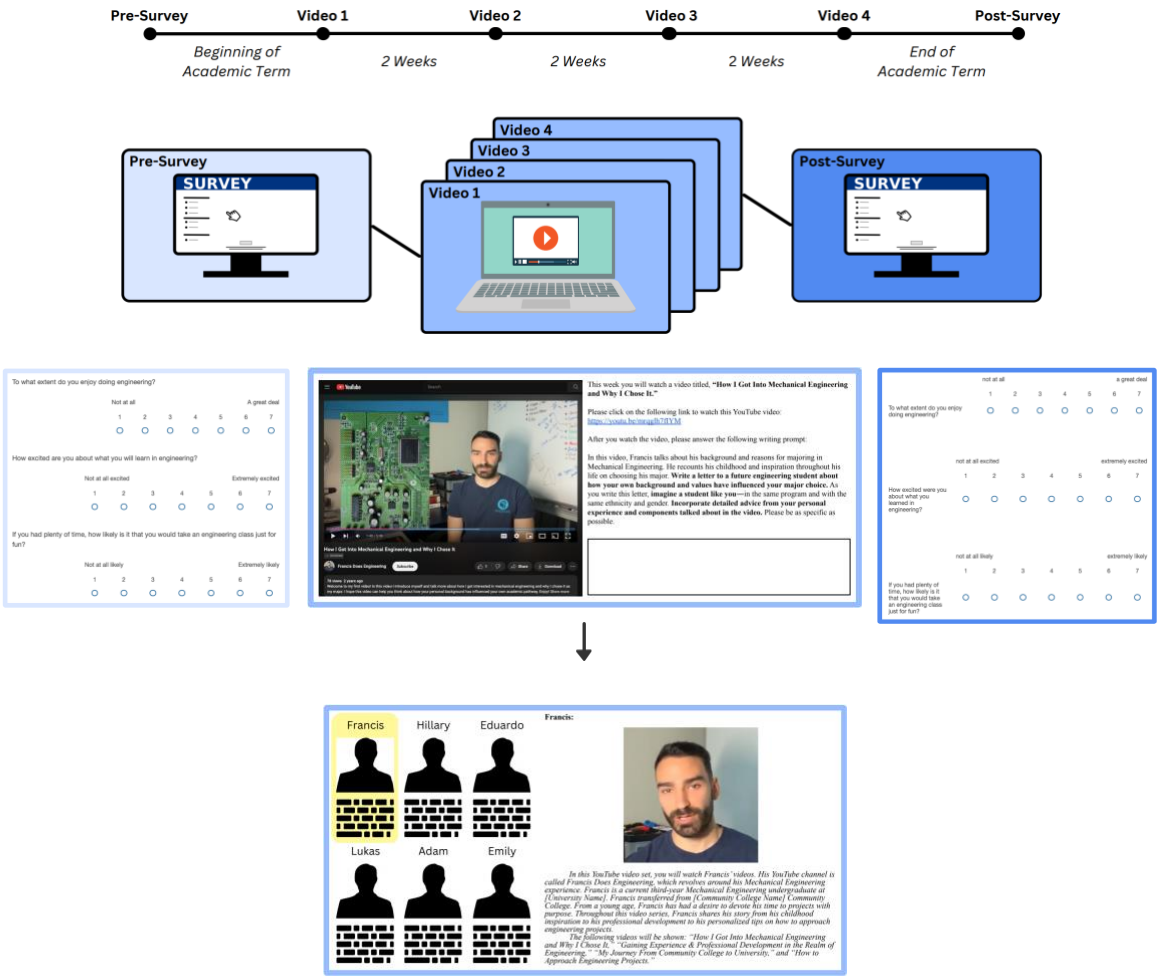

Fig. 1. Procedure of the intervention.

C. Measures

For the purposes of this study, we focus on the writing prompts and motivational beliefs survey measures.

a) Expectancies for Success: Survey items for expectancies for success were developed by researchers under the SEVT framework [7]. Four items were used to measure students' expectancies for success in both the pre- and post-survey (pre- alpha 0.94, post- alpha 0.94). An example item for this measure is: "How confident are you in your ability to learn engineering?". Students responded to these items on a 7-point Likert scale from *1* (not at all) to 7 (extremely).

b) Subjective Task Values: Survey items for subjective task values were developed under the SEVT framework [7]. Four facets of subjective task value were measured: utility, intrinsic, attainment, and cost. Students responded to these items on a 7-point Likert scale from 1 (not at all) to 7 (extremely). Examples of items used include: (1) "How practical is it to know engineering for you?" (utility value; pre- alpha 0.85, post- alpha 0.89); (2) "To what extent do you enjoy engineering?" (intrinsic value; pre- alpha 0.93, post- alpha 0.94); (3) "How central is pursuing engineering to your core identity?" (attainment value; pre- alpha 0.88, post- alpha 0.91); and (4) "To what extent do you feel drained after doing tasks related to engineering (cost; pre- alpha 0.92, post- alpha 0.91).

c) Writing Prompts: Three expert motivation researchers created writing prompts that accompanied each video (see Figure 2 for example). First, researchers individually watched each video to note down the main topics discussed. Then they met as a group to discuss their thoughts on the main video topics (e.g., study tips) and create writing prompts specific to each video. Questions were created to promote motivational beliefs from SEVT and elicit personal connections to topics discussed in the video. For example, questions on how students overcame a difficulty from remote learning video topics were created because reflecting on overcoming challenges is useful for reducing cost [2]. In addition, questions asked respondents to make personal connections as it has been shown to be effective in similar motivation interventions [5]. Each question was also designed to be relevant to the experiences of the students in the intervention (e.g., studying for a challenging engineering course). Each writing prompt asked students to write a letter to a future student because being in the position of helping others rather than needing help can promote more positive emotions [15, 16].

Francis Writing Prompt for Video 2

This week you will watch a video titled, "Gaining Experience & Professional Development in the Realm of Engineering."

Please click on the following link to watch this YouTube video:
https://youtu.be/25Ot74SKGaQ

In this video, Francis talks about how he was able to gain professional development experience in engineering. He discusses his experiences outside of school (e.g., internships, hackathons, projects, etc.) and how he was able to effectively use his education to supplement his outside experiences. Write a letter to a future engineering student who is searching for opportunities outside of the classroom. As you write this letter, imagine a student like you—in the same program and with the same ethnicity and gender. Include the following: What were some of your experiences outside of the classroom, if you had any opportunities? How can you use your education to supplement current and/or future experiences outside of school? When and how can (or did) you apply your engineering knowledge to everyday life? Incorporate detailed advice from your personal experience and components talked about in the video. Please be as specific as possible.

Fig. 2. Example writing prompt for Francis' second video.

IV. RESULTS

A. *RQ1*

The following guidelines were created for each video writing prompt: quantity and quality scores. Quantity scores referred to whether students answered the question in the prompts. Quality scores referred to the quality of the students' response to the prompts. Three expert motivation researchers met to create a codebook for each video writing prompt based on the types of questions. For example, researchers first subdivided the writing prompt by questions as it had multiple questions within a prompt. Then each question received one quantity score point. Each question also received a quality score, which was determined by the type of question. For example, questions that asked students to just mention an experience relevant to the question were scored out of one quality point. Questions that asked students to discuss how the topic was relevant in general, but not necessarily specific to their personal lives (i.e., could be answered hypothetically), were scored out of two quality points. Finally, questions that asked students to elaborate and make personal connections in their responses (i.e., not hypothetical) were scored out of three quality points. Figure 3 provides an example codebook for a video writing prompt.

Francis V2	Qual	Quant	Score
Q1: What were some of your experiences outside of the classroom, if you had any opportunities?	Out of 1		
Q2: How can you use your education to supplement current and/or future experiences outside of school? - This question can be answered as a hypothetical, if they failed to gather future experiences outside of school it should not be an asterik answer.	Out of 2		
Q3: When can (or did) you apply your engineering knowledge to everyday life?	Out of 1		
Q4: How can (or did) you apply your engineering knowledge to everyday life?	Out of 3		
Total	7	4	# /11
Q3 asks "when" and should be simply looking for a time or instance when knowledge can be applied as opposed to Q4 asking "how can," which should look for more elaboration how the knowledge can applied to that certain instance.			

Fig. 3. Example codebook for Francis' second video.

B. RQ2

Three expert motivation researchers independently coded students' writing responses based on the corresponding codebook. They coded each question in the writing prompt for both the quantity and quality scores. For questions with a quality score of one, students addressed all aspects of the question with much detail. For questions with a quality score out of two or three, a score less than the total possible score meant that the student had failed to make personal connections or did not fully elaborate on the relevance of the question—generally or specifically. For example, a participant responded to Francis' second video writing prompt:

> "Dear future engineering student, I am writing to you in hopes of inspiring you to involve yourself in the many great opportunities for you outside of school to pursue your interests in engineering. As I was growing up, I found that unfortunately not many opportunities lied present to me directly through school, and finding opportunities to explore engineering were incredibly difficult at my young age, and it seemed to be niche groups off the grid so to speak. That being said, finding these groups to participate made the search absolutely worth it, and I would encourage you to do the same as now. So many opportunities lie present simply at your fingertips and I recommend you take full advantage of this. Say for example, **participating in a robotics competition, or applying for an internship at a local tech company, or even signing up to tour a technology facility, all of these are great opportunities for anyone with serious interest in engineering. The moment I found my spot in the opportunities I had; taking part in robotics competitions, applying for jobs, working with clubs in my area designing and building cool tech projects**, I found that I now search more and more not for clubs to take part in or opportunities to take advantage of, but rather I search

more for ways that I can start pursuing my interest directly in the way I like and creating groups for others just as I have participated in groups curated for people like me. I hope you take this advice to heart, and I want to re-encourage you that pursuing engineering is not always easy, but with a true passion for this field the opportunities waiting at your doorstep are simply endless."

The bolded section represents what was coded as answering the first question, in this case, the experiences that the student has had outside of the classroom. Here, the student mentioned participating in robotics competitions and tech-related projects. Because the student clearly responded to the question asked, they received the full quantity point. For this question, the quality score was out of one since the question only asked them to mention any experiences that they had without elaborating on them in any way. As a result, the student received the full quality point because they answered the question completely by mentioning their experiences. This particular student did not answer the next three questions, so the student received a quantity and quality score of zero for each subsequent question.

After individually coding the prompts, coders met weekly to discuss their scores and resolve any discrepancies. Discrepancies between coders were noted to track potential issues with the way questions were framed. After discussion, a final score for each question was determined. A final writing prompt score was then created by creating a sum score for each question (see Figure 4 for an example).

	Coder 1			Coder 2			Coder 3			Final		
Participant ID	Quality	Quantity	Total	Quality	Quantity	Total	Quality	Quantity	Total	Quality	Quantity	Total
910	1	1	2	1	1	2	1	1	2	1	1	2
231	0	0	0	0	0	0	0	0	0	0	0	0
239	1	1	2	2	2	4	2	1	3	2	1	3
252	2	2	4	1	3	4	1	2	3	1	3	4
253	1	2	3	2	1	3	2	1	3	3	1	4
254	1	2	3	1	2	3	2	2	4	1	3	4
174	0	0	0	0	0	0	0	0	0	0	0	0
262	2	2	4	1	1	2	1	2	3	1	1	2
264	1	2	3	0	1	1	1	1	2	1	1	2
268	7	4	11	5	4	9	7	4	11	6	4	10

Fig. 4. Example of the coding score breakdown from each coder. Final scores (column furthest to the right) were decided upon after discussion.

C. RQ3

First, pre- and post-survey scores for each motivation belief (i.e., expectancy for success, intrinsic value, attainment value, utility value, and cost) were compared. Results show that there was a statistically significant increase in students' intrinsic and cost value beliefs. There were no statistically significant increases in students' expectancies, attainment, and utility value beliefs (see Table 2).

TABLE 2
PRE- AND POST- SURVEY COMPARISON

	Pre	Post		
	Mean (SD)	Mean (SD)	t	p
Expectancy for success	4.97 (0.97)	4.93 (0.96)	0.81	.42
Attainment value	5.49 (1.07)	5.63 (1.19)	-1.86	.06
Intrinsic value	5.18 (1.01)	5.48 (1.10)	-5.52	>.001
Utility value	5.54 (0.69)	5.61 (0.82)	-1.21	.23
Cost	4.41 (1.03)	4.65 (1.00)	-4.10	>.001

Then, separate regressions for each motivational belief were run. Missing survey variables were first imputed using the multivariate imputation by chained equation (*mice*) package in R [17]. This package substitutes missing values in a dataset with a set of possible values by taking into account the uncertainty in predicting the actual missing value [18]. Results showed that the total writing prompt score did not predict post-survey motivational beliefs, controlling for students' pre-survey motivational beliefs and the number of writing prompts they completed (see Table 3).

TABLE 3
REGRESSION ANALYSIS

	Post- expectancy				Post- attainment				Post- intrinsic				Post- utility				Post- cost			
	Estimate	*SE*	95% CI		Estimate	*SE*	95% CI		Estimate	*SE*	95% CI		Estimate	*SE*	95% CI		Estimate	*SE*	95% CI	
			LL	*UL*			*LL*	*UL*			*LL*	*UL*			*LL*	*UL*			*LL*	*UL*
Total WP score	-0.001	0.003	-0.008	0.007	0.0004	0.004	-0.008	0.009	-0.002	0.003	-0.009	0.005	-0.003	0.003	-0.001	0.004	0.001	0.003	-0.006	0.007
Total WP completed	0.18*	0.08	0.02	0.34	0.03	0.10	-0.16	0.21	0.02	0.08	-0.13	0.16	0.13	0.08	-0.09	0.18	-0.04	0.08	-0.18	0.11
Pre- expectancy	0.47***	0.07	0.34	0.61																
Pre- attainment					0.61***	0.08	0.46	0.76												
Pre- intrinsic									0.63***	0.06	0.50	0.76								
Pre- utility													0.49***	0.09	0.37	0.68				
Pre- cost																	0.50***	0.07	0.36	0.64

Total $N = 179$
CI = confidence interval
LL = lower limit
UL = upper limit
WP = writing prompt
*** $p > 0.001$
** $p > 0.01$
* $p > 0.05$

V. DISCUSSION

This study aimed to highlight how to develop writing prompts, effectively code them, and to understand the extent to which students' scores on the quality of writing prompts are associated with changes in their motivational beliefs in a YouTube role model intervention. First, the results provided clear guidelines for developing writing prompts for a YouTube role model intervention framed under SEVT. These guidelines are significant because they provide insight into the type of questions that writing prompts can use. Second, the results provided directions for coding students' writing prompts. While there has been some research that has begun to qualitatively code students' writing prompt responses [e.g., 11], there is still limited research on how to code responses that target a spectrum of motivational beliefs. Results provide clear steps for researchers to take into consideration when analyzing the content of students' writing responses in interventions. Evaluating the content of engineering students' writing responses to a role model intervention allows researchers and educators to understand the underlying cognitive and motivational processes, thus enabling them to better support these students in their academic pathways. Third, results showed that, contrary to our hypotheses, there were no statistically significant associations between the total writing prompt score and any of the post- motivational belief scores. One reason for this may be that we did not differentiate between the different types of motivational beliefs expressed in the writing prompts themselves. While writing responses were qualitatively coded based on the content of the response, the study did not distinguish between the types of motivational beliefs that were expressed by students and the frequency that they expressed those beliefs in their responses. Future research should examine what motivational beliefs are being expressed by students to see if they may be associated with changes in specific motivational beliefs.

A limitation of this study is that it did not assess the long-term effects of the intervention on engineering retention, such as transferring to a four-year university as an engineering major. While transferring was not an explicit goal of the study, it was designed to promote engineering persistence and retention. Future research should explore how these interventions influence students' long-term academic pathways.

VI. CONCLUSION

This research provides guidelines for writing prompt creation and scoring in a YouTube role model intervention aimed at increasing the persistence and retention of engineering students in community college. In the present study, researchers can utilize our guidelines when designing interventions that target a wide range of motivational beliefs. These guidelines may be particularly useful for targeting the challenges that engineering students face during their first few years of college, such as at the community college. Interventions targeting a range of motivational beliefs can be particularly useful for increasing persistence and retention within the community college context since they address different facets of the engineering experience. These findings offer insight into the potential association between students' writing responses and changes in their motivational beliefs, which can be particularly useful for understanding the motivational processes underlying the effects of the intervention.

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