

➤ **Dr. Streveler: Welcome to the Research Briefs podcast.**

I'm your host, Ruth Streveler coming to you from the School of Engineering Education at Purdue University.

The goal of Research Briefs is to expand the boundaries of engineering education research. In these podcasts we'll speak to researchers about new theories, new methods, and new findings in engineering education research.

My guests today on Research Briefs are Dr. Devlin Montfort, assistant professor in the School of Chemical, Biological, and Environmental Engineering at Oregon State University and Dr. Geoffrey Herman, teaching assistant professor in the Department of Computer Science at the University of Illinois at Urbana-Champaign.

I've had the pleasure, and it really is a pleasure, to work with Devlin and Geoffrey in past research projects and they developed a new approach to analyzing student transcripts called, "Novice-led thematic analysis." Sometimes we might lapse into calling this NLTA, but we will probably keep calling it novice-led thematic analysis, and that's what I'd like them to speak about today.

So, Devlin and Geoffrey, welcome to Research Briefs.

❖ **Dr. Herman: Hi. Thanks you, Ruth for having us.**

➤ *To start out as a bit of an introduction to the listeners, can you each briefly tell us a little bit about your pathway into engineering education? And, Devlin, would you like to start off?*

❖ **Dr. Montfort:** I think my primary pathway into engineering education was actually was due to another one of your guests I think. In my engineering undergrad education my Senior Design instructor was Shane Brown, and he kind of poked me in ways that were helpful. He didn't let me get away with things that other people did. It was interesting, and I wanted to work with him over the summer and we had a little waste water treatment project that fell through and he kind of said, "Well, I have this other stuff going on, do you want to try that?" And I did, and it was exciting, and reminded me of everything that I missed in the kind of purely engineering world; I'd been in for a while. So, I just kept doing that.

➤ *Cool. And, you were at Washington State then, is that right?*

❖ **Dr. Montfort:** *Yes.*

➤ *Yes, and so now you've moved a little bit south to Oregon State.*

❖ **Dr. Montfort:** *Just a little, yes.*

➤ *Just a little, and continuing to do engineering education research there, correct?*

❖ **Dr. Montfort: Yes.**

➤ *And so, Geoffrey, do you want to say a little bit about how you got into engineering education research?*

❖ **Dr. Herman: Yes, absolutely. So, my hard transition came in grad school when I was a TA for a course and was completely mystified by how students weren't learning from the excellent explanations and sheer brilliance in the classroom. So, I happened to be talking with another person who had been a TA for the course who was currently doing research with Michael Loui about what students find hard and why students struggle to learn computer architecture concepts. And, I pretty much emailed Michael within a few days and said, "This sounds really cool. I don't understand why students are struggling in my course; I'd love to learn more." So, I kind of began the process and then within a few weeks like I was working with Michael and Craig Zilles on projects. That eventually became my Ph.D. education developing assessment tools to measure students learning in the architecture and programming context.**

➤ *And that was at Illinois and you are still there, correct?*

❖ **Dr. Herman: Yes. I'm still here now.**

➤ *So, you didn't move a state over like Devlin did, but doing good work at Illinois.*

So, we want to talk again today about novice-led thematic analysis, so

first of all what is that? Geoffrey, I think you were going to be prepared to explain it.

- ❖ **Dr. Herman:** Yes, so novice-led thematic analysis shares many of the same underpinnings of thematic analysis and other qualitative approaches in that one of the core things that we're trying to do is to bring our biases and our entire beliefs out to the surface and to challenge our assumptions about what is happening in the minds and perspectives of other people.

And so, one of the things that kind of came out of it is that, just in terms of the method. What we found was that it was often very provocative to have a content-knowledge expert and a content-knowledge novice analyzing student transcripts as they're discussing and reasoning about problems in their domain. And the idea of why it is called *novice-led* is that the novice is the one who takes the reigns on saying, "Hey, here's what I think is happening. Here is what I think the interpretation is." And, it's really until the novice is satisfied with the interpretation, with the observations, with the coding, with the teams that we move on. That the expert has to take the back seat and not be the driver and saying, "Oh, well I think this is what's happening," and the novice says, "Okay, whatever."

And so, giving the novice that power really forced the dynamics to say, "Is what we are seeing here really born in the data or from our prior experiences in the classroom or whatever it might be?" And so that's a core of the framing of the method that we're trying to get to.

- *So, if I may paraphrase, and tell me if I'm getting this correctly then, the big difference between what you did and what another pair of people doing coding might be is that you were sure that there was a person that was much more naïve about the concepts than the other person was really the content expert. And that the person that was the novice was the one who had to be okay with explanation.*

- ❖ **Dr. Herman:** Yeah, and I think we tried to balance out, I don't know if the "power relationship" is the right word but just it's very easy to say like, you have the expert saying, "Well, this is what's happening." Then the person who had less content knowledge may feel like, "Oh, okay," versus saying, no, you as the novice have to be satisfied. And you have the right to speak up and challenge the content-knowledge expert.

- *I want to then bring up the next phase into this and explain to our listeners some more background about what this project was that you were working on and how this idea came about. And I think, Devlin, you were going to lead off with that.*

- ❖ **Dr. Montfort:** Yeah, the project was organized around studying conceptual change. I don't remember where the proposal idea came from but a key part of it was moving beyond a single course or discipline. A lot of conceptual change research, probably because of the depths of content area expertise needed, is focused on like the first half of physics, or just fluid mechanics with water and no other liquids; something like that. And, we wanted to look for broader themes to try and develop a theory or move toward solutions that are more than just kind of band-aiding particular

misconceptions.

So then, Geoffrey and I were kind of faced with the logistical problem of having a pretty big data set that one of us had gone through half of it. I brought my data and Geoffrey brought his data, and then there was some more. And, in early conversations we kind of got into the circular loops where we'd see something in a transcript of the person who hadn't already analyzed it; we'd see something and the expert would kind of immediately have a response, "Oh, yeah, here's what's happening there. This is the context, or that you don't know." It wasn't as productive as we were hoping.

And as I remember I think we said, "Let's try next week we each analyze something that we're not expert in and then give the floor to the novice to kind of lead the way." And as we went through that process in the coming weeks, the possible strength of it kind of came out in that the content novice was also kind of a context novice so they would . . . like I would be reading about Geoffrey's digital logic interviews and they would switch between vocab that to Geoffrey is completely synonymous or is something that he is familiar hearing those two words and it would really catch me and we would have to stick to the data to decide whether that was an important distinction or not.

So, having the novice lead the way helped us rely primarily on the actual data that we have instead of the interpretations and context that we bring to it; which is a strength to know all that much about what's going on in the

course. But, for this particular analysis it was very helpful to have that check in place. I think that is how it all came about.

➤ *And, Geoffrey, I know you have one particular example of something that Devlin saw that was really eye-opening for you.*

❖ **Dr. Herman:** Yeah, so I think one of the things that really crystallized this approach as being something useful was, well first of all let me tell you that Devlin's an incredibly intelligent person that I respect as just being this amazing colleague that I got to work with, and so that changed the dynamic for me into a degree of like being, "Okay, if he thinks I'm saying or not dealing with something it's not 'cause he's just not paying attention, he's trying as hard as he can, and so when we were like working through a lot of the interviews one of the concepts that we have in logic is conditionals, and particular what's called the "bidirectional conditional," where the phrase "if and only if" means something to a logician that's different from everyday language. 'Cause I mean say, if like you may cross the street if and only if you look both ways first, the "and only if," is just kind of like an emotional emphatic to say like, "Yes, I REALLY mean you need to look both ways." But, it doesn't really add any new meaning to the sentence.

And, this is a realization I never would've had if not working with Devlin where he was reading the transcripts, or reading the prompts, and he would leave off the word, "and only if." Like it was just something he would naturally say, "Wait, that's not what the problem says." And he would read it again and it was like happening automatically. And I'm like, "Wait, why do you keep not reading that?" And he's like, "Well, it doesn't mean

anything.” I was like, “No, it does.” So, the ability to see that and having a very intelligent, earnest person to do something and the same thing like as the students were doing in the interviews, but then he’s able to be way more metacognitive and reflective about what he was doing. And so, as he was explaining it he was the one that kind of gave it that language of a definite emphatic is just emotionally saying, yes, I really mean it’s conditional. Which was something I could never come up with ‘cause in my brain that is a set of words that have meaning and not just emotion to it.

And so, being able to have that outsider analyzing data from my discipline helped us get closer to the mind of the novice that we were trying to analyze.

➤ *So, what was happening was that you as an expert you were realizing those words were really having incredible meaning, but that Devlin, as the novice in the field, was really behaving in a way that the students do and that really gave you insight because you still respected his intelligence and it wasn’t just that he wasn’t trying. It was, “This is a really bright guy. Huh, maybe something else is going on here that I’m not taking into account.”*

❖ **Dr. Herman:** Yeah. And we were able to engage in a much longer back and forth; like, “What’s going on?” And he’s being able to be extraordinarily metacognitive about, “What am I doing? Why am I doing that? What assumptions am I bringing to this text?” And, it would never have occurred to me, and it didn’t occur to me after having already analyzed these interviewed and having published all those interviews that that’s what

students were doing. And so, it was a new insight that came out from working with someone not from the field.

➤ *I was just reading an article, I don't even remember where now, but it was in the popular press not a research article that talked about something like a semester at sea, or something of that fashion, where there were several experts, different professors in different fields that were traveling together. And, so the astronomer would like sit in on the geology class, and the geologist would sit in on the astronomy class, and they were beginning to say something like you noticing of being able to have those outsider's eyes there with yet somebody who is really trained in science was just a way to freshly see their own discipline. And, I was excited to see that knowing that I was going to talk to you two today that this was yet another example of that.*

So, we've talked a little bit about how the method worked with the one example, and how you've looked at interviews in a different. Looking back now, what might you do differently if somebody was just starting to do this, or if you're doing it again, what would you do differently then as you just stumbled upon this than you did when you just stumbled upon it?

❖ **Dr. Montfort:** I think one thing we talked about in the moment of trying to produce a paper or come to some sort of analytical confident statements, we didn't think to record the process much, and that could've been, I think, really useful to actually see what are the specific things, other than ones that we happened to remember, what are the things that we got stuck on

and how did the other person eventually move us into another understanding.

And, I think also it'd just be good to have sort of a lap-time. How long does it take for people who are spending their full workout, well I guess it wasn't our full workout, but you know, 15-20 hours a week trying to learn these concepts that we ask sophomores to learn a couple of hours a week; how long did it actually take us? That would be helpful to know.

➤ *So, this process itself, now reflecting upon it, of having this dialogue about the concepts between the content expert and the novice would be actually a source of data itself is I think what you're saying and you didn't realize that at the time.*

- ❖ **Dr. Herman:** Yeah, I mean that whole exchange that I just described, that felt like in respects it's almost like doing a cognitive interview with someone who is just beginning to grapple with the content but this person is more bought-into explaining their reasoning, and they're a little more trained in explaining their reasoning than your typical novice is. And so, they're pouring out tons and tons of data about like, "Oh, this is an observation I just had, or a realization I just had in a way that's like super-hyper real time, than even what you can get a good qualitative interview generally. So, it was really fun from that perspective. Getting new ideas.

- ❖ **Dr. Montfort:** There's sort of a – I can't remember what this quote is from but, "making the familiar unfamiliar." Just a quick insight into some of the material that I was familiar with. I was showing Geoffrey is mechanical

materials or solid mechanics, in that whole course it basically tries to analyze how objects react to forces and when you come into it you think, “Okay, I’m going to learn about how things break or how they bend,” and sort of in the first 30 seconds we say, “No, actually you’re not, we’re just going to be looking at tiny, tiny invisible movements and we’re going to be doing a lot of calculus.” But, that takes more than 30 seconds to understand why we might do it that way; what the history of it is, where it’s going to fit into the other courses, and then just sort of emotionally how we as civil engineers or academic undergraduate programs treat this content. That’s something that you would never include in a class, but if you’re talking to a colleague, and again you have the time you may say, “Well, what would happen if you keep pushing it and it breaks?” And you go, “I don’t know that’s not a good question.” They’re like, “Yeah, it is. Why can’t you tell me?”

➤ *Uh-huh. It’s always so fun to look at things like this.*

- ❖ **Dr. Herman:** And kind of in line with what Devlin has said of having a better record, what did you talk about? One thing I’ve been doing with some of my grad students, and since, I can continue to use the method on, when I do other studies and it’s been fun because we’ve been intentionally trying to keep audit trails. Saying like, what did we talk about, what hypothesis did we come up with, what weird discussion did we have today that was just you trying to understand what the heck are we talking about? So, I can even see in just the way we’ve written papers, like the papers I was writing in 2011 how I would describe a concept has changed in part because of my realization of like, “Oh, there’s so much implicit information that I have that

I never had to articulate until I was having a persistent grad students who does great qualitative research but doesn't know the discipline and it's just like, 'But why? But why? Tell me why I'm wrong, I don't get it.'" And being incessantly curious, so we've been trying to be better about collecting those audit trails to better understand what happened, how did we change in our own understanding of what we were analyzing here?

➤ *So, Geoffrey you've spoken about how you've continued to use this; Devlin do you have examples of how you've used this method more recently?*

❖ **Dr. Montfort:** Yes. Kind of moving into trying to study engineering practice as a social practice and it comes in two directions. So, I'm kind of a novice about engineering practice, so taking that approach working with practicing engineers or researchers that have been more embedded in that context has been helpful saying it is worth our time for you to explain these things to me.

And then the other direction, I work with social scientists trying to learn discourse analysis for example; I work with somebody who does that. And, sometimes they'll, "Well, I don't understand the engineering content so I can't look at those interviews with you" or something. So, I kind of use this method to frame, "Yeah, you can. I think it's helpful and there are things that I skim over and ignore that are important and we should dig back into them and it's valuable, it's not time wasted translating or something. It's a valuable part of the analysis to verbalize and be explicit why I skip some things, or particularly focus on other things."

I'm always reminded, I mean I've seen it enough times now that I kind of remember, but often you show somebody a transcript of a student working and if they're not in an engineering context, or not really in sort of STEM undergrad right now they're surprised that we talk about letters all the time. We're saying "Well V will increase when A decreases because that P goes up." And they're like, "You're speaking nonsense when you say that." And we literally hear "Velocity, Area and Pressure," when the people are saying "V, A and P." Or "Sigma." But then there are some letters that we don't, "K" is a mystery, it could be anything. All those things, and partly they're saying, "This is confusing." And you go, "Yeah, it is, I forgot about that." Not only is the concept confusing but the way that we navigate it can be its own challenge.

➤ *And so, I'm sitting here just thinking of how fascinating this is to really start to get into the head of the learner and how much we forget what it's like to learn it the first time. This is very, very intriguing.*

❖ **Dr. Montfort:** I think a key of it was how it developed the way it did is Geoffrey and I were both committed to that and pushing the other person to do that, to humanize and respect the learner and then to kind of almost de-prestige a little bit the way we get used to thinking about it because so often Geoffrey would say, "Why is it that way?" Or, I would say, "Could we do it this way?" or something like that and the answer's like, "Yeah, but we don't." And you kind of realize that yeah there is a lot of arbitrary wishy-washy stuff even in the most concrete definitive context. And, I'm not sure everyone believes that, I'm not sure that the method would have that same

benefit if people weren't just authentically committed to constantly checking and rechecking their own sort of biases in that way.

➤ *Right, right. Geoffrey, I think you were going to add something there.*

❖ **Dr. Herman:** Well similar to what Devlin was talking about this whole like variables thing, how we speak, I've had similar experiences where I had a mechanical engineer where A is the coloration, and if V is shear force (I'm clearly not knowledgeable on that one) and for a moment like each letter has a variable assigned to it that we kind of know across context, whereas in computing we can use variable of whatever we want, and this weirdness of, "Wait, excuse me, the variable isn't specific?" "No, you can use whatever you want, we just have some loose connections and recommendations, but no one follows those." And so, just how we reified certain things are in different disciplines and like, "Oh, wow!" There are all of these little subtle things we do that we have no idea we're doing until someone asks about it.

➤ *And, that you're open to them asking and that you respect their questions as valid questions, right?*

❖ **Dr. Herman:** Yeah, you can ask me that question but just do it this way versus, "Oh, that is weird."

➤ *Well, my final question for you is the question I like to ask all the guests, and that is what advice you would have for people who are wanting to develop methods, who maybe feel that the thing that they're doing doesn't meet their needs, and what they could learn from your example*

*to try something different. So, what would you both say about that?
What would be kind of your closing advice for people listening to this
podcast?*

- ❖ **Dr. Herman:** So, I think we talked about this before, just pair up with a rock star and let them cover you. So, we had you and Shane as our advisors and so we were ultimately like, “Hey, these people do good work. Fine.” I know that’s not always going to be the case but it definitely did help working closely with people who are known, who have experience. I think this is something any new researcher should be doing is staying connected to people who can help check them, help them have a confidant, have a mentor, an advisor, and say, “Hey, does this make sense?” Bounce it off of them, build your confidence with them and don’t be too worried about perceptions because you can then you can just turn this person, “Hey, am I off my rocker? Am I doing something that makes sense, that’s defensible, that’s reasonable?” We really had that with you as own advisors; so, that’s always helpful.

And then, I think, kind of going back to the description I started with, research methods are there in large part because we as humans love to see patterns or normality where it may not actually exist. And so, getting back to what is a good research method? And that’s a thing you’re like, “Oh a method is Step 1, Step 2, Step 3,” but it’s more like, “How do I structure my observations, my tasks, whatever it might be so that I don’t buy into my own assumptions. And so, if whatever you’re doing to modify your research method is getting back to those core things of what makes a good research better research; it’s a reasonable thing to do. Those are some quick

thoughts.

➤ *So, have somebody that can kind of protect you as you're doing new things that you feel gives you safety to do it, and then keep going back to the core principles of why you're doing it in the first place, right?*

❖ **Dr. Herman. Yeah.**

➤ *Devlin, do you have anything you want to say about that question, any advice for people?*

❖ **Dr. Montfort: Yeah, of course, I never turn down an opportunity to give advice. Buy low – sell high. No, I think a key part to me was finding research articles particularly and education, or cognitive science, where the genre of the writing in those fields was a little more personal and you're allowed to share some affect. And so, there's a couple of articles where somebody is saying very humbly, "I think this is a better way to do it for these reasons. Take it or leave it." And, I'm much more comfortable with that than those sort of commercialized or product-based innovations thing like, "I'm going to go define the Montfort-Herman-Streveler method and it will sweep the nation," instead of just thinking, what do I want to accomplish and how can I communicate that to a particular audience. And I kind of think anyone who's using a method, even if they are trying use a recipe are making it up again on their own.**

So, I think it's much more important to talk about why and how you're trying to do things rather than what you actually do. So, instead of here's

how you . . . here's the inoculate you take to make sure that you're not biased. It's like, "Well, what do we really mean by "bias" and what would it look like if we were, what would it look like if we weren't?" I think there's lot of value in the more abstract conversations and as a field we tend to only discuss the actual action without their attending meaning and reasoning.

➤ *Yes, humans beings creating the methods, right? They're not something that has come down on golden tablets.*

❖ **Dr. Montfort:** There are golden tablets methods. [Laughter]. But mostly, mostly they aren't.

❖ **Dr. Herman:** And, I think once you start publishing more you start realizing no one actually agrees on how you should report things. I mean I think in the past week I've had like about 15 different conversations about what effect sizes mean and whether we should use them. Then it's like everything is . . . there's limits and merits to pretty much anything you can do in research and it's being honest about what was good and what bad about the approach we took. And it's really useful mindset and attitude to have especially, once you start moving into interdisciplinary fields where not everyone agrees what standards of evidence are.

➤ *Yes. Well, thank you so much for being with us. I remembered why I love working with you two, you're both so smart, and honest, and thoughtful, and we even got in a giggle here and there which we used to do a lot of. And, I hope that your example and your story inspires other people, and I'm happy that I got to share both of you with a wider*

audience. So, thank you very much.

❖ **Both: You're welcome.**

➤ *Research Briefs is produced by the School of Engineering Education at Purdue.*

- *Thank you to Patrick Vogt for composing our theme music. The transcript of this podcast can be found by Googling "Purdue Engineering Education Podcast." And please check out my blog, RuthStreveler.Wordpress.com.*