Exploring the Intersection of Emotions and Epistemic Engagement

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Abstract: This symposium explores the complex relationship between emotions and epistemic engagement across diverse learning contexts. Emotions, integral to cognitive processes, can enhance epistemic engagement by triggering curiosity, focus, and critical evaluation, especially when knowledge-building is the goal. This session will present studies on the relationships between emotions and epistemic cognition, within different thematic areas, such as social media interactions, bioinformatics education, data-infused interdisciplinary learning, and knowledge-building collaborative online platforms. Each presentation aims to uncover the roles emotions play in fostering or inhibiting epistemic actions. The discussant will synthesize insights from these studies to shed light on the generative potential of emotions in supporting critical and reflective engagement. The outcomes of this symposium can deepen our understanding of the role emotions can play in fostering epistemic engagement in formal and informal settings.

Symposium overview

Emotions have been argued to play an integral role in guiding rational thinking and decision making (da Sousa, 2009). Although emotions are a well-studied area of research, significant gaps remain in understanding how emotions relate to epistemic engagement and learning. Most research on emotions in education has focused on the types (i.e., achievement emotions) and valence (i.e., positive/negative) of emotions (Pekrun & Linnenbrink-Garcia, 2012), emotional regulation, the influence of the setting on emotional responses (Järvenoja et al., 2009), and teacher-student interactions and emotions. Few studies report on the links between emotions and epistemic engagement (Muis et al., 2015).

Emotions comprise interrelated psychological processes that occur in response to an event that is subjectively important; these processes can have affective, cognitive, physiological, motivational, and expressive components (Scherer, 2009). They refer to conscious emotional experiences which are distinguished according to their object focus and according to two dimensions: activation and valence (Scherer, 2009). Pekrun and Stephens (2012) distinguish four types of academic emotions according to their object focus: achievement, epistemic, topic emotions, and social emotions. When knowledge generation is the object that the emotional reaction is focused on, people experience *epistemic emotions* (Pekrun & Linnenbrink-Garcia, 2012); these emotions are caused by the cognitive qualities of an information task and the processing required to complete it (Pekrun & Linnenbrink-Garcia, 2012). Some of the commonly mentioned emotions that may arise during information processing are surprise, joy, fear, anxiety, anger, frustration and curiosity (Muis et al., 2018).

Epistemic engagement has cognitive, behavioral and affective components, and takes into account the goals or aims one sets across different information contexts, and the criteria and strategies relied on in order to reach epistemic judgments (Varda et al., 2024). It can foster epistemic actions, which can lead to acquiring or generating knowledge, or gaining enhanced understanding. Emotions can arise as a result of goal-directed

cognitive activity but can also influence next steps in the cognitive activity (D'Mello & Graesser, 2012). An emotional response is considered a precursor to cognitive, motivational behavioral, and social engagement in learning (Pekrun & Linnenbrink-Garcia, 2012) and can serve different epistemic functions according to the phase of learning and engagement. For instance, emotions can provide salience by focusing attention on distinct aspects of a situation and can also function as an additional source of knowledge, and, in turn, both of these epistemic functions can contribute to cognitive efficiency.

This symposium will explore links between emotions and epistemic engagement by presenting research examining different learning contexts, thematic contexts, and methodologies: *Yoon, Shim, Zhang, Leung and Nguyen* will discuss how socioscientific issues in high school science can foster strong emotions that can lead to generative epistemic practices. They investigate student interactions with bioinformatics curricula that require them to collect and analyze empirical air-quality data in local neighborhoods and demonstrate the prevalence of curiosity, surprise, and enjoyment that propel further epistemic engagement. *Törmänen and Järvenoja* will report findings from a study investigating how secondary school students in collaborative groups respond emotionally and regulate their learning when encountering cognitive and metacognitive challenges, termed as epistemic challenges. *Teo, Chan, and Ong* will report on the investigation of students' academic emotions when dealing with epistemic-oriented ideas during online collaborative knowledge building using Knowledge Forum. *Tran and Polman* will contextualize the emotionally-laden process of learning about and writing a data story on the experience of Japanese Americans during forced incarceration in World War II, drawing from data from a broader co-design project aimed at integrating data practices into interdisciplinary learning. Their focus will be on discussing the intricate and complex relationship of the interplay between emotion, sensemaking, and practice. *Kyza and Varda* will discuss social media as an informal space where emotional reactions to controversial posts may spur information; their focus is on characterizing emotional reactions and examining their co-occurrence and relation to different types of epistemic engagement. Their aim is to understand the extent to which, and how, adults engage in critical evaluation of information shared on social media. *Tabak, Reznick and Radinsky* will present data that emotion plays a role in how people form epistemic trust relationships in naturalistic settings. They call for increased recognition that forming epistemic trust extends beyond analytic appraisals. They demonstrate these ideas through adult retrospective interviews concerning their health information behavior.

David Hammer, who has written extensively on the topic of students' epistemologies and on the relation between emotion and cognition, will be the discussant of this symposium. The symposium will consist of a 5-minute introduction which will address the overarching questions that the symposium seeks to answer, followed by individual presentations (10-min each) and the commentary by the Discussant (10-min). This will allow for a 15-minute general discussion between the symposium participants and the session attendees. The motivation behind this more traditional format is to allow everyone to form a deeper understanding of each team's research, methods and findings on this emergent topic of scholarship, which can then support the moderated discussion session.

Epistemic emotions and their triggering of further epistemic engagement in a socioscientific high school unit on bioinformatics and air quality

Susan A. Yoon, Jooeun Shim, Weiyi Zhang, Vivian Leung, Zoe Nguyen

Engaging with socioscientific issues can evoke strong emotions due to their implications for personal and planetary well-being which can lead to greater civic engagement and sociopolitical action (Hodson, 2020). Emotions arising in epistemic engagement can also foster caring and enjoyment when applying scientific epistemic practices to complex problem solving in students' communities (Chinn et al., 2021). Furthermore, when tied to processes of knowledge generation, emotions can shape how students engage with scientific inquiry (Muis et al., 2018). Following this line of research we created a problem-based learning unit that engaged students in interpreting empirical air-quality data and its connection to high asthma rates in Philadelphia (Yoon et al., 2023). We analyzed student activity from three lessons in which students plan and collect particulate matter (PM2.5) and carbon monoxide (CO) measures around their neighborhood; analyze the data; compare results to other parts of the United States; and then make inferences and plan to take action. We explore two questions: (1) What epistemic emotions were triggered during students' data investigations? and (2) To what extent and how did emotions influence their engagement with data inquiry?

We worked in 13 classrooms and analyzed data from selected student groups that totaled 72 hours of video recordings through interactional analysis using a coding scheme that identified 7 epistemic emotions (Pekrun et al., 2017). *Curiosity* emerged when learners perceived a gap in their knowledge. *Surprise* occurred when students encountered unexpected information that contradicted their prior knowledge. *Confusion* was triggered when students faced complex or unfamiliar information. *Anxiety* arose when students questioned the

accuracy of their knowledge or felt uncertain about their understanding. *Enjoyment* emerged when students' ideas were confirmed. Lastly, *boredom* was apparent when students disengaged from learning activities.

The analysis revealed that curiosity and surprise were the most frequent categories, followed by enjoyment, anxiety, confusion, and frustration (Figure 1 provides an example of coded student interactions).

Figure 1

Example of Coded Epistemic Emotions Emerging from Student Data Investigations

#	Timestamp	Enactment
1	0:12	Student 1 (in black and white shirt): Oh, we got the PMs. Look! [Eyes widening and mouth opening] It's calculating, oh my god! [Enjoyment]
2	0:17	Student 2 (in orange shirt): That's actually kind of sick.
3	0:18	Student 1: That's epic!
4	0:29	Student 2: Wait, breathe into the thing and see what it does. [Curiosity]
5	0:34	Student 1: 95?! [Surprise]
6	0:36	Student 2: [blows on the sensor] [Note: This is the action that follows and sustains his curiosity]
7	0:37	Student 3: It's not 95 in here.
8	0:39	Student 2: Alright, what did that change into? [Curiosity]
9	0:43	[Student 1 blows on the sensor] [Note: This action was likely influenced by his peer in the orange shirt's curiosity (e.g., his previous action/questions)]

In the above enactment, students exhibit several epistemic emotions as they engaged with the sensor. Student 1 expresses visible excitement figuring out how to get the sensor to work "Oh we got this PMs, Look!". This excitement is further emphasized by the exclamation "It's calculating, oh my god!". Student 2 continues this pattern of engagement by expressing curiosity (i.e., "That's actually kind of sick") and becomes more exploratory at line 4, when they want to test it out further. This curiosity sparks a chain of actions, leading to a moment of surprise at line 5. Curiosity continues to drive the interaction in line 8, when Student 2 asks, "Alright, what did that change into?" This further inquiry shows a continued desire to understand the data. This enactment also illustrates the generative nature of emotions to trigger further epistemic engagement which we explored in research question #2. Overall, nearly half of the enactments that displayed epistemic emotions led to further spontaneous data inquiry. These were coded for specific epistemic practices related to data science. For example, curiosity led students to pose additional questions, make predictions, and evaluate multiple hypotheses. Surprise led students to test assumptions and modify understanding based on new data. We expand further on these findings in the symposium presentation.

Supporting epistemic engagement through emotion regulation in collaborative learning

Tiina Törmänen, Hanna Järvenoja

Understanding how emotions and their regulation contribute to epistemic engagement is crucial for advancing knowledge in collaborative learning contexts, as the cognitive and metacognitive demands of the learning tasks are deeply intertwined with emotional experiences. Epistemic emotions, in particular, emerge as students monitor and evaluate task-relevant information (Pekrun & Stephens, 2012). Accordingly, in group settings, students not only build shared knowledge but also manage cognitive and metacognitive demands, which often require effective emotional regulation to maintain focus, motivation, and sustained engagement when emotions arise due to challenges (Törmänen et al., 2023; Zabolotna et al., 2023). This study examines how groups respond emotionally and regulate learning in response to cognitive and metacognitive challenges, referred to here as epistemic challenges — moments when difficulties in content comprehension, task understanding, planning, or monitoring give rise to (negative) emotional reactions that prompt regulation. By exploring these interactions, the study aims to shed light on how emotional regulation can indirectly support epistemic engagement.

The research questions are: 1) What types of emotional reactions and regulation strategies do group members employ when encountering epistemic challenges? 2) What sequential patterns exist between emotional reactions and the types of regulation strategies enacted in response to epistemic challenges? Data were collected from 95 secondary school students working in 31 collaborative groups on a science task. The groups' interactions, including co-regulation (CoRL) and socially shared regulation of learning (SSRL), were video recorded, and electrodermal activity (EDA) was used to capture emotional activation. Epistemic challenges were identified from

the video as moments when groups experienced challenges in content and task understanding, planning, or task monitoring. Video was also used to code the positive or negative valence of students' visible emotional reactions to the epistemic challenges, and EDA was used to determine the activation level of these reactions. Regulation strategies in response to the challenges were coded as situation modification, attentional deployment, cognitive change, response modulation, humor, and empathy. Additionally, it was identified whether the regulation was based on one group member's contribution (CoRL) or involved reciprocal contributions from multiple members (SSRL). Sequential patterns were analyzed using Fluxicon's Disco (https://fluxicon.com/disco/) process models to reveal relationships between epistemic challenges, emotional reactions, and regulation strategies.

Next, we highlight the key findings derived from the process models. The first process model was built to show the frequency of transitions between epistemic challenges, regulation types (CoRL/SSRL), and emotional reactions. The results indicated that negative evaluations of epistemic challenges (f=113) most often led to negative activating emotional reactions (f=67), which could be effectively managed through SSRL. That is, while CoRL (f=95) was slightly more common than SSRL (f=77), the process model indicated that SSRL was more frequently followed by shifts toward positive activating emotional reactions (f=10), emphasizing the role of the entire group in restoring positive emotions after challenges. The second process model was formed to reveal the transitions between epistemic challenges, emotion regulation strategies, and emotional reactions. Regarding the overall use of regulation strategies, humor (f=48) and cognitive change (f=47) were the most frequently employed to manage emotional reactions related to epistemic challenges. Surprisingly, situation modification strategy, where the group members modified the learning situation by altering tasks or the learning environment to manage the issues causing emotional reactions (Harley et al., 2019), was used less frequently (f=17). The process model also showed how other emotion regulation strategies often led to positive deactivating emotions ($f =36$) and how using humor, in turn, reinforced positive activating emotions ($f = 40$) after the epistemic challenges.

These results highlight the importance of emotion regulation as a complement to cognitive regulation in fostering conditions conducive to epistemic engagement in collaborative learning. When group members make negative evaluations of the task content or progress, the resulting negative activating emotions can hinder subsequent cognitive and metacognitive collaborative activities, such as knowledge construction and the regulation of learning (Zabolotna et al., 2023; Törmänen et al., 2023). Thus, regulation targeted solely at cognitive learning activities may not suffice to ensure epistemic engagement in the face of challenges (Järvenoja et al., 2009). Although the video-coded challenges were related to content and task understanding, planning, and task monitoring, groups rarely employed situation modification to address the associated negative emotions. Instead, they predominantly relied on cognitive change strategies to alter their emotional appraisals of the situation, thereby mitigating its emotional impact (Harley et al., 2019). Furthermore, the role of SSRL in fostering positive activating emotions highlights the significance of engaging in emotion regulation at the group level. By detailing how groups manage emotions in response to epistemic challenges arising from cognitive and metacognitive aspects of collaboration, this study sheds light on the regulatory dynamics that sustain epistemic engagement in collaborative learning environments.

Emotion and online collaborative knowledge building using the Knowledge Forum

Chew Lee Teo, Carol Chan, Aloysius Ong

Knowledge building (KB) theorizes learning as a collective knowledge creation process (Scardamalia & Bereiter, 2014) widely translated into a principle-based pedagogical approach supported by Knowledge Forum (KF), empowering students to pursue knowledge advancement. Knowledge building engages students cognitively, metacognitively, socially and emotionally, with increased research attention now given to unravelling students' emotions in epistemic actions (Zhu et al., 2024). A common challenge teachers face when facilitating collaborative KB is understanding students' collective ideas improvement often not visible or explicit. Text-based learning analytics have been used to help teachers identify idea growth on KF, yet emotion-affect is more nuanced and complex. Technology provides new ways to use multi-modal data, including physiological metrics (e.g., facial expressions, skin conductance) expanding our analysis of collaboration (Järvelä et al., 2021) and surfacing socio-emotional states in knowledge building actions. This project investigates students' epistemic emotions using *multi-modal data* to illuminate the quality and dynamics of knowledge-building processes. Epistemic emotions can be defined as emotions that arise from navigating and processing information during deeper and more complex learning (Pekrun & Stephens, 2012). Existing research has shown positive emotions linked to deeper discourse and epistemic inquiry (Zhu et al., 2024) but the complex relations between emotions and KB warrant further investigation. This study employs multi-modal data to examine students' emotions and epistemic actions. We conjecture that students' epistemic emotions – such as anxiety, boredom, confusion, curiosity, enjoyment,

frustration, and surprise (Muis et al., 2015) – will correlate with their feelings of learning, physiological responses and knowledge building actions. Building on our previous work, we conceptualized a taxonomy of multi-modal data, to tap into students' emotional-affective states and investigate students' epistemic emotions as part of social interactions and conditions for knowledge building, informing designs for team-collaboration dynamics. The key question addressed is "How do multi-modal data illuminate epistemic emotions and their association with epistemic actions across different collaborative activities in knowledge building?

The study was conducted in a graduate class with students engaging in collective knowledge-building inquiry using Knowledge Forum. We designed various knowledge-building lesson activities—whole-class teacher talk, student presentations, group reading of KF notes, group reflection on KF inquiry, group creation of rise-above notes, and whole-class sharing. We posit that triggers for cognitive, social, and emotional responses align with different phases of lesson designs. These triggers may involve the quality of ideas in online writing, behavioral interactions in group settings, and individual variations in engagement. Specifically, we tracked whether and how different epistemic emotions and trajectories emerged during various collaborative KB activities. We collected multi-modal data, including (1) teachers' lesson plan designs, (2) an epistemic emotion survey assessing epistemic emotions and feelings about learning, administered multiple times during KB activities, (3) Knowledge Forum online writing, (4) physiological data using skin conductance data from Empatica wearables and software Ledalab (with peaks indicating physiological arousal; see Järvelä et al., 2021), and (5) video-audio data capturing gestures, movements, and social interactions.

Analysis and integration of multi-modal data regarding epistemic emotions and knowledge-building actions yielded several findings: (1) Results from emotion surveys showed significant correlations between students' feelings of having learned and emotions of being challenged ($r=0.597$), feeling excited ($r=0.504$), feeling interested ($r=0.496^{**}$), and feeling happy ($r=0.469^{**}$). Specifically, the strong association between feelings of having learned and emotions of being challenged points to design considerations in knowledge-building activities. (2) Physiological responses and group emotion trajectories indicated a higher degree of change in epistemic emotions and recorded higher arousal in skin conductance during the idea-connecting phase compared to the idea-generation and idea-building phases. These results suggest that the design of the idea-connecting phase plays a crucial role in students' changes in epistemic emotions. (3) Posting of KF co-authored notes, which indicates collaboration, is related to high behavioral triggers of gestures and movements rather than verbal exchange; these results further emphasize the importance of capturing multi-modal gestures and collaborative actions. This study contributes to our understanding of epistemic emotions in collaborative knowledge building by using multi-modal data, including textual, verbal, and physiological indices, to uncover the range of emotions and identify triggers and conditions in KB activities that inform design. It extends the current emphasis on idea development and text-based analysis in knowledge building by examining the associations between emotions and epistemic actions, and illustrates how multi-modal data can illuminate these connections, leading to richer conceptualizations of collaboration and design implications.

Emotional configurations and epistemic engagement with data

Trang C. Tran, Joseph L. Polman

Engaging classroom teachers, curriculum developers, data specialists, and learning scientists, our broader team effort aimed to integrate data into existing interdisciplinary project-based learning curriculum modules, centering the lessons from the forced incarceration of Japanese Americans during World War II. In this study, we employed emotional configurations (Vea, 2020; Pierson et al., 2023) and data feminism (D'Ignazio & Klein, 2020) frameworks to explore how emotions emerged and intertwined with sensemaking and data practices. Vea (2020) identified the significance of viewing emotion as both an integral aspect of learning and itself a sociocultural practice "involving not merely pre-given internal states, but rather in-progress configurations that include meaning making and embodied practice in the social world." (p. 315). Meanwhile, D'Ignazio and Klein's (2020) data feminism framework envisioned opportunities for learners to engage with key aspects of critical data practices, encompassing elevating emotion and lived experiences, considering context, examining and challenging power, rethinking binaries and hierarchies, making labor visible, and embracing pluralism. By blending the two framings together, we sought to better understand and articulate diverse pathways and conjunctions of emotion and epistemic engagement in the context of data learning (Vea, 2020).

Following ethnographically oriented case study methods, we organized data—including classroom recordings, observation notes, end-of-module survey responses, interview transcripts, as well as learning artifacts—into student case studies. We recognized the challenging aspect of "coding for emotion," as some emotions can be harder to observe, depict, and explain than others. As such, rather than cataloging every instance

of salient emotions, we assembled the data through a heuristic process that helped us trace the co-emergence and interplay of emotion, sensemaking, and practice (i.e., "emotional configurations" as described by Vea, 2020).

More specifically about this process, we reviewed survey responses and coded interview transcripts to observe patterns of significance that have bearing on further analysis and interpretation of emotions. This process enabled us to identify concrete examples of emotions, emotional configurations, sociopolitical relations embedded in data learning contexts, and possibilities for collective actions (Vea, 2020). Moreover, this process surfaced powerful segments of classroom interactions, allowing us to review them more thoroughly in observation notes and recordings, and incorporate some into case studies. Case study writeups utilized a creative writing approach that resembled the process of short story writing. We blended depictions of how students generally presented themselves in the learning environments with narratives highlighting moments and multimodal factors (e.g., interacting with data, text, and archival artifacts) appearing to shape their emotionally-laden experience. We will present a shortened version of the original story written about one focal student, Mhina.

When her teacher announced that one day, students were going to craft questions and start writing data stories, Mhina recalled that just a month before, the overarching topic of "the experience of Japanese Americans before, during, and after the forced incarceration" was completely unknown to her and her friends. This was the case despite its significant detriment to generations of Japanese Americans. She recalled lots of emotions throughout the gallery exhibition when she saw archival photos and artifacts concerning the interment era for the first time (such as the Executive Order 9006, images of people cramped into buses, trains, and behind barbed wire). But most vividly, she recalled feeling troubled and angry when reading the *Farewell to Manzanar* memoir, where the author—Jeanne Wakatsuki—described the Loyalty questionnaires. Before the camps were shut down, to apply for clearance to leave, prisoners were asked to renounce any allegiance to the Japanese emperor and swear allegiance and willingness to serve in the U.S. military. Thinking about that moment, an idea came to mind: Mhina wanted to write her data story about the people who refused to comply in the Loyalty questionnaires, and compare their whereabouts after leaving incarceration camps to those who complied. While Mhina was able to make a compelling data inquiry that connected directly to both a theme central in the memoir and a detail that she resonated deeply with, her contentment was soon interrupted when she found out that the dataset that was available to her in CODAP did not have the data she was looking for. The next day, together with her teacher, Mhina searched on the internet and learned that less than one sixth of the 78,000 people that were asked either answered No, refused to answer, or provided a qualified response. This finding, while contributing to answer part of her question, filled Mhina with dread, as she vividly remembered Jeanne's words narrating the dire consequences these people were facing, which involved being taken away, killed, or forced to leave the U.S.

Our analysis illustrated how emotions emerged and remediated data practices, characterizing emotional configurations in the case of one focal student in the context of data learning. We argue that affective elements and interrelations contributed to a productive sensemaking process. We recognize that events—identified and narrated here by researchers—are situated in and interacted with other emotionally-laden anchors in a multiplicity of arrangements. Yet, we hope our efforts—emphasizing the possibility of emotional configurations being both sustained and interrupted by various trajectories of emotion, sensemaking, and practice—may enrich understandings of the roles of emotions in learning, in a way that contributes to the field.

Exploring the nature of epistemic engagement on emotionally-charged comments responding to controversial social media posts

Eleni A. Kyza, Christiana Varda

Social media platforms promote connectedness and can afford epistemic engagement through commenting, liking or sharing a social media post (Varda et al., 2024). In previous work we investigated adults' emotional reactions and epistemic engagement in response to accurate or misinformative social media posts with a simulated Twitter timeline (Varda & Kyza, 2022). While we observed co-occurrences of emotional reactions with epistemic engagement (such as source evaluation), we argue that we do not yet fully understand the nature of the relationship between emotions and epistemic engagement, and as a consequence we cannot engage in an evidence-based discussion of the implications of these interactions for epistemic education. This study explores this under-researched relationship by investigating reactions (in the form of comments) to controversial social media posts in a real-world social media context. The focus on comments is motivated by literature suggesting that user-generated comments, especially critical ones, hold persuasive power over the perceived credibility of online information (Metzger & Flanagin, 2015), can influence the evaluation of source trustworthiness (Gierth & Bromme, 2020), can provide insights into the commenters' thinking process and can allow an unobtrusive examination of epistemic engagement with online information.

We purposefully chose two socio-scientific posts on different controversial issues (CO_2 emissions; Wildfires' origin) using these criteria: a controversial socio-scientific issue; inclusion of a knowledge claim (i.e., an argument that posits something is true based on evidence); sufficient (at least 100) number of comments; and posted within last year. Coding first focused on the type of reaction (cognitive, emotional), followed by a second round of coding to categorize the types of basic (Plutchik, 1980) and epistemic emotions (Pekrun et al., 2017), and epistemic engagement (Varda et al., 2024). Substantial intercoder agreement was established using 15% of the data (Cohen's κ=.649).

Our first research question examined whether the characteristics of a post evoke different emotional reactions. A Pearson Chi-Square test examining the relationship between the post (CO_2 emissions vs. Wildfires' origin) and response type (emotional vs. cognitive), indicated a statistically significant association between the variables, $\chi^2(1, N = 440) = 4.252$, $p = .039$ (two-tailed). This suggests that the CO_2 emissions comments were more likely emotional, as compared to comments to the Wildfires' origin post. An analysis of the characteristics of the posts indicated that the CO_2 post used more personal and concrete language, that referred to an existential threat with possible catastrophic outcomes and urged for individual responsibility. In contrast, the climate change post used more statistics but less personalized language, placing the emphasis on collective responsibility.

The second research question examined the relationships between emotional reactions and cognitive engagement. Based on relevant literature, our theoretical presupposition is that all emotional reactions are preceded by an appraisal of the presented information. We therefore examined whether this emotional reaction, occurring after an evaluation, co-occurs with further epistemic engagement. For both posts, most comments were coded as emotional (74%, 62% respectively), and fewer (43.2%, 54.45%) were coded as cognitive. Notably, 17.6% and 14.8% respectively were double coded as both emotional and cognitive, indicating overlap between the two categories. These findings indicate a high prevalence of emotional reactions but also a moderate extent of cognitive engagement. The smaller but existing overlap of emotional and cognitive activity suggests a relationship between the two that requires additional data to be investigated than the data we had access to in this study.

Our third research question examined the nature of engagement. Most cognitive comments (about 96%) were epistemic in nature and related to the evaluation of the claim or evidence. When epistemic and emotional engagement co-occurred, the epistemic engagement was related to the evaluation of the claim, with much less attention to the evaluation of the evidence. In our presentation, we will share more details and will describe the nature of engagement, focusing on emotions and epistemic engagement. We will conclude with a discussion of the implications of such work for enhancing our understanding of how people epistemically engage with social media, how this engagement may be connected to emotional reactions and to the design of social media posts, and the digital literacy implications of this work. We will also discuss limitations and next steps for this work.

Examining the relationship between emotion, trust, and epistemic practices

Iris Tabak, Nirit Yona Reznick, Josh Radinsky

Epistemic practices are cognitive and metacognitive actions related to knowledge goals. In the case of online information behavior, these might include considering the relevance of an information source, or comparing claims across information sources. Increasingly, scholars point to the ways in which epistemic emotions, such as curiosity, joy, or puzzlement, mediate knowledge construction and take part in driving and regulating epistemic practices (Dubovi & Tabak, 2021; Radinsky & Tabak, 2022). Even if people rely on expert knowledge, they still engage in the epistemic practices of determining whether to trust the information provider. For example, people might evaluate the information provider's level of relevant expertise, and the degree to which they adhere to the knowledge production norms of their field (Hendriks et al., 2016). These are clearly valuable practices for determining whether to trust a source. Yet, they are also mostly analytical rationalistic practices. In this presentation, we propose that affective processes also take part in forming trust, sometimes to the exclusion of rationalistic practices, and illustrate this through participants' retrospective depictions of health-related information behavior. We further suggest that although such affective aspects of trust may be overlooked, or disparaged, they may be apt and worthy of further research.

We draw on a corpus of retrospective interviews, from two past studies (Radinsky & Tabak, 2022; Reznick, 2019), in which participants described how they seek, evaluate, and take up information for health-related knowledge goals. In the first study, participants were adults aged 50 and older who participated in a continuing education program and reported on their routine practices. In the second study, participants were varied adults who reported on their practices during COVID-19. Thus, the corpus reflects practices from routine and charged experiences. The main goal in both studies was to characterize information behavior practices. In the COVID-19 study, we were struck by one participant's account. She described how she mostly turned to Dr. Sanjay Gupta for information: "when it came to COVID I only watch CNN and I used there's on Spotify, a podcast with

Sanjay Gupta, who I like trust him 100% so I take his information very seriously." She mentioned him a few more times during the interview (e.g., apologizing for mentioning him again: "he's just my king during COVID"). It seemed like she was describing a good friend rather than a journalist, and she did not refer to his credentials other than noting his title of doctor. This piqued our interest in purposefully seeking whether similar trust relationships that seem to be based on affinity and emotion can be found in this corpus of data.

Due to space limitations, we elaborate only one example. *Description*: A 51-year-old electrician states that he gets his health information mostly from the internet ("Dr. Google") and that he tries to verify it by reading more or speaking to friends. When asked, he reports that he does not consult his family physician. He explained this by his overall skepticism about the science of medicine, and specifically as embodied in his family physician. This lack of trust in the family physician was not in response to a particular person, but to the role itself, in fact, he said he had little to no contact with his family physician (i.e., the physician to which he is assigned through his health maintenance organization). When asked if he consults any medical personnel, he noted two groups of doctors: one group were medical students who volunteer with him is supporting sporting activities of visually impaired people, the second group were physicians who were clients of his electrician services. He said that the physicians who were his clients spoke with him "at eye level." *Interpretation*: We find that the participant is contrasting trust and mistrust of different types of physicians where "type" refers to the form of relationship between the two: client-service provider and co-volunteer versus doctor-patient. From his report, we further find that the trust relationship is not based on his assessment of medical expertise. The trusted relationships were more symmetrical, in which the participant played an active role and exhibited competence. We suggest that these relationships represented an affinity between the participant and doctors beyond the doctor-as-purveyor-of-information role, and evoked emotions such as pride, security, and confidence. We further suggest that these affective dimensions established the trust relationship.

Synthesizing the depictions that we found, we articulate and present an initial, conjectured, model of the relationship between emotion, affinity, trust, and epistemic practices in information behavior. While some research on online information behavior connotes that emotion sways publics away from deliberation and considerations of evidence (Martel et al., 2020), we posit that emotion is multi-faceted and intertwined with additional factors that influence epistemic engagement. Specifically, we suggest that emotion may underlie the formation of epistemic trust relationships. The main contribution of our presentation is in advancing the recognition that in naturalistic settings epistemic trust is not a strictly analytic process, and that we need to further investigate and understand the circumstances in which people form epistemic trust relationships based on affinity and affect. At times, emotions might thwart deliberation or push toward problematic trust and at other times might support deliberation and worthy trust relationships. Future research should identify the factors influencing worthy trust to inform educational efforts aimed at better preparing learners for efficacious information behavior.

References

Chinn, C. A., Barzilai, S., & Duncan, R. G. (2021). Education for a "post-truth" world: New directions for research and practice. *Educational Researcher*, *52*(1), 51–60.

D'Ignazio, C., & Klein, L. F. (2020). *Data feminism*. MIT press.

D'Mello, S., & Graesser, A. (2012). Dynamics of affective states during complex learning. *Learning and Instruction*, *22*(2), 145-157.

da Sousa, R. (2009). Epistemic feelings. *Mind and Matter*, *7*(2), 139-161.

Dubovi, I., & Tabak, I. (2021). Interactions between emotional and cognitive engagement with science on YouTube. *Public Understanding of Science*, *30*(6), 759-776.

Gierth, L., & Bromme, R. (2020). Attacking science on social media: How user comments affect perceived trustworthiness and credibility. *Public Understanding of Science*, *29*(2), 230-247.

Hendriks, F., Kienhues, D., & Bromme, R. (2016). Trust in science and the science of trust. In *Trust and Communication in a Digitized World* (pp. 143-159). Springer.

Hodson, D. (2020). Going beyond STS education: building a curriculum for sociopolitical activism. *Canadian Journal of Science, Mathematics, and Technology* Education, *20*, 592–622.

Järvelä, S., Malmberg, J., Haataja, E., Sobocinski, M., & Kirschner, P. A. (2021). What multimodal data can tell us about the students' regulation of their learning process? *Learning and Instruction, 72,* 101203.

Järvenoja, H., & Järvelä, S. (2009). Emotion control in collaborative learning situations: Do students regulate emotions evoked by social challenges. *British Journal of Educational Psychology*, *79*(3), 463-481.

Martel, C., Pennycook, G., & Rand, D. G. (2020). Reliance on emotion promotes belief in fake news. *Cognitive Research: Principles and Implications*, *5*(1), 47. https://doi.org/10.1186/s41235-020-00252-3

Metzger, M. J., & Flanagin, A. J. (2015). Psychological approaches to credibility assessment online. In Sundar, S. S. (Ed.) *The Handbook of the Psychology of Communication Technology*, 445-466.

Muis, K. R., Chevrier, M., & Singh, C. A. (2018). The role of epistemic emotions in personal epistemology and self-regulated learning. *Educational Psychologist*, *53*(3), 165-184.

Muis, K. R., Pekrun, R., Sinatra, G. M., Azevedo, R., Trevors, G., Meier, E., & Heddy, B. C. (2015). The curious case of climate change: Testing a theoretical model of epistemic beliefs, epistemic emotions, and complex learning. *Learning and Instruction*, *39*, 168-183.

Pekrun, R., & Linnenbrink-Garcia, L. (2012). Academic emotions and student engagement. In *Handbook of Research on Student Engagement* (pp. 259-282). Boston, MA: Springer US.

Pekrun, R., & Stephens, E. J. (2012). Academic emotions. In K. R. Harris, S. Graham, T. Urdan, S. Graham, J. M. Royer, & M. Zeidner (Eds.), *APA Educational Psychology Handbook, Vol. 2. Individual differences and cultural and contextual factors* (pp. 3–31). American Psychological Association.

Pekrun, R., Vogl, E., Muis, K. R., & Sinatra, G. M. (2017). Measuring emotions during epistemic activities: the Epistemically-Related Emotion Scales. *Cognition and Emotion*, *31*(6), 1268-1276.

Philip, T. M., & Gupta, A. (2020). Emerging perspectives on the co-construction of power and learning in the learning sciences, mathematics education, and science education. *Review of Research in Education*, *44*(1), 195-217.

Pierson, A. E., Brady, C. E., & Lee, S. J. (2023). Emotional configurations in STEM classrooms: Braiding feelings, sensemaking, and practices in extended investigations. *Science Education*, *107*(5), 1126-1162.

Plutchik, R. (1980). A general psychoevolutionary theory of emotion. In R. Plutchik & H. Kellerman (Eds.), *Emotion: Theory, research and experience*, *Theories of emotion* (Vol. 1, pp. 3–33). New York: Academic Press.

Radinsky, J., & Tabak, I. (2022). Data practices during COVID: Everyday sensemaking in a high-stakes information ecology. *British Journal of Educational Technology*, *53*(5), 1221-1243.

Reznick, N. Y. (2019). *Perceptions of health literacy among non-academic adults with low scientific literacy.* Ben-Gurion Universit of the Negev [Master's Thesis]. Beer-Sheva, Israel.

Scardamalia, M., & Bereiter, C. (2014). Knowledge building and knowledge creation: Theory, pedagogy, and technology. In R. K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (2nd ed., pp. 397–417). New York, NY: Cambridge University Press.

Scherer, K. R. (2009). The dynamic architecture of emotion: Evidence for the component process model. *Cognition and Emotion*, *23*(7), 1307-1351.

Törmänen, T., Järvenoja, H., Saqr, M., Malmberg, J., & Järvelä, S. (2023). Affective states and regulation of learning during socio-emotional interactions in secondary school collaborative groups. *British Journal of Educational Psychology*, *93*, 48-70.

Varda, C. & Kyza, E. A. (2022). The role of epistemic emotions during engagement with online information encounters. In Chinn, C., Tan, E., Chan, C., & Kali, Y. (Eds.), *Proceedings of the 16th International Conference of the Learning Sciences - ICLS 2022* (pp. 735-742). International Society of the Learning Sciences. Hiroshima, Japan [online].

Varda, C., Kyza, E. A & Chinn, C. (2024). Capturing epistemic engagement on social media. In Lindgren, R., Asino, T. I., Kyza, E. A., Looi, C. K., Keifert, D. T., Suarez, E. (Eds), *Proceedings of the 18th International Conference of the Learning Sciences - ICLS 2024* (pp. 2253-2254), Buffalo, USA: International Society of the Learning Sciences.

Vea, T. (2020). The learning of emotion in/as sociocultural practice: The case of animal rights activism. *Journal of the Learning Sciences*, *29*(3), 311-346.

Yoon, S. A., Shim, J., Miller, K., Cottone, A. M. et al. (2023). Professional development for STEM integration. In Superfine, A.C., Goldman, S. R., & Ko, M. M. (Eds.), *Teacher learning in changing contexts: Perspectives from the learning sciences* (pp. 69–90). Routledge.

Zabolotna, K., Malmberg, J., & Järvenoja, H. (2023). Examining the interplay of knowledge construction and group-level regulation in a computer-supported collaborative learning physics task. *Computers in Human Behavior*, *138*, 107494.

Zhu, G., Scardamalia, M., Nazeem, R., Donoahue, Z., Ma, L., & Lai, Z. (2024). Metadiscourse, knowledge advancement, and emotions in primary school students' knowledge building. *Instructional Science, 52*(1), 1-40.

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