



Narrative Analysis in Engineering Education Research: Exploring Ways of Constructing Narratives to have Resonance with the Reader and Critical Research Implications

Dr. Nadia N. Kellam, Arizona State University

Dr. Nadia Kellam is Associate Professor in the Polytechnic Engineering Program at Arizona State University. Prior to this position, she was an Associate Professor at the University of Georgia, where she was co-director of the interdisciplinary engineering education research CLUSTER. In her research, she is interested in understanding how engineering students develop their professional identity, the role of emotion in student learning, and synergistic learning. A recent research project uncovers the narratives of exemplar engineering faculty that have successfully transitioned to student-centered teaching strategies. She co-designed the environmental engineering synthesis and design studios and the design spine for the mechanical engineering program at UGA. She is engaged in mentoring early career faculty at her university and within the PEER National Collaborative. In 2013 she was selected to be a National Academy of Engineering Frontiers of Engineering Education Faculty Member.

Karen Sweeney Gerow, University of Georgia

Karen Sweeney Gerow is pursuing her PhD in the Lamar Dodd School of Art at the University of Georgia. Her research interests include STEAM (Science, Technology, Engineering, Art, and Math) education, narrative inquiry, and interdisciplinary studies. She is also the founding director of the Double Helix STEAM School in Athens, GA.

Dr. Joachim Walther, University of Georgia

Dr. Walther is an assistant professor of engineering education research at the University of Georgia (UGA). He is a director of the Collaborative Lounge for Understanding Society and Technology through Educational Research (CLUSTER), an interdisciplinary research group with members from engineering, art, educational psychology and social work.

His research interests range from the role of empathy in engineering students' professional formation, the role of reflection in engineering learning, and interpretive research methodologies in the emerging field of engineering education research.

His teaching focuses on innovative approaches to introducing systems thinking and creativity into the environmental engineering program at the University of Georgia.

Narrative Inquiry in Engineering Education Research: Exploring Ways of Constructing Narratives to have Resonance with the Reader and Critical Research Implications

When engaged with engineering education research, whether it was quantitative or qualitative, I often found myself with this nagging feeling that something important was missing. Many of the common research methods used within our community involve breaking down data into smaller pieces, e.g., codes and categories, or numbers of occurrences. It seemed to me that something more was within the data but was not surfacing during the research project. As a researcher, I felt as if I was not accessing the full potential of my research project.

While working on a research project exploring the role of creativity in a transdisciplinary art and engineering context, I realized that we were missing the story. The pre and post quantitative data indicated that students were more creative after engaging in the transdisciplinary design studio¹ and the qualitative data supported this outcome with focus groups and written reflections that were analyzed using phenomenological approaches.² I took some of the previously collected data and tested the idea of using narrative analysis as a way of uncovering important stories that could have strong implications for the research study and for the readers.³ Narrative analysis promised to be powerful in helping us make sense of complexities inherent in engineering education systems and in resonating with the consumers of our research.

My sense that we were missing the story is reflected by Damasio's explanation of what storytelling accomplishes. "The problem of how to make all this wisdom understandable, transmissible, persuasive, enforceable—in a word, of how to make it stick—was faced and a solution found. Storytelling was the solution—storytelling is something brains do, naturally and implicitly... [I]t should be no surprise that it pervades the entire fabric of human societies and cultures."⁴ If storytelling is something that we do naturally and implicitly, why not use this to our advantage when designing research studies? These stories can be used as a genuine way to capture the inter-subjective realities of our study participants. It makes sense for us, as engineering education researchers, to analyze these stories and to construct stories that emerge from our data for further analysis. Narrative inquiry also promises to have a greater impact on practice, as stories are such an effective way of communicating to others and helping consumers of our research become absorbed in our research participants' stories. In this paper, we explore different variations of constructing narratives and the implications that these narratives have on our research projects.

Background

Narrative research methods are gaining popularity across diverse disciplines and are starting to be adopted in engineering education research projects.^{3, 5-7} Many commonly used research methods in engineering education, such as grounded theory and phenomenography, involve coding and categorizing data; and while this is useful in many contexts it does not capture the complex, nuanced, and distinct identities of the participants that can resonate deeply with the reader and lead to different types of insights during analysis. Narrative research provides a way to understand data by keeping stories intact during analysis (i.e. analysis of narratives) or by constructing narratives based on the data that is then analyzed (i.e. narrative analysis).⁸

Narrative research methods enable researchers to keep the stories of their participants intact while conducting research on complex phenomena and then generate theory to explain the complex phenomena. Within the qualitative realm of engineering education research, researchers have become competent with fragmenting data into smaller parts, but some have begun to struggle with how to capture the emergent properties of the larger, complex system. Narrative research methods offer a way to capture the essence of the larger system.

Below, we will provide an overview of thematic, structural, and constructed narrative analysis methods.^{8,9} Thematic analysis focuses on what is said in interviews or the content of the interviews, structural analysis focuses on how the narrative is told, including the sequence of events, and constructed narrative analysis involves constructing narratives based the data of single or multiple participants and then developing theories based on these constructions.^{8,9} These narrative analysis methods are not simply a different way of presenting qualitative data, but a different way of conducting qualitative research that changes the research process from collecting the data to disseminating the results.

Thematic analysis focuses on the content of interviews or other data sources and answers the question, what? Thematic analysis involves the identification of themes within a specific case. Prior theory informs this analysis and, specifically, the development of themes. The case is kept intact through this analysis and theory is developed from the specific case. In thematic analysis, it is common for the context of the narrative to be excluded. This type of narrative analysis most closely resembles commonly seen write-ups of findings from qualitative research studies in engineering education, but it is important to note that thematic analysis is significantly different from grounded theory in which themes are developed and compared across the cases, because the narrative is kept intact throughout the analysis.^{8,9}

Structural analysis focuses on the structure of the interview and reveals how the story is told.⁸⁻¹⁰ Structural analysis reveals insights that are missed when focusing simply on the content of a narrative. Structural analysis can occur at a more macro-level, where the researcher looks at the structures commonly found in a story: an abstract, orientation, complicating action, evaluation, resolution, and a coda.^{9,11} An alternative way that researchers conduct structural analysis is at a micro-level where attention is paid to the units that a participant uses in their speech. This method involves closely listening to audio recordings to understand how the story is told, with every utterance and pause, and then parsing out stanzas as the basic structural unit of the narrative.^{9,12}

Constructed narrative analysis (also known as narrative analysis, while thematic and structural analysis are considered analysis of narratives) involves creating explanatory stories based on the events from the narrative data.⁸ In constructed narrative analysis, the researcher moves from events to stories, where in the previously discussed thematic and structural analysis the researcher moves from stories to common events and themes. Constructed narrative analysis is important as it develops a holistic account out of individual events, bringing order and meaning to data and events.^{8,9}

In thematic and structural analysis methods, the researchers begin with the narratives of the interviewees and break the narratives down into events, themes, or structural parts of a story, while in constructed narrative analysis the researchers begin with events from a single source or multiple sources and then construct a coherent story that explains the events that they uncover. In this paper we will provide examples of two variations of constructed narratives and a thematic narrative analysis to explore the methodological implications of the types and variations of narratives that are commonly used when conducting narrative research.

In a similar exploration of constructed narratives, Coulter and Smith applied common literary elements in fiction writing to narrative research—point of view, person, omniscience, narrator reliability, narrative voice, and authorial distance.¹³ These elements are helpful to think of as we move through each of the constructed narratives in this paper. One of the first considerations when constructing a narrative is related to person—who is going to be telling the story? Is the narrative going to be in the voice of the research participant and constructed based on interviews and observations of the participant? Or is the narrative going to be in the voice of the researcher? Another consideration is narrator reliability—how are the researchers going to represent the narrative of the participant? Identifying direct quotes in the narrative is one way to increase the level of trust that the reader has in the narrative construction. Authorial distance refers to the time between the event and the time of the writing. Typically researchers choose to take more distance between the event and the time of writing to give more credibility to the research—it looks as if the research is more objective if there appears to be more distance between the events that are being described and the current time. However, in narrative research it can be quite impactful to have less authorial distance between the event and the time of writing—this can help envelop the reader into the narrative and really begin to experience the story as the research participant.¹³

Methods

In this methods paper we are exploring the implications of research decisions when making or handling data.¹⁴ This is part of a larger study in which we were exploring the role of emotion in engineering student learning. In the study we performed 21 narrative interviews that lasted 45-90 minutes each with undergraduate students across engineering disciplines and ranging from year one to year five in their engineering program. Participants were recruited through an email listserv and fliers posted in the engineering building and those that participated in an interview were provided with an amazon gift card as an incentive. The research team working on this project and conducting narrative interviews includes all of the co-authors on this paper and research assistants Gregory Wilson and Chad Steacy.

The purpose of this paper is to explore ways of constructing narratives to be used for narrative analysis and the methodological implications of these narratives. Our research question is:

How do different ways of constructing narratives capture and convey the inter-subjective reality of the participant, have resonance with the consumer of the research, and have methodological implications for the larger research study?

Three narratives were constructed using our common data set and were based on the same interview to make them easier to compare and contrast. The first narrative is a constructed narrative and is in first person, using direct student quotes whenever possible, and included

connecting words and phrases as needed to make the story coherent. The next constructed narrative was also in the first person and was based on the same interview without using direct student quotes, where attention was paid to crafting a story that involved the protagonist having a goal and responding to events. The final narrative was a thematic analysis of a narrative and was told from the researcher’s perspective with direct quotes (see Table 1 for a summary of these narratives). After each of these narratives was constructed, each narrative was analyzed independently to determine the methodological implications and types of impact of each type of constructed narrative.

Table 1: Summary of narrative types

Narrative	Type of narrative	Point of view	Narrator reliability	Authorial distance
#1	Narrative construction with direct quotes	1 st person	Medium	Low
#2	Narrative construction	1 st person	Low	Low
#3	Thematic analysis of narrative	3 rd person	High	High

Results

In the results section we will first describe how each narrative was constructed, then provide the entire narrative, and finish with an analysis of the narrative. A discussion will follow this section that will more comprehensively answer our research question.

Narrative 1—Constructed narrative, third person with quotes directly taken from interviewees’ responses

This constructed narrative was written by co-author Karen Gerow. This analysis involved multiple passes of the data. In the first pass, Karen listened to the recorded interviews. After the interviews were transcribed, she checked the transcriptions for accuracy. She then used the emotional trajectory that emerged out of a prior analysis and selected three interviews to uncover how the trajectory aligned with the lived experiences of the undergraduate students. She constructed three narratives based on three interviews in order to be responsive to the multiplicity of experiences. In these narratives, most of the narrative is extracted directly from interviewees’ responses; extra text was used for setting and clarity of the narrative and is denoted with italics. Below is one of these constructed narratives based on an interview with Jake, a fourth year agricultural engineering student with an emphasis in structural engineering.

Growing up I always had a knack for figuring things out or fixing things. It was always simple things like Legos, or Lincoln Logs, or anything like that. An uncle of mine is an engineer, on my dad's side of the family. My granddad always told me, "Oh, you're going to be just like him, you're going to be an engineer."

We were always in the shop, always building. When we went to the house, besides fishing or hunting, we were in the shop building something. I always had the smaller *job*, tinkering, just grab two blocks of wood and see what you could build. Then, my other

granddad got me into Legos and K'NEX and stuff like that. My dad and mom both said you could sit me down in a room with anything, a remote control, and I'd take it all apart and put it back together just to see. I always figured *out* that aspect of it. I was always a problem solver: *if* something is broken, let's fix it. I always enjoyed that. I think a huge part of engineering is just being a problem solver.

I never put any thought to *what I wanted to be* until senior year. I was good at two things, science and math. *When I started college*, I *decided* to do structural *engineering* just because that was what *my uncle* did and what I was used to, building things and tinkering. I figured that was more geared toward it.

So that's how I ended up here. I guess looking back, that first introduction class was a big pool. It was, yeah, this is cool, you decided what you want to do and I think you're going to like it. *But then* I took MATLAB that year. MATLAB was just not my thing. I just was real quiet, sat in the back. Really I just went through and did what I had to do to get out and didn't enjoy it that much. I *still* feel like I *will* never use it. I haven't ever heard of anyone using it. Even when I did the job experience, we never did anything like that. It was all hand calculations. MATLAB really was, well, at least now I know I don't want to do any coding. I feel like some of the classes are there to tell you what you don't want to do and some of them are *to show you what you do want to do*.

Other early classes caused more stress. I hated Calculus. Physics was awful too. I actually got to a point in physics I was doing *so* horribly I was like, "I can't do physics, I can't do Calc. I can't be an engineer. The only class I'm making an A in is the engineering psychology class." *Everyone said*, "Oh, this [engineering psychology] is an easy freshman class." I was like, "If this is an easy class and I'm barely getting an A in it, I can't go to college." All these thoughts go through your head when you're freaking out.

I think my biggest thing coming in was I didn't know how to study. I mean, I always made A's in everything, it came so easy. I just didn't know how to study.

So I talked to my mom on the phone and she was like, "You've never given up on anything. Don't give up." I was like, "I'm not giving up, I just can't do it." She's like, "I don't want to hear that. I'm not listening to I can't." That was huge. I'll never forget that.

Then one day, it dawned on me. It was like, "I got through. I'm fine. I got what I needed to do and I'm okay." Now it's like, "Oh, I've got a test on Thursday? I'll go study, I'll be fine, regardless of what happens." I mean, if it goes wrong you can always recover. Even now, I still strive to do well, but *early on* it was so much piled on you with one grade could change your *scholarship* average by an entire letter grade. Now, I've got so many hours that it's just like, I got all A's last semester *and my GPA goes up* .001.

Freshman year was really rough, but I mean, once you get through it it's fine. I think you just have to put in the work, number one, and number two, you have to keep your head straight. No matter how much you freak out, you can't give up.

I think after I started settling down and started getting used to studying, I started using more resources that were there I just didn't know about, *like* office hours for professors. I never went the first couple classes or semesters. Never went, never knew anything about ... I mean, I knew people went, but I was like, "I'm not going to go sit in my professor's office for two hours. I've got stuff to do." *I didn't realize* you get tips from *them*: For this class you should study like this. At that point, *I realized*, they teach this class; they teach the material; they make the test; they obviously know how you need to study for it. Once that clicked it was like, I know I can go talk to them, I know I can study, and I know it will help me.

I feel the professors here are a lot more personable *than in other departments*, a lot more helpful. It really motivates you. Even if you don't like a class, if you can go sit down with a professor and learn more about it, then you start *thinking*, this is cool, I see how *it works*. I mean, I think the biggest part of frustration comes from *when* people say, "I hate that class." But they don't really hate the class, they just hate it because they don't know what they're doing. When you look at a class and go, "I hate this class", nine times out of ten I feel like you're going to do worse just because you're not motivated. When you like a class you do a lot better.

The biggest eye opener and greatest experience I've had here as an engineer *was the* co-op I did my sophomore year. I love talking about it, honestly. It's been the best thing I could have ever done. It was full-time for two semesters. I got to do so many things. I was nervous going in because I was like, "I'm a structural engineer. This is process and mechanical. I don't know if I can help you." I ended up doing a lot of process engineering, a lot of mechanical, a lot of pumps and piping, and even a lot of electrical work. I really do feel like I'm a completely different person after that. I was more involved; I was more socially outgoing. I think I grew up a lot. Just learning *and* doing new things, but mostly just in the sense of being a working person. Yeah, you'll learn all the math and science here, but you have no clue of interaction with coworkers.

The biggest thing *I learned* was *that*, especially in a manufacturing environment, if you go down there and tell a process operator to do something, he's going to look at you like, "What is this kid telling me what to do for?" But if you'll go down there with him and get in the hole with him and dig out some mud, that guy's going to respect you no matter what. You're willing to get down there and do it. I learned from *my boss* that it's not a big deal to go get covered in mud. You can *always* change later but that *process operator* is going to respect you a lot more for it. After *learning* that, I started noticing things. I'd call down there and say, "Can you check so and so for me?" *And they'd say*, "Yeah, I'll get you the numbers right up." They'd send you a spreadsheet. Whereas, if you ever ask that *of somebody else who hasn't seen you get in the mud*, you could tell *the difference*. They'd write it on a sticky note and walk down there and hand it to you, you couldn't even read what it said.

It was probably the best experience of my four years here. I realize *now* that college is a lot more about, not necessarily what you learn in class but what you do outside of class.

In this narrative, the reader gets a clear idea of what was said by the participant. In many ways this has a lot of resonance with the reader—the reader engages in a coherent story of the participant that is in the words of the participant. It is close to the social reality that is being investigated in that it describes Jake’s perspective of that social reality using Jake’s words. The narrator reliability is increased with the use of direct quotes. The transitions between sentences and paragraphs are rough and less polished, but in some ways this gives validation to the story being constructed from the words of the interviewee. It is a cohesive story that resonates with the reader, in that it is believable and tells the struggles of an engineering student as he becomes an engineer.

The priority of this narrative construction style is to maintain the fidelity of the interviewee’s story by relying almost exclusively on direct quotes. As such, the researcher must employ an editorial role by selecting which of the tangential details in the story need to be preserved. One example from these narratives is the omission of Jake’s decision to major in Pharmacy when he first entered the university. Below is the original interview data:

Jake: I've always been a huge [University name] fan, loved the school, loved the area. We used to come up here to games all the time, so I was like, "I'm definitely going there." I don't want to be in [nearby large city], I don't want to go to [nearby university with engineering], I want to go there. That was why I started thinking, "Well, what else would I do? They don't have an engineering school." I said pharmacy.

Interviewer: That was the pharmacy, were that came in.

Jake: Yeah. That was where that came up because I knew several people from back home that had done it. Once I got here and looked into a lot of the majors they had, it was all within a couple of days I was just like, "This is what I want to do." My parents were like, "How did you go from pharmacy to engineering?" That's the story I tell everybody, is just well, growing up that's all I did.

The language Jake used to describe the process (“That was where that came up.” “How did you go from pharmacy to engineering?” “That’s the story I tell everybody, is just well, growing up that’s all I did.”) was vague and would have required liberal use of the researcher’s language to clarify the meaning. As Jake changed his major to engineering as soon as he became aware of the program’s existence, the researcher considered this detail tangential to Jake’s overall narrative. Rather than construct Jake’s brief dalliance with pharmacy using her language, the researcher chose to omit this portion of Jake’s narrative.

In the second constructed narrative, which relies less heavily on direct quotes, the researcher was able to condense the essence of the pharmacy storyline so that it fit the narrative without distracting from the overall story:

“I was accepted early at UGA, but didn’t know that they had an engineering program so I decided to major in Pharmacy. When I arrived I learned that engineering was an option so I changed my major to engineering immediately.”

Narrative 2—Constructed narrative, first person, direct quotes are not differentiated

Co-author Nadia Kellam constructed this narrative. This constructed narrative also involved multiple passes of the data, including listening to the audio recordings of the interviews and reading through the selected interview multiple times paying attention to events. The interview with Jake was selected to allow us to compare the results to the other narratives in this paper. Lessons on crafting a story from *Wired for Story* by Lisa Cron were used to help construct this narrative.¹⁴ In her book, Cron explains that a story must involve a protagonist who has a clear goal; the story must follow a cause-and-effect trajectory throughout the narrative, the protagonist must be tested on his or her journey towards the goal, and everything that is included in the story must be on a need-to-know basis. The protagonist reacts to events and, when writing in the first person, everything is filtered through that protagonist. To construct this narrative, events were coded within the transcript and were then used as the foundation to construct this narrative. This is also known in the literature as a critical incident constructed narrative technique.¹⁵

It is important to note that this narrative was constructed using Jake's direct quotes in some cases, but the direct quotes are not differentiated from the words that were crafted in the story. The intended focus of this narrative is on the story itself. Below is the narrative:

It's no surprise that I am in college working on my structural engineering degree to anyone in my family. Growing up I always had a knack for figuring things out or fixing things. An uncle of mine is an engineer. My Granddad always told me, "Oh, you're going to be just like your Uncle, you're going to be an engineer."

As a kid you could always find me in the shop with my Dad and Granddad—always building something. They would be working on a bigger project and I would entertain myself by tinkering around with things. I'd grab two blocks of wood and see what I could build. My Granddad saw how I liked to build things and gave me Legos and K'NEX kits to encourage me even more.

I love fixing things. If something is broken I take it apart, figure out what is wrong, and fix it. I remember once our remote control didn't work. I took it all apart and put it back together. It wouldn't have surprised me if it didn't work, but when it worked I was so proud. I always wondered if my parents didn't like me taking everything apart. Occasionally things would never work the same again.

During my senior year of high school I had to decide what I wanted to major in for college. Even though my Granddad always told me that I would be an engineer one day I never took him seriously. When my advisors told me that since I was good at science and math I should major in engineering I considered their advice. I was accepted early at UGA, but didn't know that they had an engineering program so I decided to major in Pharmacy. When I arrived I learned that engineering was an option so I changed my major to engineering immediately. I decided to do structural engineering because that was what my uncle did and what I was familiar with—building things and tinkering. I thought I was more geared towards structural engineering.

I was excited about going away to college and majoring in engineering. I thought it would be cool--I finally figured out something I was good at and that I would actually like. Everything was great until I took my first engineering course, Matlab. I thought engineering school was going to be different than this class. I was quiet during class and sat in the back. I just did what I needed to do to get through it.

I thought engineering would be fun. And then I ended up in this class that seemed like a complete waste of time. I was sure that I would never use Matlab again. The only thing that I learned is that I don't want to do any coding. This was one of those classes that helps you understand what you don't want to do—at least that was what this class was for me. I'm just glad I didn't give up on engineering as a major then.

I never went to any office hours. Why would I want to go sit in my professor's office for two hours? What is the point of that? I had more important things to do.

I stayed in engineering and was hopeful that the classes would get better. I was wrong. I ended up in Calculus, which I hated. Physics was awful too. There was a point in Physics where I was doing horrible and started to wonder what I was doing as an engineering major. I can't do Physics; I can't do Calculus, what makes me think I can do engineering? At that point I had one class where I barely had an A—an engineering psychology class. This was the class that everyone said was easy. If this is the only class that I barely have an A in, maybe I shouldn't even be in college. I really started freaking out.

I was ready to give up. I remember calling my mom and telling her my plans to quit. She told me that I had never given up on anything and to not give up now. I was annoyed—I wasn't giving up I just couldn't do the work. I didn't belong here. She told me that she didn't want to hear me say that I can't do anything. She was right. I'll never forget that conversation—I was ready to quit and she was the voice of reason.

After almost dropping out I continued to take classes. I managed to calm down a little bit. I would tell myself that I can do this. I had already gotten through it this far. I'd be fine.

I finally figured out that I was missing out on a lot of resources that were available for me. Office hours are one example—if I went to office hours I could get tips from my professors. They would help me understand how to prepare best for tests. I mean, they teach the classes—of course they know how best to study. It seems so obvious now. Now I always go talk to my professors. I know how to study and I know that they actually want to help me.

One day I saw a professor in the hallway and he encouraged me to apply for a co-op at the meet-and-greet that day. I was only a sophomore and wasn't prepared for the meet-and-greet but went because my professor encouraged me. I ended up being selected for a co-op and learned so much during it. I worked full-time for two semesters and feel like I'm a different person because of the experience. At first I was nervous because I only thought I could help with structural engineering—but I ended up doing lots of process

and mechanical engineering. I worked with pumps and piping and even some electrical work. I learned so many new things. I went in thinking that my math and science in college were the most important but I realized when I worked that the interaction with my coworkers was even more important. I learned what it meant to be a working person.

Now I really like encouraging people towards doing a work experience—I even gave a talk one time at a co-op meeting and lots of the students asked me questions afterwards. I would tell them that at work I felt a bit like a big shot—it was like I wasn't even in school anymore. It has been cool to give back and encourage other students to do co-ops. A lot of people probably shied towards doing one because of my advice and after hearing about all of the stuff that I got to experience when I was working. I was worried that people would get tired of hearing me talk about how great it was but they keep asking. I really feel like I learned more in that summer than was ever possible.

Now that I'm back in school I don't worry too much about tests. I study and try to be prepared and now I know it isn't the end of the world if I don't do well. I can always recover. I still try to do well. It does help that now my GPA isn't that affected by one grade in a class. Will I make it through engineering school? Absolutely. Now I finally feel like I belong.

This constructed narrative is a more polished story than the first constructed narrative. It will likely resonate well with the reader but may not be as believable as the earlier one that consisted almost entirely of direct quotes. This narrative is close to the reality being explored, but does depend on a certain amount of trust that the researcher is capturing this reality and not just focusing on writing a good story. A combination of this method of constructing a narrative (focusing on elements of good story construction and critical incidents) while using direct quotes from the interviews may be a better way to both have resonance with the reader and to accurately and convincingly represent the social reality that is being investigated.

Narrative 3—Thematic analysis of a narrative

Co-author Nadia Kellam also wrote this thematic narrative. This narrative was written in the third person as the researcher describes her analysis of Jake's story. This narrative includes analysis and discussion as the narrative unfolds. This narrative was written after the above narrative was written and involved multiple passes of listening to the interview, reading through the transcript many times, and reviewing the events that were identified in the previous analysis. It is important to note that the analysis that happens within this narrative would happen in constructed narratives 1 and 2 but would be included in later sections of those papers.

Jake is an agricultural engineering major in his 4th year at school. Jake's narrative starts when he was young. He was an inquisitive child who enjoyed making and tinkering—he loved taking things apart and figuring out how things work. He never really thought that he would be an engineer; he thought he would play sports. He did, however, have multiple exposures to engineering as a child--his uncle and friend's dad were engineers and he attended an engineering conference. Throughout his childhood his granddad often told him he would be an engineer, "He was always just like, 'Oh, you can figure anything

out. You're going to be an engineer. You can fix anything, build anything.” Later in the conversation he describes some of his other early exposure to engineering, during a conference he attended when he was in middle school,

Like I said, the guys that came in and talked were engineers and I was just like, ‘Oh, yeah. My granddad always said that I was going to do that.’ It started getting-I think subconsciously it built as a career, but I didn't know it. Every time it was brought up, it was like, ‘Oh, yeah, I could do that.’ Then, it never actually dawned on me until, like I said, I started thinking about where I was going to go, what I wanted to do.

As he was growing up, he had this constant exposure to engineering and people around him giving him confidence and telling him that he would be an engineer one day. Even though he did not decide that he wanted to be an engineer until he started college, he does admit that it was subconsciously built as a good career option for him. Throughout this period his emotional state is positive with emotions such as happy and enjoyment, and these types of emotions are associated with self-regulated learning¹⁷ which aligns with his inquisitive nature during this part of his life—with much of his time spent tinkering and building.

When he went to college, things quickly began to change. His positive emotions and outlook on his life changed to negative emotions of frustration, intimidation, nervousness, and negativity where he began to lose confidence in himself. “Pretty much just my entire freshman year was a freak out year because I freaked out about everything.” Throughout his narrative he repeats the words ‘freaking out’ and ‘hated.’

It was the same way with freshman engineering class for calculus. Hated Calc. I was like, ‘I chose the wrong major because I hate math.’ Physics was awful, too. I hate physics. I'm glad I didn't do chemistry because I hated freshman Chem. I mean, I couldn't stand it. After that, I was like, ‘I hate chemistry, I don't want to do pharmacy.’ I actually got to a point in physics I was doing horrible. I was like, ‘I can't do physics, I can't do Calc. I can't be an engineer.’

This experience of being sad and frustrated aligns with Carver and Scheier's control-process model of self-regulation, which suggests that emotions are impacted based on whether or not a person is moving towards their goal.¹⁸ In this case, Jake perceives that he is not moving towards his goal of becoming an engineer and therefore experiences frustration and anxiety. According to the control-process model of self-regulation, the person reflects on their situation and decides whether or not to continue to work towards their original goal. During this assessment they explain that the person, Jake in this case, relies heavily on memories of prior experiences. During this assessment, Jake talks to his Mom and Granddad and they remind him of past experiences where he never gave up.

They always just, like I said, my mom was always like, "I swear, you can give him anything and he can figure it out." My granddad still says that now. Even if I—I called him the other night on his birthday and said, "I had too much going

on. I was freaking out. I had this going on." He's like, "Ah, you always figure whatever out." There was always a confidence that if something was messed up or broken or something, somehow "Jake could figure out how to do it."

These interactions and reflections led to a renewed effort of moving towards his goal of becoming an engineer. If Jake had not had these positive prior experiences and his Mom had not pointed out some of these prior experiences, he may have not continued towards his goals of becoming an engineer.

It was rough. Like I said, freshman year was really rough, but I mean, once you get through it, it's fine. A lot of people handle it and a lot of people don't handle it. I mean, my roommate's girlfriend now, she did the same thing. She took all the classes I took, had trouble with them, but I guess she was going to veterinary. She freaked out, she couldn't handle it. She ended up, she's at [community college] now. It goes either way. I think you just have to put in the work, number one, and number two, you have to keep your head straight. No matter how much you freak out, you can't give up.

Jake's roommate's girlfriend was in a similar situation to Jake. She also perceived that she was not moving towards her goal of earning an engineering degree and then becoming a veterinarian. According to the control-process model of self-regulation, while she reflected on her situation, she was influenced by her previous experiences which were possibly more negative than Jake's, or perhaps she simply was not reminded of the positive ones by her support network. She may not have had the social support structure in place that Jake had to help identify these positive cases at this critical juncture in her education. Whichever the case, this resulted in her deciding to abandon her original goal of becoming an engineer.

As Jake continued into his second semester his emotional state began to transition away from the high activation, negative valence emotions of frustration and anxiety to low activation emotions of calmness.

Second semester I started calming down because I realized I freaked out so much and I still ended up, I think I got one A and all B's that semester. I was fine, I still had a 3.1 and I had to have a 3.0 for HOPE [scholarship]. I was on the verge. I am really close, made it by the skin of my teeth, but it worked out.

He began to broaden his support network by making friends and he began to figure out some of the resources available for him, which made school easier. Things did not seem to be as dire to him, but he describes going through the motions of school when a professor encouraged him to attend a co-op meet and greet. He attended and as a result of this ended up with a co-op position at an engineering firm in Athens. This is when his emotions took a complete turn and he began to be excited and engaged and very passionate about engineering.

At this point now, I'm open to a lot of things because of the fact that I took a co-op my sophomore year with [Engineering Company] here in [city]. That was the biggest eye opener and greatest experience I've had, I think, as an engineer here. I tell people that all the time and try to get other people to do it. I mean I got to do so many things.

Working for two semesters in a co-op was a turning point for Jake. His confidence returned and he had a positive outlook about engineering. He began to see himself working towards his goal of becoming an engineer—building his professional identity as an engineer.

I was nervous going in because I was like, "I'm a structural engineer. This is process and mechanical. I don't know if I can help you." I ended up doing a lot of process engineering, a lot of mechanical, a lot of pumps and piping, and even a lot of electrical work... I mean, like I said, I've had experience doing just about all of it so I feel comfortable saying that I can, at least from the classes I've taken and the work, that I can probably do, I won't say any of it, but to have at least some knowledge for everything.

In this quote Jake describes his transition from not having much confidence and being nervous about whether he was qualified to do the job to being confident and comfortable that he can do whatever engineering job he puts his mind to. His professional identity begins to develop as he tells stories from his co-op experience. Towards the end of his co-op experience he became the only person that was familiar with some of the processes. He began teaching the full-time replacement because he was the only one with the expertise in that area.

It was great. I was, like I said, scared to death but it worked out fine. After they got the guy to replace Cory; that was the one I had to teach. It was weird. This guy is full-time; I'm in college... You're salary out here and I'm a co-op telling him what to do. I mean, like I said, it was always a respectful thing, but it was just so weird. That was the scariest thing. They're going to be like, "This kid, he doesn't know what he's talking about. He's a kid. What does he know?" That was the greatest thing about it was it was not like that at all. I was really grateful that they respected me enough to say, he's done it, he knows what he's talking about.

In this story he started being 'scared to death' a negative valence, high activation emotion to becoming very confident and describing the co-op experience as being the best experience during his time in college—describing a positive valence, high activation emotional state. Now he is in a state where he is moving towards his goal of becoming an engineer. Throughout these latter stories, Jake's emotions are positive valence and high activation. He found his confidence again and then when he returned to school had a different perspective that allowed him to continue to be positive about his experiences.

A lot of people, I feel like, I mean, I'm not saying it was anything to do with me, but I feel like a lot of people probably shied towards doing it [co-op] and learning,

and wanting the work experience just because they heard how many great things that I did. I got to do all kinds of stuff. I feel like I grew up more in that summer than I have throughout anything so far--I mean, it's just amazing. I really do feel like I'm a completely different person after that.

Now he is confident and sees himself as an engineer. He returned to school as a different person from when he left—a confident person who is clearly on a path to becoming an engineer.

In this thematic analysis, there is a shift from the perspective of the interviewee to the perspective of the researcher with quotes from the interviewee. This has advantages in that the analysis is included within the narrative. There is a greater narrator reliability as the narrator is the researcher. The reader is exposed to the story of the interviewee and then immediately with the researcher's understanding of what is happening in the story. This narrative gives the researcher a more prominent voice and has a more authoritarian tone to it, though it takes control of the story away from the participant. There is a greater authorial distance in this story as the researcher is recasting the story of the participant.

Discussion

In this methods paper, we have explored the implications of different ways of constructing narratives for narrative inquiry projects. In all of the narratives the researchers took many passes through the data with the first being to listen to the audio file soon after the interview took place. The transcripts were then checked by a member of the research team, and then read and re-read with different goals for each reading. The first passes through the data involved becoming familiar with the data. Later ones involved the researcher identifying emotions present in the data or identifying events and critical incidents present in the transcriptions. This iterative process helps ensure quality of the results and deep engagement with the data. There were also weekly discussions of the interviews with the research team.

The purpose of this methods paper is to begin a critical dialogue about the implications of researcher choices during a research project. Many times researchers make a critical decision and may not realize the extent of the implications that this decision can have on the overall research project. The quality typology is a helpful tool to help us, as researchers, begin to think more deeply about quality not as something that can be decided at the end of a project, but something that must be considered from the inception of the project and throughout the research process.¹³ In constructing these narratives we want to ensure that we have validity and reliability. In ensuring validity we are considering how closely our narratives are aligned with the social reality as experienced by our interviewees. We are communicating these narratives to our reader and want to ensure that we are accurately representing the social reality of our participant. This communicative validation comes in two forms as the researchers are representing and grounding the narratives in the data from the interviewee and in demonstrating that there is alignment between the interview data and the narratives that are constructed (or the analysis of narratives as in narrative 3).

There are some substantial differences between these narratives and these differences have significant implications for the research study. One of these differences is that the third narrative is an analysis of a narrative while the first and second narratives are considered narrative analysis. In the thematic analysis (narrative 3), the researcher is analyzing the narrative throughout the write up the narrative. This is a common format to see in engineering education research projects, especially in the write-up of the results, and helps guide the reader through the analysis while providing a view of what the narrative means, especially as it relates to the research questions and the theoretical framing of the paper. This gives a greater authorial distance to the stories being told, something commonly seen in engineering education research as it gives a greater perception of objectivity.¹⁴ The narrative analysis examples 1 and 2 involve constructing a narrative based on a single interview and then using that constructed narrative as data for the analysis.

Thematic analysis of a narrative is the furthest away from the traditional story or narrative. This type of analysis involves the researcher telling the reader what they should believe (or think or feel). In *Wired for Story*, Lisa Cron warns writers to avoid editorializing when writing a story. She explains that, “In a story, telling readers what to feel not only annoys them but pushes them right out of the story.” Admittedly, we are researchers, not storytellers, but if we are moving towards narrative inquiry because we want the readers to experience the story of our participants, then the thematic analysis of a narrative approach may not be well suited for these purposes. In the constructed narrative examples (1 and 2), a section in which the researcher analyzes the story and guides the reader in how to think about the story would follow the narrative while keeping the story intact and allowing the reader to come up with their own alternative interpretations of the story.

If one chooses to construct a narrative as in narrative 1, there are important implications for how the narrative interview is conducted. If the interviewer asks many clarifying questions and interrupts the participant while they are telling the story it can be harder to use direct quotes from the participant. During interviews, sometimes interviewers try to help the participant by finishing their sentence when they are struggling to think of a word—this results in an incomplete incident as recalled from the participant and forces the researcher to add words to the narrative to complete the event (as in narrative 1) or will render the data to be less usable (as in narrative 3).

In the thematic analysis example (narrative 3) the researcher and interviewee’s voices are mixed throughout the write-up. The researcher provides a summary of the story of the interviewee, possibly including direct quotes, and then provides an interpretation of this narrative. In this type of narrative there is more of an authoritarian tone throughout the paper with the researcher being the primary voice and the narrator’s voice being secondary to the researcher’s voice. In the constructed narrative examples (narratives 1 and 2) the interviewee’s voice is given a space without interruption within the narrative, and is followed with an interpretation of the narrative by the researcher. This allows the narrator an opportunity to present the experience-near constructs in their entirety while the researcher can provide an interpretation of the experience-distant constructs.¹⁹ This allows the researcher to empower and provide the interviewee an opportunity to share the story uninterrupted and in its entirety to encourage the reader to become immersed in the story.⁸

In the constructed narrative examples (narratives 1 and 2), the researcher and audience are listening first to the voice of the interviewee within the narrative and then situating this within research or comparing across narratives.²⁰ This is a significant departure from many methods common in interpretive engineering education research where the researcher looks for common codes, categories, and themes across an entire set of data. This gives the interviewee a voice that is then shared with the audience and the audience can think or feel based on the narrative of the participant instead of relying solely on the researcher to tell the audience what to think or feel about a particular interview.

In many narrative research projects, there is concern about the privacy of the interviewees. If the interviewee is from a vulnerable population or wants to be guaranteed to be anonymous a narrative that is constructed based on one individual could have a higher risk of someone being able to identify that interviewee. In this situation it may be best to either 1) construct a narrative that is a compilation of multiple interviews or 2) perform an analysis of narratives (similar to example 3) to ensure the anonymity of your research subjects. It should, however, not be assumed that the interviewee's do not want their story to be shared in its entirety. In Pawley's work, she found that many of the interviewee's wanted their story to be shared and their name to be associated with their story—this was an opportunity for them to share their story and feel empowered.⁵

In each type of narrative explored in this paper, there are strengths and weaknesses and these are captured in table 2. As we design research projects and begin to explore new research approaches, it is important for us to think critically about the decisions that are made throughout the research process. In engineering education interpretive research projects we typically use the interview transcription as the data source; however when using a narrative inquiry approach, we extend the 'data making' to also include the construction of a narrative, which is then analyzed for common themes or patterns and to develop theory.

Now that we have more deeply explored these types of narrative analysis, we plan to use a combination of the constructed narrative examples 1 and 2 for our larger research project. We will identify critical incidents in the interview transcripts, construct a narrative based on these incidents and use the participants voice whenever possible, and then analyze the narratives.¹⁶ One of the disadvantages to this type of analysis is that providing the complete constructed narratives with a conference paper or journal article results in longer papers than those typically seen in engineering education research venues. It may be necessary to share the complete narratives online to provide access to those narratives to remain true to the narrative research methods, while meeting paper length requirements.

There are research projects where the thematic analysis would better suited—this is dependent on the researcher, the research questions, and the overall goal of the project. Thematic analysis is less of a departure from methods more commonly seen in engineering education research such as grounded theory and may be more easily explained and accepted within our community.

Table 2 provides a summary of the narratives and strengths and weaknesses of each type of narrative. After going through this process of creating multiple narratives, we have uncovered

the best way for us to construct narratives for this larger research study. This is, of course, something for each researcher and research team to decide and this paper may help in that decision-making process.

Table 2—Summary table of each narrative, a description, and strengths and weaknesses.

Narrative	Description	Strengths	Weaknesses
1—First Person with Quotes	Constructed narrative with direct quotes when possible	<ul style="list-style-type: none"> • Credible • Increased narrator reliability • Reader becomes absorbed in the story • Memorable • Explicitly grounded in the accounts of the interviewees • Visible communicative validity (use of quotes throughout) • Interviewee’s voice is given priority 	<ul style="list-style-type: none"> • Messy, not as polished as others • Minor details may be omitted in order to preserve a more coherent narrative • A departure from accepted methods in engineering education research community
2—First Person, Polished	Constructed narrative with quotes not differentiated	<ul style="list-style-type: none"> • Not as credible as narrative 2, reader must trust the storyteller • Reader becomes absorbed in the story • Memorable • Grounded in the accounts of the interviewees • Interviewee’s voice is given priority 	<ul style="list-style-type: none"> • Researcher must establish credibility to ensure the reader that the story emerged from the data—there could be a concern that the story was given precedent and that parts of it were fabricated for the sake of the story • A departure from accepted methods in engineering education research community
3—Third Person, Researcher’s perspective with quotes from the participant.	Analysis of narrative, thematic analysis.	<ul style="list-style-type: none"> • Easy to read • Researcher’s voice is given priority • Analysis happens while the story is unfolding • Less of a departure from more accepted methods in engineering education research community 	<ul style="list-style-type: none"> • Reader does not get as absorbed in the story • Authoritarian tone

Conclusion

It was found that there are tradeoffs with each type of constructed narrative and in this paper we explored how different choices made by the researcher has significant impacts on the project. In conclusion, many people are beginning to conduct narrative analysis in engineering education and this paper deeply explores this methodology and will help others as they design and implement a methodologically sound narrative research study that promises to have strong resonance with the reader and critical research implications.

Acknowledgements

This work was made possible by a grant from the National Science Foundation (*Connected Ways of Knowing: Uncovering the Role of Emotion in Engineering Student Learning*; [NSF #1160350](#)). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation. The authors would like to thank the CLUSTER research group at the University of Georgia for their contributions to the development of this paper. Finally, the authors would like to thank Gregory Wilson and Chad Steacy for their work collecting data for this larger research project.

References

1. Costantino T, Kellam NN, Cramond B, et al. The synthesis of engineering and art for innovative education: Preliminary findings. In: American Educational Research Association Anonymous, Denver.
2. Walther J, Kellam NN, Costantino T, et al. Integrative learning in a synthesis and design studio: A phenomenological inquiry. In: Frontiers in Education Anonymous, Washington, DC.
3. Kellam N, Costantino T, Walther J, et al. Uncovering the role of emotion in engineering education within an integrated curricular experience. In: Proceedings of the 2011 American Society for Engineering Education Annual Conference and Exhibition Anonymous, Vancouver, British Columbia.
4. Damasio A. *Self comes to mind: Constructing the conscious brain*. New York: New York, 2010.
5. Pawley AL. "Learning from small numbers" of underrepresented students' stories: Discussing a method to learn about institutional structure through narratives. In: Proceedings of the 2013 American Society for Engineering Education Annual Conference and Exposition Anonymous, Atlanta, GA.
6. Pawley AL and Phillips CM. From the mouths of students: two illustrations of narrative analysis to understand engineering education's ruling relations as gendered and raced. In: Proceedings of the 2014 American Society for Engineering Education Annual Conference and Exhibition Anonymous, Indianapolis, IN.
7. Bird S and Kellam N. Teaching Journeys of Engineering Faculty: Stories of Transition. In: Proceedings of the 2013 American Society for Engineering Education Annual Conference and Exhibition Anonymous, Atlanta, GA.
8. Polkinghorne DE. Narrative Configuration in Qualitative Analysis. *International Journal of Qualitative Studies in Education* 1995; 8: 5-23.
9. Riessman CK. *Narrative Methods for the Human Sciences*. Thousand Oaks: Thousand Oaks, 2008.
10. Labov W. The Transformation of Experience in Narrative Syntax. In: Labov W (ed) *Language in the Inner City*. Philadelphia: Philadelphia, 1972, p.352.
11. Labov W and Waletzky J. Narrative analysis: oral versions of personal experience. In: Helm J (ed) . Seattle: Seattle, 1967.
12. Gee JP. A linguistic approach to narrative. *Journal of Narrative and Life History* 1991; 1: 15-39.
13. Walther J, Sochacka N and Kellam N. Quality in interpretive engineering education research: Reflections on an Example Study. *Journal of Engineering Education* 2013; 102: 626-659.

14. Coulter CA and Smith ML. The Construction Zone: Literary Elements in Narrative Research. *Educational Researcher* 2009; 38: 577.
15. Cron L. *Wired for Story: The Writer's Guide to Using Brain Science to Hook Readers from the Very First Sentence*, 2012.
16. Webster L and Mertova P. *Using Narrative Inquiry as a Research Method: An Introduction to Using Critical Event Narrative Analysis in Research on Teaching and Learning*. New York: New York, 2007.
17. Linnenbrink EA. The Role of Affect in Student Learning: A Multi-Dimensional Approach to Considering the Interaction of Affect, Motivation and Engagement. In: Schultz PA and Pekrun R (eds) *Emotion in Education*. Burlington, MA: Burlington, MA, 2007.
18. Carver CS and Scheier MF. Origins and Functions of Positive and Negative Affect: A Control-Process View *1990*; 97: 19-35.
19. Geertz C. From the Native's Point of View: On the Nature of Anthropological Understanding. *Bulletin of the American Academy of Arts and Sciences* 1974; 28: 26-45.
20. Chase SE. Narrative Inquiry: Multiple Lenses, Approaches, Voices. In: Denzin NK and Lincoln YS (eds) *The Sage Handbook of Qualitative Research*. 3rd ed. Thousand Oaks: Thousand Oaks, 2005.