"I don’t want to be influenced by emotions"—Engineering students’ emotional positioning in discussions about wicked sustainability problems

Johanna Lönngren
Department of Science and Mathematics Education
Umeå University
Umeå, Sweden
ORCID: 0000-0001-9667-2044

Tom Adawi
Division of Engineering Education Research
Chalmers University of Technology
Gothenburg, Sweden
ORCID: 0000-0002-4135-8784

Maria Berge
Department of Science and Mathematics Education
Umeå University
Umeå, Sweden
ORCID: 0000-0003-3614-1692

Abstract—This Work-in-Progress research paper describes the results from a pilot study that aims to explore the role of emotions in engineering students’ discussions about a wicked sustainability problem, i.e., a problem that is characterized by a high degree of uncertainty and ambiguity and for which it is not possible to develop a perfect solution. There is strong evidence from educational research that emotions are important for learning at all levels of education and particularly in education related to sustainability and wicked problems. At the same time, dominant discourses and stereotypes in engineering and engineering education construct engineering as purely rational and unemotional. In this study, we explore how engineering students re-construct—but also challenge—this dominant discourse in interviews about a wicked problem. We use discourse analytic tools from positioning theory to analyze how the students construct and negotiate emotional subject positions for themselves and others. The results provide illustrative examples of how emotional positioning can strengthen and/or challenge the dominant discourse: examples from the dominant discourse illustrate how students position emotions as irrelevant or even detrimental for engineering work, while examples from the counter-discourse illustrate how students sometimes construct emotions as part of what it means to be an engineer and as important for engineering work.

Keywords— emotions, engineering education, wicked problems, sustainability, positioning theory

I. INTRODUCTION

Engineers play a crucial role in solving complex sustainability problems, such as climate change, resource scarcity, and social injustice [1, 2]. These problems are characterized by a high degree of uncertainty, ambiguity, and conflicts of interest and are therefore often called “wicked problems” [3]. Unfortunately, most contemporary engineering education does not adequately prepare students to address wicked problems and thus to assume professional responsibility for the societal and environmental impacts of technological development [4, 5].

Emotions play a vital role in engineering education that aims to prepare students to address wicked problems [6, 7] and in ethically responsible engineering work [8, 9]. At the same time, engineering education and practice are often described as purely rational activities [10] and there is very little research on emotions in engineering education.

This study contributes to an emerging body of research on the role of emotions in engineering education. We use positioning theory [11] to explore the role of emotions in learning to address wicked problems in engineering education.

More specifically, we use the concept of emotional positioning, which refers to the construction and negotiation of subject positions in and through emotional discourse [12], i.e., emotional subject positions [13]. We answer the following research question:

How do engineering students construct and negotiate emotional subject positions in discussions about wicked problems?

II. BACKGROUND

Almost all of the few existing studies on emotions in engineering education have focused on emotions as individual competencies or experiences, such as empathy [14], shame [15], and frustration [16]. However, research has also suggested that expressing emotions in social contexts may play an important role in explicating personal values [17] and ethical judgment [8, 10]. Such explicit discussion of values has, in turn, been described as an important precondition for constructive and collaborative discussions about wicked problems [18]. There is therefore a need for research in engineering education that studies emotions in and as social interaction [19], for example from discourse analytic perspectives [20, 21]. A discursive focus is particularly important for studying the role of emotions in teaching and learning processes involving controversial topics and high levels of social interaction [22], such as discussions about wicked problems.

III. THEORETICAL FRAMEWORK

Our starting point is that addressing wicked problems is an inherently social process and therefore needs to be studied in social interaction [18, 21]. We explore this interaction through the lens of positioning theory [11]. Positioning theory is based on social constructionist perspectives of identity and learning as constructed and negotiated in and through interaction and, therefore, offers a suitable lens for exploring emotions as discursive phenomena [12].

Positioning theory provides a practical analytic tool to study discourse through triangulation of three units of analysis—storylines, positions, and speech acts—which are often illustrated in the form of a "positioning triangle" (Fig. 1) [23, 24]. Storylines are collaboratively constructed narratives about what is going on in the interaction. These storylines make available certain positions that people can relate to in different ways. Each position is characterized by a set of rights and duties to perform certain types of speech acts but not others. Speech acts are understood as socially constructed meanings of actions of speech, but also non-verbal
communication, such as intonation, pausing, body movement, facial expressions, and gestures [24, 25].

In this paper, we apply the positioning triangle specifically to the analysis of emotions [12]. In the remainder of this paper, we therefore use Walton et al.’s [13] term “emotional subject positions” and we talk of “emotion-acts” rather than “speech-acts”. We further differentiate between two forms of emotion-acts: We use the term “emotion discourse” to denote emotion-acts that express something about emotions through verbal communication, for example using words that explicitly refer to emotions, such as “happy” or “frustrated” [c.f. 26]. We use the term “emotional discourse” to denote emotion-acts that express emotions through non-verbal communication, for example through verbal stress or facial expressions [c.f. 27].

![Storylines Diagram]

Fig. 1. The positioning triangle as described by Davies and Harré [24].

IV. METHODS

We analyzed empirical material from a previous study [7] for which ten third-year engineering students were individually interviewed about how to they would address the wicked problem of water-shortage in Jordan. During the interviews, the students received a problem description and a set of solution alternatives. They were then challenged to discuss the problem from as many different perspectives as possible to fully appreciate not only the technical but also the social and environmental complexity of the problem. During the interviews, both the students and the interviewer expressed a range of emotions related to the problem and the task of addressing the problem. Each interview lasted for about one hour and was video-recorded and transcribed verbatim.

We read through the transcripts multiple times and selected all (n=26) excerpts in which students used emotion(al) discourse in talking about engineering, engineers, and/or the wicked problem. To identify these excerpts, we used Hufnagel and Kelly’s [20] description of indicators of emotional expressions, which include semantics, prosody, facial expressions, gestures, and linguistic features.

In analyzing the selected excerpts, we used storylines as the primary unit of analysis because they provide the necessary narrative context within which positions and emotion-acts can be understood and described [24, 28]. Thus, we first formulated preliminary descriptions of emotion-related storylines. Based on these descriptions, we then developed preliminary descriptions of emotional subject positions in each storyline and emotion-acts through which the suggested storylines and positions were constructed and negotiated. If necessary, we divided excerpts into subsections with different storylines and analyzed each subsection individually. In an iterative process, we refined the descriptions by constantly comparing and triangulating across the three units of analysis [23].

V. RESULTS

The results provide illustrative examples of how the dominant discourse of rationality is reconstructed, and thus perpetuated, in engineering education. The results also provide examples of how counter-discourses are used to construct emotions as important for engineers and engineering. In this section, we will first illustrate the in-depth analysis with one empirical extract (EXTRACT 1, TABLE II). We then describe the overall results in terms of storylines, subject positions, and emotion-acts in dominant discourses (TABLE III) and counter-discourses (TABLE IV). And provide several empirical examples for each of the identified storylines (TABLE V).

EXTRACT 1 is taken from the end of one of the interviews. Shortly before the extract, the interviewer had asked the student to discuss the problem from the perspectives of, first, a professional engineer and, second, a local politician. The extract contains three different (but closely connected) storylines, and we have therefore divided it into three parts (lines 1-2, 3-8 and 9-15) and analyzed each part separately. In each of the three storylines, at least one emotional subject position was made available (TABLE II). Below, we explain how emotion-acts contribute to constructing these storylines and subject positions.

### TABLE I. FORMATTING CONVENTIONS FOR EXTRACT I

<table>
<thead>
<tr>
<th>Formatting</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Student</td>
</tr>
<tr>
<td>L</td>
<td>Interviewer</td>
</tr>
<tr>
<td>Italics</td>
<td>Verbal stress</td>
</tr>
<tr>
<td>[...]</td>
<td>Text has been added for clarity or to describe non-verbal communication</td>
</tr>
<tr>
<td>Bolded</td>
<td>Emotion discourse (i.e. talk about emotions)</td>
</tr>
<tr>
<td>Underlined</td>
<td>Emotional discourse (i.e. expression of emotions through, e.g., prosody or gestures)</td>
</tr>
</tbody>
</table>

### EXTRACT 1:

1. S1: How do you want me to […] solve the problem? Cause I can say that
2. I solve it *coldly* and I can solve it *warmly* and I can solve it in between.
3. And since I was asked to address the problem in my professional role as an engineer […] that’s what I did. What! [P extends one arm and lowers it in a rapid movement] And you heard me say *exactly* what I was thinking. […] Minimize risks for human lives first. That was *cold* to say, human lives *left, right, no matter, no matter, reduce lives [lost], tap, tap, tap [spoken quickly], […]
4. I don’t want to be influenced [by emotions], I mean, everyone turns a deaf ear and looks away when they see someone who’s in a *terrible* situation. But the problem is also that people who don’t do that, they become engrossed by […] every little concern. So I think that, well, I’ll just be this *cold*—until I’m done being *cold* […] I’ll take some of my *coldness […] to solve something*. And I feel that, yeah, I *did* something, *something has happened, I did something, myself.*

### TABLE II. STORYLINES AND SUBJECT POSITIONS IN EXTRACT 1

<table>
<thead>
<tr>
<th>Lines</th>
<th>Storylines (SL)</th>
<th>Subject positions (SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>SL1: There are different ways of approaching a wicked problem, coldly (rationally) or warmly (emotionally).</td>
<td>SP1: S1 as someone who is able to do either and to consciously choose between the two approaches</td>
</tr>
</tbody>
</table>
In lines 1-2, the words “coldly” and “warmly” are clear examples of emotion discourse. These words construct an opposition between emotional and rational approaches to problem solving in the storyline. This opposition is strengthened through the use of emotional discourse: both words are spoken with verbal stress, which contributes to constructing them as belonging to a pair of opposites.

In lines 3-8, the student’s use of emotion discourse constructs a focus on rationality and efficiency. For example, the expression “exactly what I was thinking” focuses the discussion on cognition and the expressions “cold” and “left, right, no matter, no matter, reduce lives [lost], tap, tap, tap” construct a focus on rationality and efficiency. Again, emotional discourse strengthens the storyline: The words “coldly” and “exactly” are spoken with verbal stress, which, respectively, constructs rationality and precision as important—and which thus strengthens the focus of the storyline on rationality. Further, the expression that starts with “left, right, …” is spoken in a rapid voice, which strengthens the focus on efficiency.

In lines 9-15, the student uses a lot of explicit emotion discourse to construct emotions as something that should be avoided in problem solving. They state that “I don’t want to be influenced [by emotions]”, “people who don’t do that [turn a deaf ear and look away], they become engrossed by (…) every little concern”, and “I’ll take some of my coldness (…) to solve something.” The focus is on actions (“solve”, “did”) and outcomes (“happened”) rather than emotions: the student wants to solve and do. At the same time, the expression “turns a deaf ear and looks away” carries negative connotations and thus constructs complete emotionlessness as undesirable. Similarly, the use of emotion(al) discourse in “a terrible situation” constructs empathy as generally important—if one is able to bracket this emotion during problem solving. The student constructs their own position as someone who is able to consciously choose between being empathic (i.e. recognizing that people can be in terrible situations) or rational ("cold").

In EXTRACT 1 as a whole, the student thus constructs an overarching storyline according to which engineers are competent problem solvers who solve problems rationally and efficiently rather than allowing themselves to be influenced by emotions. The student positions the ideal engineer as a highly intelligent, rational problem solver who wants to do the best for society from a utilitarian perspective. To be able to solve problems, the ideal engineer needs to bracket both their own and others’ emotions and concentrate on identifying the most efficient solution for achieving a predefined aim, such as minimizing the risk of losing human lives. In contrast to the ideal engineer, the student positions “others” (presumably non-engineers) as reasonably intelligent, but prone to becoming overly emotional, which reduces their ability to solve problems. Finally, the student positions themselves by combining aspects of the two prior positions: as someone who is able to switch between acting as an engineer who is able to rationally solve problems and as an empathic and emotional human being. Thus, the student simultaneously draws on the dominant discourse—engineering as purely rational—and a counter-discourse—emotions, in this case empathy, are important for engineering work.

### TABLE III. Storylines and Subject Positions in Dominant Discourse (Empirical Examples in Parenthesis, see Table V.)

<table>
<thead>
<tr>
<th>Storylines (SL)</th>
<th>Subject positions (SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL4: Emotions are irrelevant for engineering work. (#1, 2, 3)</td>
<td>SP4: Engineers as rational problem solvers (#1, 4)</td>
</tr>
<tr>
<td>SL5: Emotions are detrimental to engineering problem solving. (#1, 3)</td>
<td>SP5: Self as someone who, in their role as an engineer, approaches problems in a rational way (#1, 5)</td>
</tr>
<tr>
<td>SL6: Emotions are important for engineering work. (#8, 9)</td>
<td>SP6: Others as people who are influenced by emotions (#1, 2, 4, 6, 7)</td>
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</tbody>
</table>

### TABLE IV. Storylines and Subject Positions in Counter-Discourse

<table>
<thead>
<tr>
<th>Storylines (SL)</th>
<th>Subject positions (SP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL7: Engineers need to be able to manage others’ emotions. (#6, 7)</td>
<td>SP6 (see above)</td>
</tr>
<tr>
<td>SL8: Certain emotions are part of what it means to be an engineer. (#12)</td>
<td>SP8: Self as someone who experiences these emotions (#12)</td>
</tr>
</tbody>
</table>

### TABLE V. Empirical Examples

<table>
<thead>
<tr>
<th>#</th>
<th>Data excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>[See Extract 1]</td>
</tr>
<tr>
<td>2</td>
<td>S2: “A politician experiences more “psychological stress” than an engineer when addressing wicked problems.”</td>
</tr>
<tr>
<td>3</td>
<td>S7: “Engineers are strongly committed to [basic] theory” and decisions about which solutions to implement should be based on a “objective analysis of what actually happens”</td>
</tr>
<tr>
<td>4</td>
<td>S10: “Engineers’ work is “facts-based”, focusing on “causal effect”, while politicians’ work involves “a lot of emotions”.”</td>
</tr>
<tr>
<td>5</td>
<td>S1: “Those who don’t get enough water, “[without hesitation]: they’ll die. […] [In a factual tone] That’s terrible, but it’s converted into statistics [for the purpose of solving the problem].”</td>
</tr>
<tr>
<td>6</td>
<td>S7: “I do believe that it’s possible to calculate what the best solution would be,” but that doesn’t mean it’s possible to implement that solution. “You have to convince people that it [the solution] works.”</td>
</tr>
<tr>
<td>7</td>
<td>S10: “I don’t think you can simply implement such a quick change. You’d have to first test to exchange some of the water taken from wells with water from] desalination plants […] and then you’d see that, okay, this works. And then people would be like, okay, this actually doesn’t seem too bad, so now we can continue [to build more desalination plants].”</td>
</tr>
</tbody>
</table>
### Discussion

In this Work-in-Progress research paper, we have presented results from a pilot study that aimed to explore the role of emotions when engineering students discuss wicked problems. It should be noted that the results are preliminary and that the analysis does not cover all types of storylines and positioning that can be expected to be present in the data. Most importantly, the analysis has only focused on emotional storylines related to the student’s positioning of themselves, engineers, and “others”. An exhaustive treatment of the empirical material should include an analysis of how the interviewer is positioned [29]. For example, in lines 1-2, the interviewer could be said to be positioned as someone who should tell the student whether they should approach the given problem emotionally or rationally. Transferred to an engineering education context, such a positioning could imply that students expect instructors to specify what emotion-approach students should use for a given problem—in much the same way as instructors often are expected to specify the algorithm that students should use to solve problems in engineering education [30].

An interesting result is that students often draw on several conflicting discourses: On the one hand, they construct the ideal engineer in a way that mirrors powerful cultural stereotypes of engineers as emotionless and, sometimes, excessively rational—much like the cartoon character Dilbert or the Star Trek series character Mr. Spock. This image of the ideal engineer also matches previous descriptions in the literature, according to which engineering often is described as purely rational [8, 10]. On the other hand, the students seem to perceive these stereotypes as problematic: several students carefully position themselves as not quite like this typical engineer. Instead of positioning themselves as rational beings (i.e., someone who always is rational), they position themselves as able to choose a rational approach in order to solve a problem, but as also able to choose an emotional, empathetic approach. This double positioning is particularly clear in EXTRACT 1, where the student explicitly positions themselves as someone who is able to consciously switch between rational and emotional approaches to problem solving. As far as we know, this more nuanced emotional positioning of engineering students has not yet been reported in the literature.

Another interesting conclusion from the results is that students in this study talked about emotions in a rather unnuanced way. They talked about emotions as if all emotions were the same and as if they would have the same impact on problem solving. Emotions are also described in a dualistic manner as something that is either switched on or off and that can be consciously controlled. This unnuanced understanding of emotions is in stark contrast to how emotions are described in the educational research literature [31].

However, the analysis also suggests that at least some students have an intuitive understanding that emotions may be important for some aspects of engineering work, such as managing others’ emotions (EXTRACTS 6, 7), deciding between different solution approaches (EXTRACT 8), encouraging professional responsibility (EXTRACT 9), and strengthening personal motivation to do good and solve problems (EXTRACTS 11, 12). These results broaden descriptions in previously reported research according to which emotions are important for addressing sustainability problems [6, 7] and ethically responsible engineering work [8, 9].

Some tentative implications for practice can be drawn from the results presented in this paper. First, engineering students should receive explicit teaching on the role of emotions in problem solving to allow them to develop a more nuanced understanding of emotions. To do so, engineering educators could build on the intuitive understandings that some students have of situations in which emotions are important for engineering work. Second, engineering educators should help students to develop their ability to identify and apply an appropriate emotion-approach to a given problem; students need to learn to take responsibility for how they use and communicate emotions in engineering problem solving. Third, engineering educators should involve students in discussions about common stereotypes of what an ideal engineer is; if students have a false (and slightly negative) image of the ideal engineer as someone who is unemotional, they may feel alienated from engineering and even choose to not complete their studies and/or not work as engineers after graduation.

In future research, we want to explore engineering students’ emotional positioning in group discussions. Such an approach is particularly important in analyzing students’ positioning in discussions about sustainability problems; addressing such problems requires discussion and collaboration among multiple stakeholders and is thus an inherently social process that should be studied in social interaction. We also expect that studying positioning in group discussions makes it possible to explore how multiple, competing storylines are constructed and negotiated, and what kinds of storylines become dominant or inferior [32].

### References


