Reflexive Rejection: Confessions of our first encounters with SenseMaker®, an emerging research methodology for STEM education

Point of view (25-50 words):
We are four female educational practitioners who engage in varying degrees and forms of teaching, research, and evaluation. And, we have been educated in legacy research methods. We are curious about new approaches to conceptualizing, inquiring into, and doing science, technology, engineering and math (‘STEM’) education that have the potential to disrupt systemic social, economic, and ecological abuse and exploitation.

Value of submission (25-50 words): This autoethnographic analysis of our individual narratives serves as a cautionary tale and emotional sign-posts for those seeking to explore emerging research methodologies, particularly those that are suited for complex, dynamic social systems, such as “engineering education”; expect cognitive and/or emotional dissonance. By definition, alternative approaches to research will occur as new and possibly foreign to those trained in traditional research approaches. Such a reflexive rejection happens unconsciously and undermines the goal of learning--discovery.

Abstract
It is becoming increasingly common to hear engineering education described as a complex system (National Science Foundation, 2018). Such a perspective shifts the focus of analysis from the parts to the whole – from individual elements to the relationships between the elements. Most engineering education researchers, however, are trained in atomistic or reductionist models of inquiry (Borrego, 2007; Laszlo, 1996; Robbins, 2007), which begs the question – how prepared are engineering education researchers to conduct research on, and productively intervene in, complex systems? As four educational practitioners who have previously embraced complex systems thinking, both in our teaching and in our research, we considered ourselves well prepared to explore a new, participatory research methodology, called SenseMaker, which is explicitly designed to understand characterize and facilitate interventions in complex systems. And yet, all four of us independently and reflexively rejected this methodology upon our first encounter with it. In this study, we used collaborative autoethnographic techniques to examine what it is about our shared cultures, experiences, and training as engineering education researchers and practitioners that led us to react in this way. We reflect on how methodologies founded on complex systems theory, like SenseMaker, often sit outside the boundaries of what we are used to and may initially occur to us as “foreign,” or even “wrong.” Further, we explore how our reflexive responses were connected to embodied cognition, that is, a recognition that “[one’s] body, beyond the brain “play[s] a significant causal… role in cognitive processing” (Stanford Encyclopedia of Philosophy, 2011). We offer some suggestions for developing an awareness of both reflexive rejection responses and how to recognize and use our embodied cognition. These perspectives are important for researchers who seek new ways to understand and work with complex, dynamic social systems.

Introduction
Dave Snowden, the creator of SenseMaker, finishes his presentation and invites the audience to ask questions. He is met with silence. We look around the room and observe a sea of faces, deep in thought. We suspect that many of them, like us, are aware that we have just heard something significant. Something different that promises to transform how we think about culture, qualitative and quantitative methods, and participatory research. Like them, however, we just haven’t quite wrapped our heads around it yet. After a long, silent minute, the questions start.

[The authors], September 28, 2017

The SenseMaker workshop that took place in September, 2017, at Georgia Tech was the second time we heard Dave speak. The first time was in April 2017 at a workshop in Georgetown, which was sponsored by the National Science Foundation. In the intervening months all four of us met regularly, about once every 2 to 3 weeks, to “make sense” of SenseMaker, and explore how to apply it to our own research interests and institutional contexts.

As the observation above suggests, it took us some time to “wrap our heads around” the SenseMaker approach. In fact, as we will describe in this paper, our initial response was one of rejection. Our goal in conducting this collaborative autoethnographic study was to explore our initial response to SenseMaker and attempt to locate it in relation to the cultural features of the landscape of academic and engineering education research. We argue that such explorations are necessary because radically new methodologies are needed to solve the problems that engineers, engineering educators, and engineering education researchers face today (Chinowsky, 2009; Kapranos, 2013; Schaefer, Panchal, Thames, Haroon, & Mistree, 2012). Such methodologies, however, as we will demonstrate, may elicit strong reactions in practitioners who are accustomed to certain ways of knowing and doing. We contend that it is important to develop an embodied awareness of such reactions to ensure that we are sufficiently open to considering radically new research approaches, like SenseMaker.

Below we begin by briefly describing SenseMaker. We then unpack some theoretical perspectives that informed our collaborative work, before discussing how we operationalized a collaborative autoethnographic approach through a consideration of Hall’s iceberg metaphor of systemic cultural forces. Next, we discuss themes across our four, individual accounts (see Appendix), with a particular focus on evidence of embodied cognition. We conclude with a call to pursue actions that facilitate conscious access to our full neurological intelligence, at the level of the brain and the body.

SenseMaker - A Primer

SenseMaker is an emerging research methodology that is founded in complex adaptive systems theory, cognitive science, narrative, and anthropology (Cognitive Edge, 2018; Van der Merwe, 2019). It is participatory with those in the social system that one is trying to influence. SenseMaker facilitates the capture of hundreds to thousands of micro-narratives to provide a live snap-shot of the social system under investigation. One important way in which SenseMaker is different from traditional research methods is that participants, not researchers, ascribe meaning to their own stories through a process called self-signification or self-indexing. Quantitative
analysis and visualization of these interpretations enables the identification of “adjacent possibilities” in the system—areas of potential shifts where researchers and participants might collaboratively design and introduce small, “safe-to-fail probes” (small-scale experiments) to promote more of one type of micro-narrative and less of another. We refer readers who wish to learn more about SenseMaker to http://cognitive-edge.com/, which contains case studies, concepts papers, and descriptions of basic methods, among other resources. We have also written about SenseMaker elsewhere (Sochacka, Culloty, Harrell, & Hopkins, 2020; Youngblood et al., 2018).

**Theoretical Perspectives**

As noted in the introduction to this paper, a complex systems perspective necessitates a shift in thinking from the parts to the whole—from individual elements to the relationships between those elements. In line with this theoretical perspective, we began our study with the assumption that we are participants in the systemic phenomena that occur to us as problems in engineering education. Put simply, we are part of the problems we are trying to solve. This orientation prompted us to look to ourselves for explanations as to why we initially rejected SenseMaker. Peter Senge (2010), a leader in complex systems thinking, described this orientation as follows:

> We tend to blame outside circumstances for our problems. “Someone else” – the competitors, the press, the changing mood of the marketplace, the government – did it to us. Systems thinking shows us that there is no outside; that you and the cause of your problems are part of a single system. The cure lies in your relationship with your ‘enemy.’ (p. 67)

We turned to Argyris’ (Argyris, 1990) “ladder of inference,” as depicted by Senge et al. (Senge, Kleiner, Roberts, Ross, & Smith, 1994) in Figure 1 and described in Box 1, for further theoretical insights into how reflexive reactions, which often manifest as attributing “blame” to outside circumstances, can lead to unconscious problem framings and actions that reinforce those framings. We note here that by “reflexive,” we refer to an action that is “performed as a reflex, without conscious thought,” rather than the process of taking into account “the effect of the personality or presence of the researcher on what is being investigated” (English Oxford Living Dictionaries, 2018).
Figure 1. An example of action taken on the Argyris’ ladder of inference (adapted from Argyris, 1990)

Box 1. Argyris’ ladder of inference

The action at the top of the ladder is “reflexive” in the sense that it is a “re-action” in response to the initial action of unconsciously selecting a limited subset of data from what was observed. This initial action initiates the cascade of actions up the ladder of inference, usually unconsciously taken. This cascade of actions has also been referred to as a “reflexive loop” (Isaac, 1992) as the beliefs become self-referential as a filter when selecting data from other experiences, thereby reifying the existing beliefs. One arrives at the top of the ladder with the instantaneousness associated with observing objective truth; conclusions are therefore unconsciously conflated with “objective truth” and rarely tested against the external reality.

When we discovered that each of us initially rejected SenseMaker, a complex systems perspective led us to consider our connectedness and relationship to the “problems” we perceived with the methodology, while Argyris’ ladder of inference served as an externalized image that enabled us to see into the internal processes by which we unconsciously drew conclusions.

**Methodology and Methods**

We drew on collaborative autoethnographic techniques to examine our initial, reflexive rejections of SenseMaker. We chose autoethnography because of its explicit focus on connecting personal experiences (auto) to the study of culture (ethno) (Ellis, Adams, & Bochner, 2011). In other words, we wished to examine how our initial reactions to SenseMaker may have had roots in our shared cultures as engineering education researchers and practitioners.

Our process began with in-person, followed by on-line Skype discussions of what it was about our experiences that led each of us to initially dismiss SenseMaker as a viable method of inquiry. During these conversations, we observed that our cultural backgrounds as instructors,
educational researchers, and evaluators predisposed us to select certain types of “data” as evidence for “assumptions,” which ultimately formed the basis of our “beliefs” about the value of this new research approach, as depicted in Argyris’ ladder of inference (Argyris, 1990). In order to systematically and collectively examine our initial encounters with SenseMaker, we committed to each writing responses to a common set of six questions. The first three of these questions (i. How did I learn about SenseMaker? ii. How was I initially introduced to it? And, iii. What was my reaction/ reflexive rejection?) were aimed at recreating rich and vivid accounts of our personal experiences (Ellis et al., 2011). We then drew on the metaphor of Hall’s cultural iceberg (see Figure 2 and Box 2 below) to examine what we might learn from those personal experiences about the cultures we are a part of (iv. Where in the iceberg do I see the source of my reflexive reaction?). We decided to include the final two questions, (v. What kept me moving toward it? And, vi. Where am I now?) to provide readers with a more complete account of our journey with SenseMaker thus far. Our narratives can be found in the Appendix.

Figure 2. Depiction of systemic cultural forces (adapted from the work of Hall, 1976), which informed one of our shared questions: “Where in the iceberg do I see the source of my reflexive reaction?”

Box 2. Hall’s cultural iceberg

Hall’s (Hall, 1976) cultural iceberg model depicts the invisible social forces that give rise to unstated cultural expectations. Briefly, Hall uses the metaphor of the tip of an iceberg to represent the visible evidence of the invisible cultural forces and structures that work together to produce the tip. In an iceberg, the invisible force of gravity interacts with the structures of the polar water molecule in its liquid and solid state; the result is a buoyancy force that causes 9% of the volume of ice to protrude above the water surface. One can physically break away the tip and the dynamic interaction of the hidden forces and structures would reproduce it; one could change all the water molecules involved and the tip would recreate itself because nothing has changed about the hidden forces and structures. As with an iceberg, the cultural forces within engineering...
education (values, attitudes, beliefs) are invisibly held. These forces create and interact with deep structures—policies, rules, practices, institutions—to produce the visible phenomena—the “tip” of the iceberg—that we relate to as problematic. As with an iceberg, over the course of decades, the participants in engineering education have changed, but the “tip” of the iceberg (e.g., demographics of engineering graduates) largely remains the same, suggesting that the source of the “problem” can be found in the hidden cultural forces and structures.

After we finished individually writing our responses to the set of six questions, we transitioned back to a collaborative mode of making sense of our different experiences. In doing so, we attempted to maintain our commitments to both our theoretical perspectives and the collaborative autoethnographic approach. More specifically, this phase of our process included three steps.

First, we each returned to our own responses and looked for instances where we attributed (or “blamed”) aspects of our reflexive reactions to others. For example, we changed “we had ‘expert’ guest speakers who contradicted one another” to “we had ‘expert’ guest speakers who seemed to me to contradict one another”. The purpose of this step was to recognize how we were actively producing our point of views, and to identify parts of our descriptions where we were “climbing up” Argyris’ (Argyris, 1990) ladder of inference. This helped us to see our mental processes as action in contrast to passively and objectively witnessing a factual event.

In the second step, we examined each other’s accounts for similar instances. Despite our prior efforts to remove areas that might be described as blaming others for our reactions, this second step revealed how challenging it can be to bring unconscious worldviews, assumptions, beliefs, attitudes, perceptions, and values to the surface [18], and to own them. For example, this step led to the kinds of changes illustrated in Box 3.

Box 3. An example of the collaborative writing process

| Original text: “There we were, 30 or so academics, most of whom had flown to Washington D.C., only to be met with NO PLAN! I couldn’t help but think that the entire workshop was a waste of time.” |
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| Collaboratively edited text: “There we were, 30 or so academics, most of whom had flown to Washington D.C., only to be met with NO PLAN! None of us noticed that “allowing the understanding to ‘emerge’ from the existing social container” may have, in fact, been a plan in itself; I was certainly not prepared to participate in such an “emergent” plan. I couldn’t help but think that the entire workshop was a waste of time, at least in my model of how time “should” be spent.” |

In the third and final step, we looked across all four accounts for themes that we determined to be most salient with regard to our goal of understanding what led us to reflexively reject SenseMaker upon our first encounter with it, and what led us to persist with learning more about the approach. We present these themes below and illustrate them with excerpts from our autoethnographic writing. The full set of our responses to the six questions outlined above is provided in the Appendix.

**Discussion: Themes that emerged across the four accounts**
One of the most surprising themes that emerged across our accounts was the extent to which we identified sensation, i.e., embodied cognition as opposed to thought or logic (see Figure 3), as pivotal points for our actions. For example, at multiple points in our re-tellings of our experiences, we used constructions such as “I had the nagging feeling…,” “I felt threatened…,” or “I was excited…”. The following excerpt from Linda’s response to the fifth question, “What kept me moving toward it?” provides a rich example of how the notion of “sensing” was threaded throughout our collaborative sense-making:

...I have grown increasingly uncomfortable with what seems to me to be the gap between the complex, dynamic and fundamentally social and political nature of a real learning environment and the assumptions embedded in scientific laboratory research methods. To be honest, this discomfort is not “cognitive” (“in the mind”), although there is an awareness, it is literally “in the body.” It is a sinking feeling, a heaviness in my torso and a tightness in my back—a feeling that “something is wrong” with the common practice of applying legacy reductionist scientific methods to social systems—Linda (see Appendix for the full accounts from which this and all following excerpts are drawn from).

The next excerpt, this time from Nicki’s response to the fourth question, “Where in the iceberg do I see the source of my reflexive reaction?” similarly highlights the connection between reflexive actions and sensation, and how our collaborative autoethnographic approach enabled us to step back and reflect on our initial judgements of SenseMaker:

At a subconscious level, one likely explanation for the strength and conviction of my reflexive rejection of SenseMaker is that I felt threatened. Here was a tool that questioned much of what I had worked so hard for to become - a qualified, qualitative researcher. Without what seemed to be even a second thought, much less a discourse published in the appropriate venues, SenseMaker seemed to change all the rules, lay out an entirely new playing field, and throw me back into the role of a beginner—Nicki.

The following four sub-themes each provide insight into how reflexive sensing can lead researchers to unconsciously make judgements, whether they be positive or negative, about new methodologies, like SenseMaker. Our intention in sharing these themes is to examine the assumed “logic” with which researchers appraise new approaches. Prior research has identified
the need for researchers to attend to bias, in particular implicit bias as it pertains to race, ethnicity, nationality, gender, and social status, among other factors (Jost et al., 2009). In the following sections, we attempt to build a case for using sensory awareness as an indicator of such bias.

Violation of our unstated expectations

As part of our efforts to “own” our initial reactions to SenseMaker, rather than “blame” others for perceived shortcomings, we gradually became aware of a diverse range of unstated, or unconscious, expectations that we held about what constitutes “appropriate” approaches to social inquiry, and how one should go about learning about such approaches. As evidenced by our first draft responses (recall Box 3), these socially constructed expectations were initially hidden, and only emerged through personal reflection and group discussions.

When first introduced to SenseMaker, all four of us held strong feelings about it not fitting into our worldview of what academic research should look like. As Carol Patrice stated, “I had been taught that randomized controlled trials (RCT) were the gold standard for excellence”. Such perceptions manifested in stories about perceived deficiencies in rigor and difficulties associated with trusting perceived “non-academics”.

For example, Nicki pushed back at the outset of a workshop presentation that did not meet her expectations of how a (rigorous) presentation to an academic audience should be organized or communicated. While this reaction initially resulted in negatively impacting her view of SenseMaker personnel and the tool itself, upon reflection she saw how her personal mental model of academic presentation was getting in the way of her being open to other ways of learning:

When the workshop began and the facilitator told us that she hadn’t prepared any PowerPoint slides for the morning, nor any other activities, and that she thought it was more appropriate for our understandings to “emerge” - that was the last straw for me. There we were, 30 or so academics, most of whom had flown to Washington D.C., only to be met with NO PLAN! None of us noticed that “allowing the understanding to ‘emerge’ from the existing social container” may have, in fact, been a plan in itself; I was certainly not prepared to participate in such an “emergent” plan. I couldn’t help but think that the entire workshop was a waste of time, at least in my model of how time “should” be spent—Nicki

Linda also struggled with perceptions of a lack of academic rigor. For example, she described how her reaction to getting feedback from a “non-academic” initially closed her off to a potentially valuable learning opportunity:

[ I thought] “Hey, dude, who are you to be giving me feedback?” …What I was thinking was that he was a business consultant, someone not authorized by what was, in my
model, a higher standard, as an academic researcher. Of course, I did not remember that the word academic is sometimes disparagingly used to mean “irrelevant in the practical sense.” What I see now is my hubris; I was invested in my identity as being a “legitimate” sort of expert researcher, even though I often question my own alleged expertise—Linda

In a similar vein, at the start, Patrice Carol “...didn’t feel the people at SenseMaker really understood academics and thought that the type of research may be okay for business but it would never pass muster in an academic setting.” Her representation of academic research did not allow her to be open to the possibility that other types of research outside of academia might be the very tools necessary to gain insights and understanding of complex and dynamic educational systems:

There is no question as an academic researcher I brought with me certain beliefs about things such as rigor and reliability, and attitudes about corporate research versus academic research—

While prior experience and expertise are critical to evaluating new approaches to research, the above responses show how unconscious expectations can also serve to close off openness to new opportunities. The strength of some of the above reactions (see in particular the excerpts from Nicki and Linda) also speak to the physicality of the authors’ initial, reflexive rejections of SenseMaker. The following three subthemes demonstrate how sensation not only informed the authors’ initial judgements of SenseMaker but also their decision to persist with learning more about the approach.

Intuition of incongruence of legacy research approaches. In response to the fifth and sixth questions, “What kept me moving toward it?” and “Where am I now?,” all of us identified a sense that legacy approaches to research were somehow incongruent. For Patrice, Linda, and Nicki, the incongruence showed up in power held by the researcher in shaping the outcome through choices of focus and/or analysis of the data.

I also thought about some of those evaluation projects in which I had been involved where I had had the nagging feeling that somehow the research approach and ensuing usual data collection techniques were not capturing the change that actually took place. ...Throughout the entire evaluation process, the evaluator is in control of the data (and subsequent data analysis and interpretation), and tries to collect data to support the predetermined theory of change. This strategy is comforting in that there is predictability and sequence to the process but it is not always the approach to use and I had, on several occasions, intuitively sensed that this approach was somehow lacking—Carol

I also have become increasingly aware of the limits of what is thought of as objective research in education, a fundamentally social system. I can see the influence of the researcher on which data are collected, how they are interpreted and subsequently generalized when the more appropriate thing is often to situate the conclusions. For example, models of intellectual development like that of Perry (Perry, 1968) are
considered “How humans develop,” when they were specifically derived through studies of college men at elite universities—Linda

For Patrice, persistent biases in “who is successful in engineering” was an indicator that legacy approaches were somehow not effective:

I look at the traditional methods we’ve used to collect data, make interventions and assess impact and we simply are not moving the needle—Patrice;

A sense of authenticity of method and values. With these perceived incongruences in mind, we saw in SenseMaker an approach that aligned with the dynamic complexity of the social system of higher education and the plurality of our values. For Nicki and Linda, SenseMaker captures and creates the systemic narratives in which the culture lives:

...I saw that SenseMaker was working with the micro narratives of a social system and I had convinced myself that, as Hill (2005) suggests, the culture lives in the narrative of the system:

“...that narratives are not merely overtly ‘about’ some ‘content,’ such as what happened, when, where, and to whom, but that they somehow make public the covert, underlying presuppositions that organize the world in which speakers live.” (p. 157)

So “There is something here,” I told myself—Linda

Further, all four authors saw the SenseMaker approach as a way of congruently working with dynamically complex systems:

Given that SenseMaker is a methodological approach that is designed to characterize complex, social systems, I don’t think it’s a coincidence that learning about SenseMaker is also best done in a social system—Nicki

...this may be the way to understand the complexity, make small interventions and nudge the stories so that there are more stories of thriving. I have long felt there was a gap between research and practice and struggled with the concept of generalizing when each individual experience is so very unique—Patrice

My understanding of SenseMaker has evolved from viewing it as just another software tool to seeing it as a research approach that has the potential to empower not only the researcher or the evaluator, but participants as well, to be adaptive, inclusive, and participatory in the process of understanding change in the context of their lives. For most of us who deal with systems in which the problems at hand are complex and dynamic (i.e., dropout rates, poverty, climate change, etc.) traditional research and evaluation methods alone are not sufficient to capture change and inform us of what we need to do to come closer to solving these vexing problems—Carol
A sense of aliveness. Related to a sense of authenticity, each of us also wrote about a sense of aliveness, which we continue to experience, as we move toward SenseMaker. For Patrice and Nicki, this showed up as intellectual stimulation.

Even though the Georgetown workshop led me to experience some inner researcher turmoil I was, at the same time, enthralled and fascinated by what I was learning and instinctively knew on one level that the SenseMaker approach made a lot of sense—Patrice

I was intrigued by the fact that, in SenseMaker studies, participants both recount and interpret their own stories. For quite some time, I have been exploring ways to more deeply involve research participants in qualitative research (Sochacka, Walther, & Pawley, under review). These efforts are connected to my ongoing interest in qualitative research quality and emerging belief that if researchers “do justice” to all members of the research process, the quality of the findings will improve—Nicki

For Carol and Nicki, it was a sense of community that arose from the effort to learn together.

I think what has kept me moving toward it is community, passion for wanting to find a way to transform engineering education in more holistic ways, and, as I learn more about it, a belief that this may be the way to understand the complexity, make small interventions and nudge the stories so that there are more stories of thriving—Carol

One of the most enjoyable parts about working with SenseMaker for me has been exploring it with others - both with the co-authors on this article, Patrice, Linda, and Carol, as well as with undergraduate student—Nicki

Conclusions

We found the overarching focus on, and expressions of, sensation to be remarkable because all of our narratives intimated a preference for data and “rigor,” —the stuff of logic. We each also identify as academic researchers—those who engage in scholarly pursuits of “the mind.”

There were even places in our narratives where we used language of sensing when it would appear that we were referring to thought: “I felt that...the facilitator...did not meet my expectations...” or “I ...felt there was a gap between research and practice.” Even when we did not explicitly identify sensation as the impetus for our actions, the evidence suggests that our underlying feelings functioned to override our conscious intent. In spite of our desire to learn to work with emergence and dynamic complexity, we reflexively rejected our first encounter with it. As a reflex, our rejection was without conscious thought—it was a felt reaction of the body.

It is possible that the feeling language of our narratives, although shared, was somehow inaccurate; it is possibly biased by our shared socialization as females. At the same time, Lakoff’s (2012) and others’ research on neural theory of thought and language substantiates that “...thought is physical and is carried out by functional neural circuitry...what makes thought meaningful are the ways those neural circuits are connected to the body and characterize
embodied experience...so-called abstract ideas are embodied in this way...as is language.” If we were to take our language at face value, it would appear that to a large extent, our actions and what we imagine are conscious decisions, are often strongly governed by embodied cognition—the understanding or knowing that arises from bodily sensations, often beneath our conscious awareness.

Interestingly, as “academic researchers,” we likely have a shared, embodied neural circuitry that functioned to reflexively resist the encounter with this new methodology, SenseMaker. If we look at how we almost rejected the very thing that we intended to embrace, a potentially radical possibility is that our sole focus on cognitive development in education is undermining transformational learning. This cognitive development, or perhaps the “expert mind,” “feels” threatened by what is not already known—by what it cannot re-cognize from its prior understanding.

Although we authors have been enculturated into a simple-systems view of the world, we each sense that dynamic complexity is a truer model of the phenomenon we call learning; we believe in developing to effectively learn in dynamically complex systems. For those who also sense this, our narratives serve as cautionary tales. Our former learning is embodied and creates little capacity to work with embodied cognition. Therefore: expect discomfort; anticipate a metaphorical “threat” to your egoic identity; await the internal arising of an onslaught of hostile inferences. After all, we are part of the systems we seek to transform—if we are successful, we too will be transformed.

We note that the current neuroscientific view of “the mind” is not solely that of the cranial brain, but a gestalt of sensations arising from the dynamic complexity of our whole neurology (Gazzaniga, 2011). This study has further convinced us of the need to expand our development/education to include embodied cognition. Conscious access to our full neurological intelligence appears to be the means for transformational outcomes in education.

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Epilogue
It has now been just over three years since I (Nicki) first learned about SenseMaker. After exploring our initial, reflexive rejections to the approach, Carol, Patrice, Linda, and I started to develop a SenseMaker project based on the concept of thriving. Then, Carol, Patrice, and Linda all changed their places of employment, which made it challenging for us to continue working closely together. So, I teamed up with a group of faculty and students at the University of Georgia and continued the painstakingly slow process of developing a “signification framework” based on the concept of thriving.

It took us about two years to develop our first prompt and complete set of triads, dyads, stones, and multiple-choice questions - the four types of questions participants use to self-signify their experiences in SenseMaker. We piloted our work in early Fall 2019 and completed a full launch later that same semester. We were in the process of planning our second launch for Spring 2020.
when the COVID-19 pandemic hit, at which point we pivoted to using SenseMaker to understand how faculty, staff, and students in our College of Engineering were experiencing the crisis and transition to online and other hybrid models of learning.

The SenseMaker approach was well-received by our community and provided powerful and immediate insights. The combination of qualitative (i.e., participants’ stories) and quantitative data (i.e., participants’ responses to questions asked about their stories), alongside the approach’s online data visualization tools, enabled my colleagues and I to “make sense” of patterns in almost real-time - something I would not have previously not thought possible. Doing this work also drove home to me the fact that SenseMaker is so much more than a tool for data collection. Now I understand that, first and foremost, it is a tool to motivate action. In our case, we are learning about how faculty, staff, and students are experiencing the COVID-19 crisis so that our College can take action to amplify positive experiences and dampen negative experiences. In this way, SenseMaker provides a means to investigate and make change in complex social systems which, to me, is a key part of the institutional change aspects of engineering education research.

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Appendix: Authors’ full accounts of their initial encounters with, and present orientations to, SenseMaker

Patrice

How did I learn about SenseMaker?
In October 2014 a researcher invited a small group of people to a “think tank” that was meant to be a brainstorming event with small focused discussion on where MOOCs (Massive Open Online Courses) are going and how they were starting to impact traditional education. It was here I met the colleague who introduced me to SenseMaker. We connected around common questions and passions, and belief in the importance of hearing the student voice. And together wondered how we might give students a greater voice in research and how we might measure those things that are hard to quantify such as “transformation” and impact of “innovation”. We brainstormed on how we might begin to understand the educational ecosystem in a new way that illuminated the impact of changes we hoped to make in the educational experience. In the winter of 2015 this colleague told me about a meeting she had around the use of a tool called SenseMaker. She shared with me a link to a YouTube video of a keynote that SenseMaker’s founder, David Snowden, had done, some of the highlights of her discussion and invited me to participate in an upcoming SenseMaker pilot study she was doing.

My colleague described it to me as a way to capture micro-narratives and layer qualitative data with quantitative data, and the storyteller interprets their own story. I appreciated how this might give students more of a voice in research and how we might measure those things that are hard to quantify such as “transformation” and impact of “innovation”. We brainstormed on how we might begin to understand the educational ecosystem in a new way that illuminated the impact of changes we hoped to make in the educational experience. In the winter of 2015 this colleague told me about a meeting she had around the use of a tool called SenseMaker. She shared with me a link to a YouTube video of a keynote that SenseMaker’s founder, David Snowden, had done, some of the highlights of her discussion and invited me to participate in an upcoming SenseMaker pilot study she was doing.

How was I initially introduced to it?
I did not have any formal introduction to SenseMaker and might describe it as “baptism by fire”. I was excited by the possibilities of SenseMaker and based upon my understanding of it saw it as a tool worth exploring and using. Since I was coming into the project after the decision had been made to use SenseMaker and a research designed developed I was not part of that process. Knowing some of the other researchers involved in the pilot project, I trusted them—meaning I believed in their research expertise and knew they had common research interests to mine and we shared common goals around better understanding the educational experience and the impact of digital learning. I would call my decision to participate somewhat of a “leap of faith” thinking that I could ask questions and get up to speed as we went along. After all, SenseMaker was just a technologically advanced form of a qualitative tool in my mind.

As part of my participation in this study I got an inside look at what the raw data looks like, as well as the visualizations. Seeing the visualizations of the data results without understanding how they were derived left me with a lot of unanswered questions and skeptical about the reliability and validity of the process. I wondered how the stories were analyzed and how that analysis fit into the results and conclusions, there also did not seem to be any triangulation of data. It was during this time I learned about a workshop around how SenseMaker works and how to create a research design.
What was my reaction/ reflexive rejection?

Being in academic technology I am constantly contacted by sales people and have become suspect of anyone trying to sell me a tool. SenseMaker started in this box of distrust—that is, I didn’t completely trust the intentions. In the winter of 2017, I developed a SenseMaker research design specific to my institution. This was where my understanding of the tool and methodology began to blossom. I continued to find it difficult to quite wrap my head around how to make “good” signifiers and exactly how the data was interpreted. My participation in the workshop enhanced my understanding of how to develop a SenseMaker research design but still did not shed light on exactly how the data was analyzed. I felt a dichotomy between my excitement of this tool, and what I believed it to be, and my developing perception of what I was slowly beginning to believe the tool was and was not. The cohort in this workshop consisted primarily of people from business/industry and the cases that were shared were from business/industry. In hearing about how the tool was being used and reviewing the research designs I began to wonder about things like rigor, reliability and the process of how the designs were created. Additionally, we had “expert” guest speakers who seemed to me to contradict one another. My academic “hat” began to push back and I started to think that while it may be “fine” for businesses and industry this SenseMaker did not meet my unexamined criteria for an academic tool. The initial reason I became interested in SenseMaker was still there, and there was still enough intrigue into learning more about SenseMaker, that I wasn’t quite ready to let go.

A few months later I attended a SenseMaker workshop where I met the authors of this paper. Day one of the workshop occurred to me as chaotic relative to my model of what “should” happen. As someone who has a business and academic background, I assume that presentation will be in a particular style; the presentation did not fit my model and I found myself internally assessing it as below my imposed standards. In my model, there is always a plan with a specific outcome in mind. My perception of the presenter on the first day was that they had not taken the time to position the presentation to their audience and really did not understand academics. I did not question whether I was prepared as an academic to listen and participate in an alternative presentation style; nor did I ask myself if I really understood complexity practitioners. My initial, untested judgments of the presentation style reinforced my reflexive rejection: this approach may not be applicable in the academic setting.

Something I hadn’t heard until this workshop is that, “the story doesn’t matter”. My understanding at this point was that SenseMaker was a qualitative analysis tool, and I couldn’t make sense of a qualitative study where part of the “main” data collection—the stories—didn’t matter. The speaker made statements about data, data collection and interpretation that contradicted my model of valid and appropriate approaches, and I didn’t yet comprehend in what way “the stories didn’t matter”. As a qualitative researcher it was hard to align my thought process with that idea and I began to question if this was in fact a qualitative tool and something I wanted to use for research. I was feeling disappointed and that I had wasted my time traveling to this workshop and spending the amount of time I had exploring this tool. Then the next speaker arrived and everything changed. This speaker spoke with a sense of authority on the subject matter and spoke in a way that fit within my mental model of a world renowned researcher. I felt myself suspend my own beliefs and on some level “trust” that the things he was saying were absolutely true. I found everything I thought I knew torn down, and through actions consistent with my model of expert facilitation, new knowledge was continuously built and
rebuilt. I especially appreciated the experiences he incorporated into the workshop as a way to keep us in a state of “meaningful chaos”. He said, “Chaos is random in the absence of meaningful constraints. Randomness in a rigid container is innovation.” That was exactly the environment he created and he seemed to have quickly gotten the whole room of academics on board.

Where in the iceberg do I see the source of your reflexive reaction?
Literature and language are the two surface attributes that on a conscious level influenced me. As an academic I speak a certain language and go to the literature. As I was reading some of these studies on the one hand immediately connected to the stories and process of collecting them, but no where could I find what I expected as “rigor” that fit my mental model of it. How had they triangulated the data? How were they coding the data? Where was the theoretical framework? I didn’t reflect on questions like, “What am I assuming to be true in the method of triangulation?” “Is triangulation an appropriate method in this situation?” During the course we took and the session in Georgetown I didn’t feel the people at SenseMaker really understood academics and thought that the type of research may be okay for business but it would never pass muster in an academic setting. There is no question as an academic researcher I brought with me certain beliefs about things such as rigor and reliability, and attitudes about corporate research versus academic research. I think there was also a question of trust. Trust includes knowing that the person has the knowledge needed and that their intentions are positive. There was definitely a part of me that viewed SenseMaker’s founder through a set of habitual hostile assumptions about his motives. Prior to his speaking and due to my own mental model of presentations, I judged the (female) presenter as disorganized and insufficiently “expert.” My own novice state with dynamic complexity disabled my ability to see her existing expertise in this domain.

What kept me moving toward it?
I think what has kept me moving toward it is community, passion for wanting to find a way to transform engineering education in more holistic ways, and, as I learn more about it, a belief that this may be the way to understand the complexity, make small interventions and nudge the stories so that there are more stories of thriving. I have long felt there was a gap between research and practice and struggled with the concept of generalizing when each individual experience is so very unique. We each bring our own experiences, culture and beliefs. Each classroom, school and community has its own unique culture that changes and grows as the individuals change and grow. I had often wondered how to get at this complexity of humanness. Although I struggled initially with my unexamined judgments about the rigor and reliability of SenseMaker, much of it I connected to due to similarities in the methodology I used for my dissertation, Portraiture. Using the Portraiture methodology I conducted interviews and analyzed that data, but in addition the participants created and reacted to artwork and were a co-researcher in the development of their portraits.

For me the opportunity to collaborate with the authors on this and figure out this complex, hard to understand tool and methodology has been the greatest driver for my continuing to move toward it. As our discussions shifted toward not only using the tool in an educational setting, but in a meta way, how we were making sense of SenseMaker, has me even more excited. I look at the traditional methods we’ve used to collect data, make interventions and assess impact and we
simply are not moving the needle. One of the things that excites me about this tool is the ability to iterate, make small changes and quickly see the results, and look for patterns.

Where am I now?
I’ve seen the possibilities for using SenseMaker as a way to understand the complexity of the educational ecosystem and make meaningful change. I’ve recognized many of my own biases as an academic and am rethinking my belief system about academic research expertise and our mental models. I think I would describe where I am now as self-aware. Although I have been exploring SenseMaker for almost two years I still feel very much a novice. The opportunity to explore SenseMaker with the authors of this paper and colleagues at other universities has reinforced that there is something there worth digging deeper into and experimenting with. I’m filled with a sense of hope and optimism that SenseMaker will give us the insights we need to finally nudge the stories and reimagine the educational experience.

Linda

How did I learn about SenseMaker?
SenseMaker was brought to my attention by an academic colleague who also shares a view of the world as dynamically complex. I have been learning about dynamic complexity for a few years and trying to understand how one might conduct research in a dynamically complex system. I first viewed what might be called a video “trailer” for SenseMaker (http://cognitive-edge.com/sensemaker/). I resentfully signed up for an online introduction ($100), with a mental model that introductions “should be” free. I completed it. I could see in the introduction that there was real potential to develop a system-level view of the system itself in a way that felt consistent with the ontological assumptions of dynamic complexity: open, recursive, self-organizing, changing in time, emergent.

How was I initially introduced to it?
I then decided to take an online training course ($400). It included individualized feedback on a research design submitted by each participant. This online course violated my invisibly-held and unexpressed expectations. There were about five participants, many of whom identified as organizational change practitioners, primarily working with businesses as independent consultants. The course itself was facilitated by such a practitioner who had experience with the methodology and tool in a business context. The course was structured as asynchronous experiences—participants were to independently download case studies and whitepapers—with intermittent synchronous meetings every week for about five weeks.

What was my reaction/ reflexive rejection?
During the course of the online training, I found myself habitually (and unconsciously) applying the typical academic, analytical critical eye toward the process of data representation. I inquired about how one assigns numbers to the placement of data points; the facilitator didn’t know and referred me to one of the supporting documents. I found myself adding my own meaning to the moments when the answers to my questions didn’t satisfy me, “What? If this were a legitimate research approach, wouldn’t the facilitator know the answers?” I continued to generate these somewhat hostile inferences in my own mind throughout the course. I did not stop to consider that the nature of organizational change research might be different than what I am used to.
The learning process within the course involved submitting one’s research design to an online collaboration space (https://slack.com/). We participants were to provide insights to one another on each others’ design. I am embarrassed to say that there were several moments when I received feedback from one of the participants, a consulting practitioner, on my proposed research design, and my reflexive reaction was, “Hey, dude, who are you to be giving me feedback?” Of course, I didn’t say this explicitly. He was actually very encouraging in his feedback, but this didn’t matter to me. What I was thinking was that he was a business consultant, someone not authorized by what was, in my model, a higher standard, as an *academic* researcher. Of course, I did not remember that the word *academic* is sometimes disparagingly used to mean “irrelevant in the practical sense.” What I see now is my hubris; I was invested in my identity as being a “legitimate” sort of expert researcher, even though I often question my own alleged expertise. I didn’t remember that academic research is often conducted in highly controlled situations, often with rarified research subjects, like college students, where the researcher effortfully minimizes known variation; this is not the real world of dynamic complexity where business practitioners work. I also had a kind of “expert model”, where I was expecting the facilitator, not my “novice, learning peers,” to provide what I imagined was “correct” feedback to my submissions as the “expert.” I suppose my reactions were not unlike what students experience in my course when I structure it to include peer-to-peer learning.

I eventually received feedback from the facilitator and ended the course believing that the “tool” was a fancy way of presenting survey data (I was wrong, more on this later)...until I dug more deeply into the case studies, many of which documented compelling transformations in social systems.

*Where in the iceberg do I see the source of my reflexive reaction?*

My reflexive rejection was stimulated by my unconscious and arguably hostile inferences about the actions of the facilitator and my workshop peers. The source was in the domain of the invisible in Hall’s iceberg model: My world view of what constitutes “legitimate” research, my beliefs of who holds knowledge and my belief and attitude that those in the academy have been vetted by a more rigorous standard than business practitioners; I did not notice that the business world represents a research context quite different from the controlled environments of academic research and therefore would require a different research approach.

*What kept me moving toward it?*

Despite my somewhat dismissive inferences, I kept being interested in learning more and agreed to attend a workshop in Georgetown that was hosted by the colleague who initially directed me to SenseMaker. I saw that SenseMaker was working with the micro narratives of a social system and I had convinced myself that, as Hill [19] suggests, the culture lives in the narrative of the system,

> “...that narratives are not merely overtly ‘about’ some ‘content,’ such as what happened, when, where, and to whom, but that they somehow make public the covert, underlying presuppositions that organize the world in which speakers live.” (p. 157)

So “There is something here,” I told myself.
I also have become increasingly aware of the limits of what is thought of as objective research in education, a fundamentally social system. I can see the influence of the researcher on which data are collected, how they are interpreted and subsequently generalized when the more appropriate thing is often to situate the conclusions. For example, models of intellectual development like that of Perry [20] are considered “How humans develop,” when they were specifically derived through studies of college men at elite universities.

Objective, laboratory research works wonderfully in controlled settings on matter and energy, where it is often possible to hold the observed separate and independent from the observer. Having first learned these scientific methods that are fit for the lab, I unconsciously transferred them to studying education. But I have grown increasingly uncomfortable with what seems to me to be the gap between the complex, dynamic and fundamentally social and political nature of a real learning environment and the assumptions embedded in scientific laboratory research methods. To be honest, this discomfort is not “cognitive” (“in the mind”), although there is an awareness, it is literally “in the body.” It is a sinking feeling, a heaviness in my torso and a tightness in my back—a feeling that “something is wrong” with the common practice of applying legacy reductionist scientific methods to social systems.

Where am I now?
I am in the midst of a transformation in my views on research approaches. What I mean by transformation, is that I am taking conscious actions that literally transcend the previous forms of my past research. My original discomfort with the SenseMaker approach arose from assumptions I held internally but projected outward and unconsciously onto the person/thing that triggered my discomfort.

I can see now that methods of understanding must be coherent with the nature of the thing that I’m trying to understand. In other words, I cannot understand a dynamically complex system with a method that is static and modeled on localized cause-and-effect when I know that people in a social system of education are in flux and shaped by history, politics, spirituality, and a myriad of other unmeasurable influences, past and present.

SenseMaker to me now occurs less like a software tool and more like a research methodology that is, itself, a participatory systemic intervention. The approach is coherent with the ontology of dynamically complex systems:

- The approach assumes that “wisdom” resides in the whole, resulting in emergence, a phenomenon that arises from the whole, not from a single, expert researcher;
- By having system agents participate in the research, it creates a recursive, self-organized meaning-making by agents in the system—a dynamic which itself produces systemic learning and shifts;
- Co-created interventions by the system’s experts and laypeople are designed to nudge the system toward a desired state, rather than prove the existence of generalizable, cause-and-effect relationship (these do not exist in complex dynamic systems).
Had I allowed my reflexive rejection to lead, I would not be expanding in my point of view. We often forget that formalized academic research has the humble beginnings of a “hunch” from observations. As an example, I am reminded of Patrice Dweck’s [21] excellent research on mindsets which she began publishing in 2005, the result of a 20+ years of academic research in psychology. Ironically, her recommendations can largely be found in a paperback book published in 1980 by two moms, Adele Faber and Elaine Mazlish, called “How to talk so kids will listen & Listen so kids will talk” [22]. All this has made me reflect on what we academic researchers are not learning because of our beliefs about where legitimate knowledge comes from.

Carol

How did I learn about SenseMaker?
I first heard of SenseMaker from Linda, an engineering professor at the California Polytechnic State University (Cal Poly), on February 20th, 2017 when we had our first video conference call and she mentioned this research approach and tool. I had just corresponded with Linda for the first time a couple of weeks earlier due to a request by my supervisor to contact researchers who have been involved in assessing community engaged learning in the field of sustainability engineering. During the video conference call, I learned of an upcoming workshop that Linda thought would interest me and, later that day, she sent me an email with a link to a short introductory video on SenseMaker.

How I was initially introduced to SenseMaker
I received an invitation from the organizer of the Cognitive Edge workshop that was to be held at Georgetown University in April, 2017. A few weeks prior to the workshop, participants were given a link to a Dropbox folder that had reading materials intended to familiarize us with SenseMaker. I reviewed the material prior to the workshop and so I arrived with some basic understandings of the SenseMaker research approach and tool.

What was my reaction/ reflexive rejection?
The first part of the workshop, in my opinion, did not go well. The main presenter had not yet arrived - his flight was delayed - and his assistant was left with task of kicking off the workshop. The assistant informed us that she did not have an agenda and wanted the topics for discussion to more or less “emerge”. On hearing this plan for the morning, which did not align with my expectations of an “organized” approach, I quickly felt my initial excitement dissipating. Beyond my own reaction, I also observed signs of an increasingly tense atmosphere among many of the other workshop participants. Though it is normal to be initially confused when learning something new, the confusion I was experiencing, and witnessing, was quickly deteriorating into frustration. This scenario played out for a good portion of the morning until the main presenter arrived. My initial excitement returned as the new arrival “took command” of the room and proceeded to eloquently describe what his facilitator could not. While I appreciated this, not necessarily more organized, but certainly more assertive approach, I also experienced dissonance because some of what I was hearing about the SenseMaker approach was very contrary to the steps in conducting “sound” research that I had been taught. For example, my training had taught me the necessity of going into a research study with a hypothesis already formulated but this, I learned, is the antithesis of the SenseMaker approach. Additionally, the idea of turning over
control of the data to the study participants so that they, and not the researcher, ascribe meaning to their data was novel and unsettling to me.

*Where in the iceberg do I see the source of my reflexive reaction?*
The Georgetown workshop presentation directly challenged the invisible culture of academic research. My dissonance stemmed from what I perceived as an assault on, or at the very least questioning of, many of my assumptions, beliefs, and attitudes about how research should be done and who has access to the data. I had been taught that randomized controlled trials (RCT) were the gold standard for excellence but, during the workshop, I seemed to be receiving a different message. Moreover, I was challenged by the notion that the people from whom evaluators collect data could ever “know enough” to participate in the interpretation of the data. The assumption that only evaluators are sufficiently qualified to analyze data was one that stemmed from my elitist research training. After all, I pondered, how could people who had no qualitative or quantitative research methods training provide meaningful data interpretation? I had been trained to believe that only the evaluators had expertise and did not need to include those who were affected by the problem; evaluators simply needed to, in most cases, conduct a literature review to get a "real" understanding of the problem, develop an evaluation design and then execute it. In my evaluation expert model, the participation of research subjects in interpreting the data would directly violate the goal of objectivity in the evaluation. My training as an educational evaluation researcher created an invisible cultural bias of "experts" versus "non-experts," which was definitely being challenged. My evaluation invisible culture of “experts” versus “non-experts” was definitely being challenged by this new SenseMaker worldview that approaches research as an inclusive, collaborative, participatory endeavor.

*What kept me moving toward it?*
Even though the Georgetown workshop led me to experience some inner researcher turmoil I was, at the same time, enthralled and fascinated by what I was learning and instinctively knew on one level that the SenseMaker approach made a lot of sense. I also thought about some of those evaluation projects in which I had been involved where I had had the nagging feeling that somehow the research approach and ensuing usual data collection techniques were not capturing the change that actually took place. Typically, in the world of program evaluation, the evaluator seeks to determine program impact. The process for doing so is largely a linear process. The evaluator is encouraged to first create a theory of change, logic models, and evaluation goals and objective statements as a basis for developing the evaluation design. To answer the overarching question of program impact, evaluation questions are developed that align with the program goals and objectives. In most cases, evaluation questions prescribe the methodology for determining the extent to which the intervention was successful in enabling the program to achieve its objectives. Data are collected from program participants at various points in the study by using at least one of the following data collection tools: questionnaires, interviews, focus groups, or direct observation. Throughout the entire evaluation process, the evaluator is in control of the data (and subsequent data analysis and interpretation), and tries to collect data to support the predetermined theory of change. This strategy is comforting in that there is predictability and sequence to the process but it is not always the approach to use and I had, on several occasions, intuitively sensed that this approach was somehow lacking. The Georgetown workshop was novel, intellectually stimulating, and fascinating to me and confirmed my suspicions about the incompleteness of the evaluation approach that I had often used. I was
captivated because I realized that SenseMaker was more than just a software tool but was a research approach and methodology that, perhaps, had the potential to revolutionize the academic research culture in higher education and elsewhere.

Where am I now?
My understanding of SenseMaker has evolved from viewing it as just another software tool to seeing it as a research approach that has the potential to empower not only the researcher or the evaluator, but participants as well, to be adaptive, inclusive, and participatory in the process of understanding change in the context of their lives. For most of us who deal with systems in which the problems at hand are complex and dynamic (i.e., dropout rates, poverty, climate change, etc.) traditional research and evaluation methods alone are not sufficient to capture change and inform us of what we need to do to come closer to solving these vexing problems. Mostly because the issues are not static but dynamic and therefore require tools and approaches that can capture change immediately as it occurs and not weeks or months later when the evaluator attempts to analyze and interpret the data. As I began to gain a greater understanding of SenseMaker, my dissonance level decreased as I came to the following understanding: Complex adaptive systems call not for evaluators to abandon traditional research methods but to use whatever combination of traditional and adaptive research approaches are required in a particular context to more accurately inform us of the state of the system [23]. And, depending on the system, RCTs may very well be the standard of excellence but in a complex system this is not the case.

Nicki

How did I learn about SenseMaker?
I first learned about SenseMaker from a colleague who is also an advisor on my research project - “How Stories Shape the System of Engineering Education and provide a Lens for its Investigation”. In this project, I conceptualize engineering education as an autopoietic system that is maintained by a network of communications – of stories which, through their telling and enactment, autopoietically (re)produce the culture(s) of engineering departments and colleges. In his invitation for me to attend the Georgetown workshop in April 2016, my colleague described the challenge of operationalizing complex systems and ecosystems theory in the context of engineering education, and the need to do so if we are to successfully transition to more socially, environmentally, and economically just states. So, I learned about SenseMaker from someone who shares a common goal to find novel ways to understand, characterize, and ultimately change systems of engineering education.

How was I initially introduced to it?
Prior to attending the Georgetown workshop, I studied the pre-reading materials, which comprised of a book chapter [24], a draft description of a case study [25], and an article published in the Harvard Business Review [26]. I imported the papers as pdfs into OneNote and proceeded to read and comment on them. As I worked through these pages, I circled multiple paragraphs, scribbled question marks in the margins, and also felt compelled to annotate some sections with disparaging remarks like “not very well written” or “like all qualitative research!”.
When I finished, I felt unsatisfied. I didn’t understand the novelty, logic, or practical application of SenseMaker. I attributed my confusion to a combination of poor writing and a lack of
understanding, on the part of the various authors, of complex systems and of qualitative research. I didn't consider that, at some level, I may have had a role in my state of confusion - that I may have been actively filtering what I was reading, based on my own assumptions.

What was my reaction/ reflexive rejection?
Looking back, it is clear to me now that my judgements of the pre-readings primed me to ask some tough questions on the first day of the workshop. As someone who considered themselves well versed in complex systems, and qualitative inquiry, I felt well positioned to get to the bottom of this new approach. So, when the workshop began and the facilitator told us that she hadn’t prepared any PowerPoint slides for the morning, nor any other activities, and that she thought it was more appropriate for our understandings to “emerge” - that was the last straw for me. There we were, 30 or so academics, most of whom had flown to Washington D.C., only to be met with NO PLAN! None of us noticed that “allowing the understanding to ‘emerge’ from the existing social container” may have, in fact, been a plan in itself; I was certainly not prepared to participate in such an “emergent” plan. I couldn’t help but think that the entire workshop was a waste of time, at least in my model of how time “should” be spent. What followed can only be described as an unproductive onslaught of academese. Qualitative experts picked apart SenseMaker’s apparent positivist underpinnings, to which the facilitator explained that SenseMaker is, in fact, primarily a quantitative tool. What?! “But it uses narratives,” we all cried.

Another attribute of SenseMaker that went against my mental model of qualitative research was the discussion around researcher bias. The facilitator said that after interpreting a certain amount of data, all researchers are inescapably affected by their biases. I rejected this idea, as I knew that methods such as reflexive research practices, bracketing, and other well-documented techniques are effective means to mitigate researcher bias. In looking back, the workshop participants’ attention, mine included, was focused on why the SenseMaker approach did not meet our pre-conceived standards and criteria of “legitimate” research; we were attentive to deficiency rather than attempting to explore or inquire into what was apparently a methodology that was based on a different ontological model than traditional research.

Where in the iceberg do you see the source of your reflexive reaction?
Considering Hall’s iceberg analogy, I would locate the source of my reflexive reaction to SenseMaker both above and below the waterline, that is, at the conscious and subconscious level. On a conscious level, I was offended by my perception of the facilitator’s failure to conform to best practices of effective teaching. I expected a scaffolded structure to guide my learning in the workshop. I wanted a PowerPoint presentation, handouts, examples, and active learning exercises. As an educator, I felt that I knew the best way to teach people and the facilitator not only did not meet my expectations, but outright admitted that she “didn’t like PowerPoint” and expected our learning to “emerge”. As an aside, I do now note the irony of my resistance to “emergent learning” in the context of working with a tool that is designed to characterize complex, social systems.

At a subconscious level, one likely explanation for the strength and conviction of my reflexive rejection of SenseMaker is that I felt threatened. Here was a tool that questioned much of what I had worked so hard for to become a qualified, qualitative researcher. Without what seemed to be even a second thought, much less a discourse published in the appropriate venues, SenseMaker
seemed to change all the rules, lay out an entirely new playing field, and throw me back into the role of a beginner.

*What kept me moving toward it?*

Despite these initial reactions, there were three aspects of SenseMaker that piqued, and have since sustained my interest, in learning more about the approach. The first is the way in which SenseMaker deconstructs the traditional roles of researchers and research participants. While I did not initially appreciate claims that all researchers inescapably suffer from interpretation bias, which inevitably reduces the quality of their research, I was intrigued by the fact that, in SenseMaker studies, participants both recount and interpret their own stories. For quite some time, I have been exploring ways to more deeply involve research participants in qualitative research [27]. These efforts are connected to my ongoing interest in qualitative research quality and emerging belief that if researchers “do justice” to all members of the research process, the quality of the findings will improve. So, SenseMaker’s focus on “self-signification,” and then inviting all participants to collectively make sense of various visualizations of the data offered a thought provoking avenue for me to continue to explore this aspect of my research program.

The second feature of SenseMaker that kept me moving toward it is its focus on not just characterizing complex, social systems, but on *changing* them. While I love a good theory and tight empirical study as much as the next educational researcher, at this stage of my career I am very much drawn to, and motivated by, concrete action and change. So, when I first heard about how SenseMaker findings could be used to design “safe-to-fail” experiments, which are collectively designed by all participants in the system, I couldn’t help but want to learn more.

The third feature of SenseMaker that encouraged me to work through my initial negative reactions is its focus on narrative as a gauge of culture. In the research project I mentioned above, my colleagues and I had proposed to use a systems thinking perspective to investigate how stories autopoietically (re)produce the shared system of beliefs, explanations, and values that underpin the culture(s) of engineering education. Before learning about SenseMaker, my colleagues and I had piloted several different ways to achieve this goal, each of which had their own affordances and limitations. SenseMaker, however, offered a way to collect narratives at scale, to meaningfully involve all members in the system, and to experiment with ways to shift systems to enable “more stories like this and less like that”. Of course, this focus on scale and action extended far beyond the scope of my initial study. Now, though, I could see a tangible path forward.

*Where am I now?*

At present, I am still very much a SenseMaker beginner, and I suspect I will remain one for quite some time. One of the most enjoyable parts about working with SenseMaker for me has been exploring it with others - both with the co-authors on this paper, Patrice, Linda, and Carol, as well as with undergraduate students. It has been a fascinating process for Patrice, Linda, Carol and me to get as far as we can with a particular triad and then to observe the students pick it up and take it forward to places we couldn’t have done ourselves. Given that SenseMaker is a methodological approach that is designed to characterize complex, social systems, I don’t think it’s a coincidence that learning about SenseMaker is also best done *in* a social system. Of course, I still have some outstanding questions about SenseMaker. I am still not entirely sure about how
a particular signification framework, compared to another, might limit the value and usefulness of the data collected. I’m also unsure about some aspects of the data processing to produce various visualizations, and about the time entailed to engage participants in the system in the design and implementation of safe-to-fail probes. I also have questions around how such a participatory approach might lend itself to the reward systems that are currently recognized in academia, like publications and grants. But I am excited at the prospect of “giving it a go,” making lots of mistakes, and seeing what might come of this very different way of doing research and creating change in engineering education.