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Making Sense of Collocated Teamwork Activity: The Multimodal Matrix as a Quantitative Ethnography Methodology

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Abstract

Collocated, face-to-face teamwork remains a pervasive mode of working and learning, which is hard to replicate online. In team-based situations, learners' embodied, multimodal interaction with each other and with digital and material resources has been studied by researchers, but due to its complexity, has remained opaque to automated analysis. The ready availability of sensors makes it increasingly affordable to instrument work spaces to automatically capture activity traces to study teamwork and groupwork. Yet, a key challenge is the enrichment of these multiple and intertwined quantitative data streams with the qualitative insights needed to make sense of them. In this seminar, we will discuss our inroads into giving meaning to multimodal group data. We have followed a human-centered approach to design meaningful end-user interfaces that convert multimodal data into data stories. Based on Quantitative Ethnography principles, we developed a modelling technique, termed the Multimodal Matrix, to grounding quantitative data in the semantics derived from a qualitative interpretation of the context from which it arises. We will present practical examples in the context of high-fidelity clinical simulations in which multimodal data (physiological, positioning, and logged actions) have been transformed into learning analytics interfaces that support teachers' and learners' reflection.

Brendan:

Creating data intensive solutions that enable learners and educators to interact with artificial intelligence outputs, and data visualizations meaningfully. And then we have Gloria Milena Fernandez Nieto, who's a PhD candidate at the University of Technology Sydney and connected, Intel at the connected Intelligence Center, and her current research focuses on exploring alternatives of feedback to understand traces from data collected in the cscl classroom to problem reflection in teaching and learning practices, and many of you who've been to the series before. I've gotten to know Simon Buckingham Shum, who's a professor of learning informatics at the University of Technology Sydney. Prior to which he held this title at the Open University in the UK, as the director of UTSA connected Intelligence Center, his team invents pilots and deploys advanced educational technologies at UTS and using data analytics and AI to provide better feedback to educators and students. And he's co-authored and edited several volumes dedicated to the design of software to AR augmented thinking, addressing specifically the interplay of learning analytics AI and Human Centered Design. Alright so, without further ado I'm happy to hand things off to our presenters, and thanks again for everybody for joining us.

Simon:

Thanks very much. Brenda and dogs just joining in with me right on cue. So, it's my pleasure to present this joint work I'll set the scene and then hand over to Roberto, who will then pass to Gloria, Vanessa can't join us today, unfortunately, but this is based on a lot of PhD work as well, which you can find out more about. Okay, so today we're going to talk about using quantitative ethnography as an approach for studying and co located. Teamwork activity, and learning. We'll talk about a construct called the multi modal matrix approach to modeling, and we'll illustrate how quantitative ethnography principles are carried through in this work but we're not using epistemic network analysis, unlike most of the previous presentations.

So we're going to argue that this is still QE in spirit and in the way that we're thinking, but we're not using DNA. Alright, so very quickly. Well, the promise of big data and all the excitement about it in the broad scheme of things, is that we have a way of studying complex societal systems. That's why people are so interested in it, I think, because we have we can have sensors, pick up what's going on in these complex systems, huge scale and speed, and that enables us to, to make changes to sense the system in ways that we've never been able to do before. Obviously, sensing systems at scale and high fidelity brings its own ethical issues with it which are being widely discussed as we, as this infrastructure emerges. And those issues carry through into any context where you're using sensors data and analytics, and even AI.

Okay, now we're obviously all interested in human activity systems, particularly, not just about studying machines talking to machines. And that introduces all the complexities of trying to understand what things mean. In those systems and that's why we're so interested in in the ethnographic qualitative aspects that QE brings. And the key challenge is well what does it

mean to handle that intersection with integrity to actually take seriously the meanings that the participants are constructing as they engage in some activity, and then claim to be able to say something about that when we're talking about, you know, the low-level sensor data that computers, see the world that we're particularly interested in learning and teaching systems, and the role of data science and analytics. But we're not just interested in studying them as researchers, so that we can say new things about the processes of learning. We want to actually develop practical tools that mean they augment that learning and teaching activity. And that's where Human Centered Design comes in because we want to create artifacts that are going to do a good job of that. That may well be extremely useful for us as researchers studying those phenomena, but we want to, we want the participants of that activity system to themselves, be able to see that process. Okay. And that closes a feedback loop to them. So Human Centered Design comes in. And we are therefore drawing on the kinds of disciplines that tell us how we design such artifacts HCI, how we design data and AI and think about that ethically in a learning context. And also, you know, the broader science and technology studies and critical data studies kinds of perspectives that are brought to thinking about what happens when you bring big data into learning. And then because we're talking about learning and teaching of course we have to appeal to education and the learning sciences and the assessment sciences, to, to understand how you actually design specifically for these contexts, the context that we are working in is the training of nurses in simulation wards of the sort. You can see here. Now you'll notice from that top photo that we've got five beds going here five teams, all working on a simulation on a mannequin playing different roles.

This is used widely and different institutions around the world, you've got multiple teams in action and you've got one instructor, typically who is roving around trying to keep track of what's going on. So, when we learn more about this kind of teaching and learning context. It's a, it's this is a complex social system and cognitive system. It's. There's a lot going on. Could we augment the instructors senses. With multimodal sensors, could we improve the ability to give feedback in a timely way using analytics. That was our intuition. These are the kinds of data sources that we're picking up voice, data streaming off the patient simulator movement and positioning, as they carry these badges around on them and physiological data off of their wristbands. So, it's like a great multimodal analytics opportunity. But the real question is, okay now we're going to have this massive explosion of data. And that there's a big gulf between that and giving meaningful feedback to the participants.

So, the question is where does quantitative ethnography of a contribution to make, and could the work that we're doing, actually help you are our QA colleagues, think differently about the way you do your work are we developing some useful representations or tools. So before we launch in. Just to note that the idea of using epistemic network analysis for example as an instance of QE to generate real time feedback has already been developed so this was an example from the work from the Wisconsin lab, right where you are using DNA to power a real time feedback interface for a teacher. This was what this was from online activity. So we're trying to do something analogous, but for face to face, co located activity. So, we're not talking about clicks, you know, we're talking about movement and action physiological data and so

forth. And we're not going to give real time feedback, but we want to input to inform the debriefing that happens immediately after the simulation.

So there's, there's the sort of the nexus of the three, three perspectives that are coming together here, and we're pulling from cscl assessment research. And we're going to try and understand the human activity system, not only from a theoretical perspective but firstly we have to observe simulations as they run we are talking to the expert clinicians, and we are using co design techniques to invent artifacts that we hope will help, and a point to notice that we are not just trying to study the human activity system as it currently is trying to reinvent the future system as well. So there was a design aspect to it as well. And that's not necessarily something that all QE work. Okay, so I'm going to just stop sharing there and pass over to Roberta, who's going to take you to the next phase of this work.

Okay, so let's now go into the details about how we did, how we did everything together. So we started from called designing features. And this means sitting with them, understanding. What is the meaning of all the actions that are expected in simulations from the teacher perspective from the students perspective where the areas in the classroom, are important that have different meanings. In order to confirm that they can actually understand. And this means applying lots of techniques brought from the design practice and disciplines. Some of them are called generative tools, or tools for dreaming. They were also thinking and telling us about what they want to see if we can capture data from these physical environments and how they want to see things. And we also put together, new tools. For example, this was a learner that journey, tool to understand how the information is flowing in the physical space, and the opportunities for for capturing data and also for visualizing. These still traces of these data. But we also started looking at an activity or actual activity, this is one early example before bringing QE into the, into this project.

This was just as we usually do, you know, as, as researchers in in application data mining. For example we collect lots of data. And we see what happens. So this was one example in which we use computer vision system to detect the bodies of the students around mannequin the patient mannequin during the activity. And we started to get patterns. For example, in the group at the top is one group of students for students and T one T two and T three just activity divided in three slices just to see the temporality of the data. And we saw behavior in which the students remain at the base of the bet. There is meaning there, and teachers when look at that they explain art. This is where there's a hangover they're looking at documents, and we realize that there's lots of meaning in these positions, because in groupie for example these students were immediately very close to the, to the patients right.

And without to see these two emerging patterns from other students. And we realize okay we need the meaning to add the meaning to the data. So we had to revisit our process and tie it to the outputs from the core design sessions, and we start for this one example, how we extracted some qualitative codes from these interviews from observations and from the learning design for for the specific simulations. So for a specific simulation. In this case is our solicitation case in which the patient needs to be rescued. Using CPR. These were the areas that the teachers and

especially the teachers from the Learning Design were indicating were very important. So for example being behind the, the bed area is critical because someone needs to be there holding the space. When there's CPR being executed. And students need to be next to the patient or being on top of the patient during the procedure, being closely trolley is the source of meaning. So we selected these compared to this physical space into codes of the physical space. So we could then compare X and Y coordinates into meaningful areas. And we also use another theoretical framework. Because we're working with, with a complex information, there are things that are happening at the dialogue level in physical space so according to this framework the activity framework, or activity center analysis framework proposed by Alice like a balloon does a good job originally they specify that there are three things that the teacher can design for the physical space and the tools are being used. Obviously the past. The past epistemic aspect for the task, the goals that need to be met, and how to scaffold the status, and in the social situation as well, like in this case, each student has role to steam work. Not everyone is supposed to be doing the same with a leader.

But we also have effective responses, and it's not necessarily inside the framework. But we start to realize there are different aspects, they mentioned some of the collaborative activities that makes a complex and from effective we can from the effect of room we can get physiological responses that are very important for these scenarios because nurses are under pressure and then they need to reflect on the levels of stress, and how they react and how they react even if they are stressed or not stressed helps them or, or is actually stopping them to do the work effectively. And so we put together everything. And we started to map from low level data to these higher order constructs or four dimensions in this case, collaboration. So, we start from the middle these constructs include the strategies in physical space, know how these are moving the actions and procedures or dialog in this case with within conceal the dialog. Within automatically capture the actions that are related to the procedures are part of the epistemic, they mentioned, collaboration, communication with the patient, the more communication, obviously, social aspects, and changes in emotional arousal was one of the indicators for us. That belongs to the affected beyond. And we then start to map okay what data we can capture Now, obviously we get, we would like to capture everything was the data we can capture. And that is important also for teachers to consider during the assessment or during the reflection. And from multimodal sensors, we started to map to this construct so there's no with that example that's going to be clearer. This the conceptualization of all this procedure we start from multimodal data. We need domain knowledge. The expert knowledge from what's happening in the, in this classroom situations, coming from the learning design but also from observing the teachers, and what the teachers were saying is important. And we propose this multi modal modeling, or the matrix.

So let's dive into these multiple matrix. This was an early version, in which we have these dimensions of collaboration at the top. By going to command on that. And then we have the rows, which in our case, A. The data is coming from different sensors so we decided to synchronize all the sensors and the sampling of each sensor is different. So, we have information that comes every second. Sometimes it comes on, just an action that happens in the time just okay someone is attach a sense a sensory measure to the patient just something

that happens in action CPR is different because it happens in span of time. So, we decided to give it a go and say okay let's create a matrix, in which each row is going to be one second. And, and then let's see if we can model extract information from this. And we also have the notion of stances which in our case, we're living phases of things that were.

So all the actions in that phase. Were contextually meaningful. And then all the columns, then started to be information about each participant so we have RM is registered nurse 1234 or team leader and they have different roles, and we get information about positioning for the physical aspects actions that each person perform and the social aspects. We had if we were speaking, not what they were saying but if there was speech, be impressed and we were capturing these via microphones. And in the affective aspect. If there were peaks and electrodermal activity. And then we feel all everything with ones or zeros, or different levels so activity with accelerometer for example we have even information about the wrist level of motion. So for example, if we look at how we divided the physical space in meaningful codes. We use those codes to convert the X and Y data so we end up ones and zeros instead of x and y coordinates. In the case of accelerometer data which is the acceleration.

We also have these levels of activity based on previous cases in which pretty much CPR was the most intense activity so that was a high intense motion captured by the wristband. And because of electrodermal activity we're a bunch of zeros because a peak is just something that happens all the time. So we try to like map, everything to ones and zeros and obviously actions, in this case they were locked by server. So we have a combination also of human protein, being inserted into this matrix so we get it's actually multimodal data coming from sensors, or in this case an actual interface to monitor what's happening. And this can be used as possible by students because they do these kind of monitoring already in these scenarios. But he was done by researcher and microphones is very chatty his microphone scenarios. We got information and we could do it for small periods of time in combat detect human voice, or there is lots of issues, I'm not going to get into this but to say that. Yeah, this is our whole problem in itself, how to capture the dialogue, not even if someone is speaking.

So coming back to this model, we did, and this was presented in 19, was to interrogate these multi modal matrix, not less not using ENA because there were no enough cases that we recorded, but we said, we were objective is to interrogate this small matrix and show something to the students and teachers. So we design some proxies. So this is one example of a week, we just focus on verbal communication, if we reconstruct the match matrix of the microphones. We just can get these this social network of who's speaking with whom we create a more complex visualization to the identified these, these dots in, in, in a timeline, which are the peaks in in arousal. And just for quickly. For the teacher for example to notice that RM for didn't have anything, not much activity normal movement. So, the idea is was for this to invite dialogue around this representation and what was happening. If RM four was disengaged, or it was in very quiet and not engaging in activity. And also we could get the areas in which these themes were present because next innovation on top of the patient compare across themes and a more complex, we're gonna go for it, which is a timeline of all the actions that students were doing.

So this is one of the examples of the, of the movement, how the one team. They were doing CPR, and how the proxies, pretty much explains where, where the team was around the money. with these codes. This is very, very simple, but was interesting just to see multimodal learning analytics, there are many interfaces so we started talking we need to have some interfaces and such information to students and teachers, and this is the most complex interface, which is for each team member in this case is a very tiny team of two people each action is presented in time. And this was became our base visualization to show information. We call this an exploratory visualizations some work was done by comparing it with other visualizations that invite people to understand the data and this is for exploring the data exploring all the data points but what does it say where these data points.

So, and then our next step was to, to help the. Whoever is looking at this complex visualization to understand the meaning okay. The students did the right or not. So there is a level of assessment so we brought the assessment criteria from the teacher that the teacher would use to describe okay this is actions were performing the right time or not. To create a learning model to assess whatever it was, in the multimodal matrix and this learning model in our enough case so far, we'll be using rule-based algorithms, which is how this, the teachers naturally, explain how the, the locks are assessed. For example, if the compression depth is below five centimeters then is too low if he's about 60 to buy a nurse should be located at the top of the bed during CPR. So there is complexity there so we look at the data, and is a nurse in this in this triangle. The X and Y positions are there during other actions have interactions are happening. And so there's lots of rules that that we can create a matrix. And the idea was to create that the stories instead of a just proxies or plotting the data. So these stories are going to be explained by Gloria, So I'm going to now stop sharing.

Gloria:

Okay so, um, we call the team timeline that Roberto was talking about the vanilla timeline, because he mentioned, it doesn't offer any guidance to students to interpret the meaning of association of the action. Their timeliness, or their correctness. So pretty much what I'm going to be presenting now, it's two different prototypes that we have the chance to test with teachers and students based on these modeling techniques of trauma to just describe the first one was broke with features. What we did was to enhance the basic timeline. With storytelling measures. So for example, this, this one tells a story about time responsiveness of two students are in one and are into executing clinical actions according to the basic life support protocol. So we propose to automatically rendered essential elements on top of the vanilla timeline, this valley station, according to the teachers learning page. So that way we translate each pedagogical intention into a set of rules to add visual enhancements, such as emphasize in relevant points.

We use shaded areas to grow that appoints, as in this case to represent him as low responsiveness and annotations that explain the meaning of particular points by highlighting

important events, for example, a delay in the liver net Association shock. All our layers can be added to highlight mistakes, my bucket team, or to communicate additional insights, such as arousal levels, especially when we are having a looking slide. So the teacher has the option to select any layer he wants to show. He actually can see different layers at a time. Additionally, we also show the rules that we use to add these different elements in a particular layer. So we explained were kind of opening the code that we are using for the students and the teachers to know and understand why we are showing them these kind of messages. The second prototype was test that we have students, the previous one was test with only teachers but we have the chance to interviews, students while they were using the tool. So pretty much of the second prototype, we evaluated the students were performing a specific actions, or these critical actions that we elicit from the teachers or the educators.

So pretty much they have to assess vital signs, every 10 minutes administer and stop antibiotics, so people send allergic reaction to antibiotic protocols simulation. They have to perform an ECG and call the doctor so these were the actions that the students are supposed to perform during the simulation, and we elicit these from the learning designer, we confirm this with the educators. So this is how the prototype looks like. So again, what we have here is just the vanilla timeline, so you can see all the actions. And we, we plot the layers of the stories in this one based on the critical actions. So each of these buttons on the bottom represent each of these actions. And the students have the chance to click on each event. For example, this theme fell in as in vital signs regularly after the Beijing complaints.

This is one of the stories we show them the same principles of data storytelling were used to present these prototypes. So this is story for example explained that the theme perform as it was expected by the educator, and the blue color indicates so these are example percent shaded area in yellow color to indicate that something was released in the second study, we evaluate our second prototype to present their physiological data, which summarizes their outhaul level of vision ours. And we plot it as a label. So they have the chance to validate if they were milea roles or high roles in each of these specific phases. So pretty much the stable summarize the for an example or collaboration process as Roberto was talking about. So for many activities which are part of the workflow are automated. There is still some manually actions, for example, all the sensors data was manually synchronized, as I recall, I mentioned previously, but we also considered are in these modeling of QE techniques. We can have actually manually added data into the matrix, modeling technique, which is also okay. So pretty much you can see here. How far are we from all you have to make the process.

So, that was all the presentation prototypes I reckon, Simon, now it's completely.

Yep. Thanks for okay so just to wrap up here. All right. So just to recap, this is the challenge that we that we think we're dealing with here with quantitative ethnography as a field. And we've discussed what we think it means to handle this intersection with integrity in a particular context.

So this is, this was the question we asked. And we found that the principles underpinning the multiple underpinning QA. You know, we saw how we derived the matrix which is based on that QE like representation of rows, columns standards, etc. And it worked. It worked for quality for, for real time streaming multimodal data, which was very encouraging.

Is the work that we've talked about giving you ideas about what you might do with QE well we hope so. But we look forward to hearing your thoughts on that. Maybe the multimodal matrix is something you might be able to use maybe the kinds of representations we've been generating off that might be useful.

And we've been doing this for colocated embodied activity. You know where the room is becoming aware of what's going on in it. There is no user interface in the traditional clicking and typing sense, the room and the space and actions are, are the sources of data. So, just to sort of wrap up. I think that what we're talking about here is that we are building on and augmenting Kiwi ideas. First of all, we've got to understand the human activity system. And we've done that in a particular set of ways, including envision practices we're talking about future work systems as well. Because we want to invent a way of doing debriefing, which is going to, it's going to change the way they do debriefing as well. We are integrating qual and quant. And moreover, We are developing techniques that can read from and write to this common data representation. And, and this, this can have machine contributions as well as human contributions in the way that we map from this low level data to higher order constructs that are meaningful to people. We would like to get to a fully automated analysis. In terms of generating the feedback replay interfaces for the debriefing, we're not there yet in terms of just an engineering challenge, in some ways, but we have a partially Automated Analytics work so far. Okay, so we're really happy to hear your thoughts about that.

Thanks very much indeed for the question. Quick round of applause, excuse me, for the presenters. That was great. So we can open things up now to questions if people want to, you know, add things to the chat or just unmute yourself to go ahead and ask.

Please go ahead. Yeah, go ahead. Rogers, yeah, yeah, yeah so thank you so much. I think the tone is very interesting, um, I was just asking around the. I think you talked about like, Oh, we create rules like how are they how the how the tool cannot show up in the teacher for example to relate to the pedagogical intentions for example. So I was just wondering, because I think that's a, that's a very important. Kind of feature for the, for that tool especially for your teachers, practice like practical use because I've been working with teachers and the question is okay if I want to use this like to, to understand like to relate the data can be captured to the actual classroom. So the question is, how possible is it for the teachers to actually do this, of course you have talked about that you are moving towards that during the admission process. And I'm wondering whether that will be possible for example, if teachers are using it from different perspectives of course someone who should be able to say okay, for this activity I want to visualize or to see. I want, for example, if it's a discussion forum. I'm just giving an example, if I stopped. If I taught students to post five times. Can we speak in radio Can this be

visualized but it also, that was, that's something I'm wondering about winners and something. Yeah.

Well if I'll just make an initial comment on that. So, you know, if I just put this diagram back up. This is where we move from the language of educators to the, to map it down into lower level data. And that is what where the conversation happens with the, with the educators, you know, do you think that these things. We are capturing are good proxies for these things you care about, which is curriculum outcomes assessment criteria and. Yeah. So, just as we've shown you rules for multimodal embodied activity.

If you wanted to capture the fact that the student had not posted five times before I'm just to take your example. Well yeah, we could say, we have this notion of engagement, high level construct. And we're going to interpret that. In terms of certain behaviors. It might be the number of times they posted it might be a whole bunch of other proxies for engagement. And then you want to make that visible in the user interface to the teacher or even to the students.

I suppose there could be a challenge, potentially, in terms of if I mean I think Rogers was talking about this a little bit if different instructors have a range of things that they would count as, as, you know, important or indicative of the things that they're looking for. I like that piece of your guyses work is that you're bringing in both the instructors and the students in terms of their interpretation. But then there's also a challenge in terms of if there's how wide of a range of things people are looking at, or would count as what would count as evidence, potentially could make a challenge, but I thought that was that was a. That's one of the strongest pieces I think of this work is in terms of having it kind of define QE, regardless of what you're doing is that the fact that you're bringing it to the people that are actually in the community that you're looking at and kind of CO constructing what the codes are and checking with them and having that aspect of validation. And then also, anyways, I will go on I know there's other people that have questions, Jamie were you gonna. It looks like there's also something in the chat Jamie Did you have your hand up. Um yeah so thanks for a wonderful presentation.

I, I also kind of work I work in the clinical space as well so this was very relevant to my sort of mindset. It seems like what you've done here, really closely situates within complex adaptive system theory, and the work that was always done by Dave snowed out of the UK. And I think you've kind of modeled that quite well in terms of social service systems thinking, but I'm just wondering about tacit knowledge so you've talked about, you know, having that knowledge that's necessary to drive the or modulate the actions simulations. Did you look at any sort of subgroup analysis for tacit knowledge specific.

Can you give us an example of what you mean by tacit knowledge their knowledge isn't necessarily learned formal knowledge that's provided within a formal education system but more so, through lived experience. So, and I think, Szilvia, Szilvia could probably talk for days about tacit knowledge but in the nursing space, it's really important because a lot of

how professionals react in a complex system isn't necessarily dependent on formal learning theory, but more so on the lived experiences and that tacit knowledge within their time spent as a nurse or nurse educator.

So I was just wondering if you looked at, or seen differences amongst different levels of nurses or students versus educators, etc.

I can respond to that. No, I mean the, the short answer is no. It's super interesting. But, what you're saying is something that we observed all the time in simulations I mean there are so many things that are happening that are important for students experience. Um, and sometimes the teacher doesn't even realize that things are happening. We focus more on to the formal learning outcomes just to start with something so complex to focus on too many things and at least the learning design and the expected learning outcomes are something that happens from one session to the other from one classroom to the other and suspected by the teacher, and is covered usually during the debrief, but yeah no that's so interesting. There's so many things that happen and we have even seen cases in which the manipulation of some objects can lead to injury, and that has happened in the classroom as well and the teacher never knows, never knew that that happened and that was not taught explicitly.

But I'm sure the student learned a lot and tried to communicate that to the teacher and there was no chance to that things, things that that were happening a lot later and opportunities that were just maybe missed or. There was no chance to do go and focus in the debrief from them. So many people and, and eventually will be, will be great to be able to capture those instances, to not to lose all those opportunities. Yes. Yeah, probably add something, when we normally talk to the teachers, and we try to extract those expected behaviors. You know what they expect from the students to do. They always have it depends on how experts, they are. So we always said okay how we model expertise. So, that's something we have to consider and yeah I agree there's many things which are happening because most of them already work in hospitals so they are more experts than others. Another dimension, some of them are just practicing in this scenario which is, you know, I'll say scenario where they can practice and even being a safe space, they can injure their set their selves, because we have seen, things like that. Yeah, there's many things that are still needs to be model. But yeah, it's very complex.

Maybe the other thing I would add is clearly we can write rules about things that are unambiguously right or wrong, you fail to do this quickly enough, you know, the patient's going to die. Right. So, there are things that are right and wrong, there are things you can do in the wrong order, that's all good explicit knowledge, those are protocols that students have to learn. Now, what I think we're trying to do with these interfaces, is making it possible to explore and replay where tacit knowledge could come out. So when we're capturing stuff that used to be.

Only recorded on a video camera, it was too much work to actually go back find a video and then scroll to the right place in the video. You know the 16th. So we're trying to make it easy to get back into the moment where the educator could talk about something.

The fact that, you know, we have got some rules about things but we don't have rules about everything. So the fact that you can look at location, and who was involved, and why the why there are such stark differences between two teams in the patterns. Those are provocations to conversation and reflection and that's where tacit expertise is going to come out on from the clinicians.

So that's another way of thinking about tacit knowledge and tacit knowing and embodied expertise, which we can't codify in advance that we're making we're providing resources for conversations. Yeah. Great. Great question, great answers. Zack I think you had your hand up first and then Szilvia. Why don't you ask after Zack.

Great. Thanks guys for the presentation. I had a question regarding some of the insights from the multiple streams of data. So from what I could tell it within the multimodal matrix you had representation of the different data streams and you use that to create these proxy visualizations are representations of different streams of data and these were used to draw insights. And I'm wondering the extent to which you guys looked at the relationships between those particular data streams to generate insights.

I'm assuming this might have happened in that storytelling visualization and maybe I just missed it but it seemed like there is a analysis of this data stream separately, but I'm wondering how they were integrated together to provide some insight for the teachers are the students are the ones that about, about how the learner, the educators intent is being carried through into the user interface.

Oh well. Yeah. I know how to pronounce your name Zachari.

Yeah, we actually you know mostly what we have been doing with these prototypes is combining just kind of two things, you know the epistemic. As I mentioned that over there was mentioned, which are the actions that are happening. And we pretty much are combining them. You know, we try, we're trying to make sense to these data so the first thing we have are the actions that are happening. And then we can say okay during these periods of time.

The positioning and proximity and localization. The physiological activity was like this. So pretty much.

We haven't explored much at the meaning of combining the different modalities, which is something which is really interesting and I reckon it must be something of research. So, we haven't combined all of them to understand cooler insights. And I reckon probably would be very interesting to do that with the prototypes actually that teachers have the chance to combine the layers, so they can choose different, different layers over time.

But that's something we need to explore in terms of how insightful is for the teachers to combine them. And what kind of insights they get by combining them, or just by using one of

them. So pretty much we've been exploring what they say when they use each of them at the time. And we know what kind of insights, they can get from that, but not by the combination.

Yeah. So the layering interface allows you to hide and show layers you know like in Photoshop. So you can you can combine those different data sources visually.

And then there's the storytelling layers model that we showed the showing how pedagogical knowledge is coming in to a generic a generic model of data visualization right the gray boxes are the generic forms of data visualization. And then we're bringing in pedagogical knowledge, here, and here. Data storytelling principles here, to create that. And that's, that's why we would claim that we've got an angle and what makes an educational visualization, different from just any old visualization. Right. Teaching and Learning are different from other kinds of domains. But how do you bring that knowledge in.

Did you want to ask your question again?

First of all, wonderful presentation and absolutely great project I think it's fascinating. I just wanted to make sure that I understand that when you say that you integrated all in quants data by call data. Are you representing that call data for now, as you're indicating who's speaking, who they're speaking to, and for how long they're speaking, so you're, you haven't yet looked at the contents of their narrative is that true.

That's correct.

But there's absolutely nothing to stop us from doing that and then inserting additional rows and columns, and values from a rich human analysis.

So, yeah, I mean, the way I would say that there's qual data in there because we spend an awful lot of time trying to understand what that activity means that shaped that shape the way that we chunk the data or the categories of data we're attending to, and how he defined zones, you know what I mean you know you can only study, understand what position means in a place by understanding that activity deeply.

And then, Yeah, if you wanted to do a very detailed qualitative analysis of the text and the discourse etc then. Yeah, that could be done manually or it could even be automated potentially using the wonderful tools we have from things like encoder etc. So that's just waiting to be done is, Can I ask a piggyback question on that is, I mean Roberto mentioned some of the challenges with the audio. But I'm wondering, Is that part of what precluded say using a tool like na or. Were there other. I think you guys mentioned having a certain amount of a certain amount of data could you talk a little bit about why you might not ever mind what you I'm imagining ways in which different analyses could be combined with the tools that you guys are already putting together. And I think one of the big values I see in this work is kind of articulating what it means like in terms of the data representation itself how it can be read and read from multiple things, it could be both machine coded and hand coded. I think those are

really important tenants, but I wonder if you could talk a little bit about maybe why you didn't use DNA or why you could and how we might be able to combine some other discourse analyses with what you guys are doing. Yeah. Yeah, no, that, that, there's so many things so many topics here. And that also related with what sac asked about also exploring how to combine the different sort of modalities, pretty much. There are multiple responses. One, we were, we are goal is to show an interface to teachers and students to be used in brief. That means that if that's our goal. If we send the videos to transcription, obviously, that's kind of tangential if we have resources probably we will just do that and bring also the content of the conversation so that that's one thing. And that also then means that if the microphones, the technology to do speech to text conversion is not accurate, then that's a different project, we want to do it that's par for work for the next three years, using technology lapel microphones and try to use the best technology to convert from speech to text, um, why now we're gonna present the DNA, we have used DNA is just is working in progress and is committed to some of the revision. So, we didn't want to show that it's been. Yeah, that's a good practice, but we have been using it on. Now for speech content data but from some of them.

And I think the one quick side as well, is how to.

If we have been trying to find relations between, not necessarily correlations but relationships, that's also very interesting. But as I said, we have been focusing on kind of driving everything from the actions. And that's probably a because that's the language of the teachers so obviously they are not going to create a rule, saying, high levels of arousal are related to the position of course because there is no research on that. So, probably we also need to continue to conduct foundational research and related to the number of instances that we have recorded as well they are not extremely high require lots of complexity yes for doing. So we have a few data sets, and the largest one is of 11 session so it's really hard to find correlations or local sessions. From this data set. Very conflict so yeah that's kind of the little answers to.

That's great. And I think, I think. Hopefully these are conversations we can, we can also continue at the conference to I think David had a question if we could sneak one in I know we're coming up on time but we did start a little bit late so David Why don't you sneak one in, and we can do some closing after asking a professor to seek a question and when there's not a lot of time is almost always a bad choice, but I did. So, first of all, there was a couple things I really liked about the presentation, for one thing I just like to work.

But the presentation was also just it was very clear and there was a lot of complicated stuff going on, of complicated machinery, and it was really easy to follow. I mean I do have the advantage of having seen some of this work before but it was a it was a very nice job of kind of showing the deconstruction of pretty complicated algorithm. The other thing I particularly Another thing I particularly like web book and presentation of the work is actually that flowchart that you guys have that goes you know, K to M to I'm butchering it here but Simon just showed that slide, which does a really nice job of kind of mapping the conceptual logic, going from the original data through the data representation, through the data analytics and then out the other end, something that is consumable, you know there's a lot we talk about the

second part of that like going from some kind of analysis to something that is actually consumable by teachers, students or other users, but this actually lays out the logic of that nicely.

One thing I wanted to. This is, this is sort of a question but time permitting I'm also okay if people just want to just want to smile and nod and pass on it but you know one of the things that I think of is the hallmark of ethnography, and therefore also quantitative photography. It's actually the, it's focused on meaning.

One of my favorite lines rather than something super is that we don't live by things we live by the meanings of things.

I think about that as sort of a very ethnographic point of view. And you guys use the word meaning and meaningful a lot of a bottom shows up on a lot of slides and it was said over and over again.

And, and I'm, I'm wondering what you meant like what, how are you were using it in this context and how you were thinking about it because that seems at the core of the matter. And I think one of the common confusions is that we can only talk about meaning in the context of stuff that people say, and I don't think that's true. I don't think it's true. And I don't think it's what's going on here so I'm just hoping maybe you can expand our horizons a little bit as to how we think about the E part of QE in terms of like what you meant by, meaning and meaning coal and this through this lifecycle of the data.

Like kickoff.

Alright, so, exactly example we put up a slide that said here are the five critical zones. All right. That's what made that that room meaningful.

In that activity that, you know, we don't care about your x y position at the definition of centimeters. We care about broadly where you are, in terms of these five zones. That's an example of meaning in the activity.

Before we even come in and do any study stuff with technology.

So that's one way of thinking about it and that would be. That's what I would think of as ethnographic work. I mean we're not trained as numbers, but we are trying to understand the qualitative phenomenon question. All right, another sense of meaning is the sense making that goes on around these visual representations we create.

We've already talked about the fact that there are some explicit rules about right and wrong right but then there's the conversation and the meaning making that goes on when we put up a social diagram. And we can see that a particular nurse who was supposed to be the team leader was not stepping back and letting the team do stuff.

He or she was diving in and doing too much. All right. And that so that's a resource for conversation, and a way of saying to the team leader you needed to step back there. Your job is different. So, these visualizations which again we have to test with the educators and test with the students are meant to be meaningful. Because they are obstructions that filter out a whole bunch of noise and focus you on just one thing at a time, which is important for this, for mastering this kind of activity. So, I'll shut up now and I'm going to revert or glory wants to jump in with other angles.

Oh yeah, coming from ACI point of view of human computer interaction. And also working with data.

I think that's the takeaway message. When we talk about meaning is. Okay, we want to show some data, some imagined physiological data when you see time series. Actually we did that once you show it to the teacher. Um, what is important in the end is the meaning. So if we want to create a user interface, we are not going to plot data, we want to tell the story, because the story is how humans make meaning of the world.

And that's the traditional way of communication not stories, so that's kind of the link and why we emphasize, meaning as a key concern.

Yeah.

I'll just add the you know the stuff that Gloria was showing.

The reason that we are doing so much post processing on the raw data is because we want the students to take the messages from it, that we want them to take from it right, you put a chart in front of a student, they could read all sorts of stuff into it, that's not either wrong or it's just not helpful.

And so the idea of, including the educators intent in the storytelling layers is basically putting a filter in front of the student, but we're not apologizing for that, because otherwise they could just drown in the data. We want them to be able to extract the story from it, that's going to be most helpful for them as a learner.

Thank you. I hate to put kind of an end or stop to the or Gloria, are you going to say something? I saw your mic move. Are you sure?. Okay. I didn't want to cut you off if you had something to add. Um, so I know we have another question for me she maybe that's something that afterwards people could follow up on. I think it's a really great question, but I think David had an announcement that he wanted to make about the QE society and I'll just quickly say, hopefully we can continue this conversation at IC QE coming up. Initially, in January. I'm also look for an email about feedbacks we'll try to get your guys's email addresses for those who have registered for all these events so that we can hopefully improve or keep things that we think are working for next year's webinar series, and I just like to thank our presenters again for

their great work and also for their, their presentation and engagement with us today. I think it was, it was really solid I enjoyed it quite a bit. So thank you guys.

And then, David, I'll hand it over to you as we kind of finalize and wrap up to make a note.

Yeah, so I can keep this pretty brief, um, one of the big take homes from the last conference was that people wanted to have a learning society that are, or QE that they could. People could belong to and that it can do work on behalf of the community. And we, we have, we set one up. We have a board of directors and everything and as you can see this is one of the activities that the society has been sponsored as sponsored but I just want to let everybody know that membership in the society is going to be included with the registration fees for IC QE and that will cover your registration for this academic year and then going forward kind of at each conferences have a chance to chance to renew that.

But as of. As of, essentially the beginning of February, you can officially put on your CV that you are a member in good standing of the International Society for quantitative ethnography if you want and I'm sure there'll be more messages coming from the society and from the board. But I just want to thank, Brandon and Simon who've done such a great job in taking the lead on behalf of the Society for this. This particular activity and of course, the program committee chairs, other folks for the upcoming for the current upcoming conferences, one program committee chairs actually here with us. I don't know. Still, if you want. If you want to say anything but. So he's gonna be one of the program committee chairs for the conference that will be next fall. in Pepperdine assuming that vaccines work.

I just want to say it's a huge honor and thank you very much and I'm looking forward to it

as well we should probably call it there then Brendan yep Thank you everyone. And I see that, Roberto thank you for answering my question to and thanks again for everybody for coming and I look forward to seeing you guys in the future. It's been great.

Thanks very much, everybody. Thank you so much.

All right. Okay, it was great Simon, not at all surprised, but it's nice to. Yeah, there's a bit of an update on a few things since we present in 2019, and our Gloria's PhD is really pushing forward more on the storytelling interfaces, she's going to be implementing some tools to help educators design their own rules and stuff like that.

Yeah, I hadn't really thought about it this way until you guys were answering that question which is that some guys and I asked him, in some ways, in within QE itself. The formal mechanism for that construction of meaning is the step to the Big C codes. Right, so essentially the column, what it would be the columns in the matrix that you analyze our assertions about the meanings of what happened. The actual data layer sits as a data layer that sits behind that. Then there's kind of this reconstruction of the original data in terms of meaning. You guys are actually adding another yet another piece on that which another layer of meaning construction

which is the meaning construction that consumers are making. After the visualization is presented that is there's another re encoding of the data and a sensor encoding of the analysis. So I think that was a, that's a really interesting way of looking at it, whether that's the way you want to look at it I don't know but that's like I was like oh right there's a whole other set of codes, which is the encoding of the significance of the way in which these meaningful categories have been have been assembled over time.

And your choice, your choice of how you're going to make sense of low level data is shaped by who you're going to present it to.

So, I mean as researchers we would choose perhaps a different set of codes than the ones that we need to present back to the non technical students and educators. Yeah, although it does raise an interesting question as to what. So now you have two sets of codes that are interfacing right and so on the one hand, like, as ethnography offers. We, of course want our construe of culture that we're observing the activity that we're observing to be grounded in the understandings that people have. But typically we don't just take the codes. There's some of there's sort of a negotiation between our understanding in a systematic way.

And then there are. So there's a way in which now, like usually ethnography is written with the goal of entering into the people in the society so they can do something better.

And now you're sort of introduced this other side of the of your diagram there which is the loopback to people, but that now also introduces as they say sort of this other set of encodings. So it's not...