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Epistemic network modeling of pre-service teacher’s STEM teaching competence through collaborative learning design

Bian Wu
Associate Professor, East China Normal University

Abstract

Pre-service teacher training is crucial to guarantee the quality of STEM education. However, how teachers develop STEM teaching competence through collaborative learning design remains unclear. This study investigated high and low-performing groups who worked together to draft STEM lesson plans in tutor-guided online design meetings. An epistemic network modeling approach was employed to compare their STEM learning competence networks drawn from conversation. The findings revealed that there are significant differences in the networks between high and low-performing groups, which may contribute to the quality of their STEM lesson plans. Implications of fostering STEM teaching competence development are discussed.

Bian:

Good afternoon, everybody. So today I will talk about epistemic network modeling of pre service teachers STEM teaching competence through collaborative learning design. The first I will talk a little bit about my, what is my research focus, and how to use QE in my research. My research focuses on problem solving. There are so many professions that require complex problem solving a rare province. However, our school system faces some challenge to prepare our students to develop professional expertise. So the purpose of my study is to investigate novel ways of calculating students to think and act like a professional expert. Many using prednisone based learning approach. The what is expertise. The long standing tradition of studying expertise tells us it's like a black box. Many scholars, look at expertise from different perspectives. For example, to compare novice expert differences, regarding knowledge structure and problem solving strategies. Even experts can be classified into two types, named routine expert and adaptive expert. A letter is more favored for the flexible and innovative. If application of knowledge to enrich under find their understanding Jennifer's famous stage model actually depicts expertise development trajectory, in general, and a key change argument of expertise lies in the connection between, problem solving, and knowledge construction, which means learning and doing can reciprocate each other, and should not be separated. And we have varied stress. So comprehensive relations of expertise elements, beyond just cognitive aspects of static free. So another side of the coin is how we can foster expertise development.

That is to identify key features of expertise development, including relevant instructional strategies or learning design principles, such as deliberate practice. And we are still having ongoing debate about the effectiveness of foreign based learning or teacher as facilitators and the cognitive apprenticeship model that can be incorporated in authentic and simulated problem solving learning environment can also be used to develop an expertise or using mental representations to help learners build mental models, and so on. So, obviously, externalizing, our modeling expertise plays a critical role of both assessment and instruction. So much influenced by this book, edited by Simon and two other scores in my PhD studies, I focused on designing elearning environment, incorporating visualization based cognitive tours, such as integrating consignment and argument map to externalize students, knowledge, construction, and problem solving processes. During complex problem solving learning. This is a great way of learning to stimulate metamodel visualization, but not all learners are easy to get to use get used to that map join first and second struggling off cognitive to can't afford, or constrain how students think and act, which can be both good and programmatic, for example, how to represent non cognitive aspects of learning. So Nabil. Another big strand of mental representation study focused on a more naturalistic way language. We also have plenty of techniques to analyze still people's thinking, reflecting their understanding and competence. And I'm very glad to have the opportunity to visit David's lap. Three years ago. To learn more about QE and ama that belongs to the family of NASA. And I have tried to apply QE method in various complex problem solving domains to address the big question of how to develop disciplinary thinking. For example, data literacy clinical reasoning. Teachers design thinking and computational thinking and and teachers design thinking. So in today's talk, I would like to

share what we have done so far, a teacher education field to perhaps student teachers, the ability to design integrated STEM lesson plan so different from traditional school curriculum. STEM learning is interdisciplinary learning requires integration of science inquiry technological literacy math thinking and engineering design. So, distinct feature of STEM learning include student centered contents oriented secured under security learnings.

So the requirement of STEM education for teachers competence development. For example, the shift of teaching belief and practice, from more teacher, centered, to more student centered pedagogy, the extension of STEM related key pack, which means technological pedagogical and content knowledge around STEM learning, as well as design thinking, similar to those required in other design fields. Here we are talking about teacher, as learning designer, instead of knowledge providers. What's the challenge is that this is not usually trained in teacher education program, especially in China, because our pre service teacher training is theory discipline based, you enter the math faculty in our university, and is trained to be a math teachers. First, a second, the predominant pedagogy, in K 12 classroom is their teacher centered. For many reasons, you know, to me, STEM learning design is kind of your structured problem, because collaborative learning in STEM education requires probabilistic design views to address the emergent complex and idiosyncratic interactions among different student groups STEM learning design. Also, unlike the class classic model of instructional design, such as Eddie's. Add IE, which follows a weird structure, step by step, linear sequence to relies on deep understanding of design principles and creativity, implementing those principles into appropriate teaching strategies.

Besides, the STEM learning design, often takes risks that novice teachers fail to link learning outcomes, back to the goals of STEM learning, or as we and MCI indicated the traditional instructional design focuses more on the inputs. They suggest that learning designers considers learning outcomes, before deciding on the approaches to teach and learning called backward design. So, stem lesson planning requires this imperative circus of design and redesign, as well as reflective practice that is design thinking is both complex and creative processes. Also many studies have indicated that teachers perform better when planning lessons collaboratively and individually. So in this study, we have 24 second year, our graduate students majoring in education technology, and they have complete tsds capstone project in the cost code introduction to the learning sciences. They have the participants have no prior instructional design experience. They will classify into six groups with four students per group. And for that assign into two conditions. Why is static scaffolding cohort wise, adapt is scaffolding cohort. There are complete, seven hour sessions, one face to face sessions. One half hours. Design discussion precision. And we use DNA to analyze their design discussion. During these seven tasks. So we adopt the idea of virtual internship in STEM teacher training. So in a fictitious primary school, the pre service teachers were required to design a school based STEM learning module. The online learning environment, and some features like modeling some backwater stem design procedure. By Design task, description, and firm design groups to do collaborative design, offering cognitive tools to guide learning design and tooling support during design discussions. When we consider as a tutoring support. This is a major challenge for the tutors to monitor different groups and guide their design, just in time on the previous study indicated

that software scaffold can provide predefined classroom prompts relates to with everyday tasks, but other scholars do believe that P scaffolds are human tutors can offer more contingent support.

So we designed these two types of scaffolding conditions, the steady, steady scaffold provided the guide question at the beginning of each design, discussions, while adeptly scaffolded provided by the tutor human tutors asked the same direct questions during the design meetings. As a three stage of backward design were further divided into eight design tasks like in the first stage, they need to define the authentic province, identify the learning goals. And in the segments, stage. They need to design the learning evidence, and linear assessment, and also refine their first draft. And the final stage, they need to further design their learning activities, affordances and rap as a final lesson playing in the third stage. So, this is a kind of STEM lesson planning example, I'm sorry it's a Chinese characters, but you can get some kind of flavor about how it looks like. It's actually automatically generated from there, using the lesson plan tools to do the design solutions. So my question is, how do stem pre service teachers develop their design thinking companies collaboratively on a static scaffold and adaptive scaffold. And we can hand off charities coding schemes, focusing on 10 aspect. Firstly, is because this is a collaborative problem solving, collaborative lesson design. So we focus on their lesson design processes. And also we focus on the social aspects of lesson design as the as the stem topic. The Learning Assessment design of the learning activity and learning goals, and also the fourth subjects. This is kind of typical interaction patterns for the static scaffolding cohort.

So you can see that the first line, the member, actually, usually repeats the guiding questions proposed by the guided questions proposed by the static scaffolds, and the members. Usually follows the past passive interaction mode to answer those guided questions. And usually some other members will agree their answers, with no change the static scaffold seems to suppress divergent thinking and encourage the group to reach a consensus prematurely. So this is another example for these groups, the mix and match strategy was widely used, for example, online. Members suggested that revising their design based on another members design solution, and the lie for the members later said that they could combine two other members assessment design into a tether. However, they did not elaborate much of their design rationale and some members in line 11 later pointed out the design criteria proposed were not systematic, but they failed to find out a way to justify their solution. So this excerpt so strong connections between learning assessment and other elements of STEM learning design, which is a critical step in the backward stem and design, design extend the static scaffolding. First, the development of routing expertise by modeling design process. The group was more willing to assign subtypes to individual members and adopt a cooperative strategy to complete the overall design work.

And this is accepted from adaptive scaffolding groups. So their STEM learning topic was amazing amusement park design are in line fine, the tutor, identified in kangaroos views and asked his group members to reflect on their previous experience of design learning goals, and in line six, a group member has the opportunity to elaborate on their opinion and negotiate the solutions with group members. And finally, in line, 11 and draft the group's agreed. Our right

verse version that combines the stress of two seemingly contradictory design solutions. Though these accept shows, comprehensive connections between STEM learning themes and in goes activity design, which will affect the a more coherent, learning design solutions. The human children not only proposed the guided questions, more adaptively. I'll also point out, important issues, emerging from group discussion to directs the group members tension and JIRA cognitive conflict resolutions. From the AMA we show that the over subtraction network reviews that as a static scaffolding cohort in red showed a stronger connections between sites subject with design process, and the assessment, technology mess element, located on the right hand side of the project is based, which emphasizes the importance of line discipline in norridge, we design process and assessment, where the adaptive scaffolding cohort showed a strong connections with learning themes, their learning goals, activities, and engineering. So located on the left hand side of the project is space, which reflected security and more goal oriented projected based on that stem lesson plan. So by looking at their net worth difference across different design tasks, we find that adaptive scaffold groups and static stifled good differ in their focus on STEM learning design dimensions, by show the comparable connection stress as the first stage.

However, during the progress of design activities, the adaptive scaffolding cohort, develop a stronger and more comprehensive connections than static scaffolding cohort from task, two to six only until task seven study IQ Stafford outperformed adaptive Stafford grouping building more connections. Fantastic two to six. So Debbie Stafford showed a clearer design patterns, shifting from connections with learning goals to learning themes. Learning Assessment learning activities, and finally Institute security Knowledge Center scan static scaffolding groups. The results suggest that although the true costs are received the same guided questions, the cohort with adaptive scaffolding will be more productive connections between the design elements are referring back to the previous design steps, such as such a curative design patterns can help to build a more integrated them lesson plan. So the same trajectory and firm said both cohorts followed the general backward design processes of moving from stem topic context design to linear assessment design, and finally to the detailed learning activity design, and the linear sources design. And we also measured the predicted centroid distance, which revealed, increasing divergent design patterns, except for testify, which is a refine drafted design solution and task seven, which is a final wrap up of the refinement. Regarding the overall network difference, and I showed before divergent trajectory for the suggest the static Stafford groups, as they are design thinking, moving towards a more process oriented, whereas the adaptive scaffold group and moving towards a more production oriented design patterns.

So, to summarize scaffolding group actually focused on the backwards Stelling design processes and create an established initial recovery of STEM lesson plan for developing their design thinking while adaptive scaffolding group folks are more holistic and interdisciplinary STEM learning design solutions and STEM learning design requires more than a formalized design process, such as conflict identification and resolution and creative designs as a co evolution of programs solution can be formulated through back and forth between different design elements and adaptive scaffolding and static scaffolding play different roles and should complement each other to balance the flexibility and the structure nice steady scaffolding, in

the form of guided questions provided as the beginning of each design tasks can easily routine eyes the backward design process and draw designer's attention to critical steps and design principles poster design knowledge synthesis, and improve pre service teacher staff efficacy and competence in their lesson plan work. Adaptive scaffold help engage group members to share different perspectives and negotiate to reach a more coherent design outcomes. It can better regulate utility and the reflective design thinking, adjust the emergent concerns of design group and promote the flexibility in the design process, and its results. Now that we kind of curious about the relations between their design process and design artifact. That is their lesson plan.

And besides, we know that pre service, teachers, previous learning experience. usually teacher centered, as some research has argued for teaching beliefs underlying teaching behavior may not be easily changed. So we hypothesize that stem design requires on learning traditional way of teaching to create new tepeyac of STEM then we further investigated design process of two quite distinctly groups based on their quality of STEM lesson plan. We try to develop stem lesson plan evaluation criteria based on some existing stem competence framework. Why is from the United States STEM education Quality Framework, and why from stem teacher competence standards, from National Institute of Education, Science in China. The two teacher educators, assess the lesson plan based on these eight criteria, and we choose from adaptive scaffolding Cohort One high performing group, and one, low performing group. So, one major difference in high performing group is high performing group had more authentic engineering change in their lesson plan, while the low performing group solution is their knowledge oriented in this study we kind of revise our original coding scheme to combine four subject codes into one code and remove the code, about, such as four pack of design processes, to make it more succinct. So the hype forming group, we can see from the network civita STEM learning design from describing authentic learning context to outcome based design solutions and emphasized answer learning assessment, while the low performing group tend to design a STEM learning around the disciplinary knowledge, and design learning activities around knowledge understandings.

Then we look at the five stages, from first to middle to the final stages, the high performing groups, followed step backward design processes to consider the learning outcomes and assessment before activity and affordance design, while loop forming group still chose to design activities in details first and then consider how to evaluate students learning performance. We have found evidence of consistence between the design process and design artifacts that are reflecting both STEM learning flavored favored features or traditional discipline. learning favorite features, which seems to corroborate our hypothesis that teaching please place some kind of roles to influence STEM learning design. So these are some premium luminary findings of our study, and I'm very happy to answer your questions and get comments and feedbacks. But before that, I also have two questions that expand further discussions. So, we can see that many studies. Now this might mention about aligning learning analytics, with learning design. So how can QE inform effective learning design for professional expertise development. The second is where I share my study with STEM teachers, they often expect to see valid instrument for assessment purpose. So how can DNA be used for formative and dynamic assessment of

professional competence, for example, teaches them lesson plans or student stem lesson learning performance. So that's all for my presentations. Thank you.

Fantastic.

Thanks very much. Thank you. Joy of online you can hear one person clapping. But lots of people clapping.

Okay.

Right. Well, that was, that was a very, very nice presentation, there's a lot of work there it's always tough to compress that into just a short summary. And I'm sure that that has whetted people's appetites to go and read your papers and see the detail, some very nice examples of how you showed the time snapshots of the DNA changing, which is very compelling. So, I'm sure there are lots of questions in mind. Does anybody want to post the question to the chat or put your, put your hand up by putting your clicking on the blue hand in the participant panel, and then we'll just allow you to ask you a question so have a little think.

While you're thinking, I'll kick off with one, just to think about. So, what you're finding is that when you have a human, as not a, not an artificial intelligent agent, but a real human engaging in the conversation with the students then obviously that had beneficial effects. So are you interested in trying to understand what the human tutor was doing in order to try and scale that into some kind of smart learning environment, which is better than just the static questions handed out to the students.

Yeah, I think from my readings they're chatting, discussions, I find that they kind of instead proceeds rely on the answer sheet human tutors, they can be assured that someone will guide them to give them the confidence of doing these lesson plan activities because they have no prior experience in instructional design. But in the, in the static scaffolding groups, sometimes they, as they cannot figure out what they are wrong or right so they kind of have lost feelings, so they can only follow the routines of doing this work. So these are the biggest difference between these two types of groups. Right.

Yeah because learning to do this backward learning design where you start with the outcomes and then think about the design of the tasks, and then etc that's that's counterintuitive. And so the human tutor is providing that scaffolding about the process. Yeah. David, throwing to you.

Well you know me I always, always have questions, I'm actually I want to start with just some, some comments because there were there were a ton of really great things in the talk and I know we've been, you know, partly partly the meta discussion around these webinars is also like how to think about communicating Kiwi ideas. I mean, one thing I'm struck by I'm looking at you, Mike. Phillips is like teaching is so hard. Like, learning to do, learning to teach well it just is I think it's people don't appreciate how hard it is, and I remember when we were doing our own work on virtual internships that you've had played, you've been connected to to be like no

matter what we did somebody always said because we were in education, like, could you do a virtual internship for teacher training and we always said no no that's way too hard like we don't even we don't want to touch that so I applaud you just for taking that off. Another thing that I really liked about this was the way that you really walked us carefully through that. The ethnographic data first. Um, you know there's there's been some discussion in the QE community about, you know, this the importance of putting the E and QE doesn't really work if you just use the quantitative ethnographic tools and aren't actually presenting some kind of grounded understanding, are we still doing that, we still doing that session Brendon is that or did that get put on the cutting room floor. We talked, we talked about holding workshop called putting the E and QE interpretation one should get towards that just yeah okay they had so big.

Yeah, you can say more about that. So I just, I just wanted to, like, highlight that as something that was really good. And, you know, Another thing that I really enjoyed with seeing the trajectories and seeing several different ways that you looked at them in particular the kind of summary view with the trajectories drawn through the points and then also walking us through the individual pieces of the trajectory and then even looking at the timing by which certain connections got made, which route is foster has done some of that, a little bit of that in his work, but I haven't, I haven't seen much of that I've seen that kind of trajectories drawn and I've seen occasionally people sort of showing change over time but I've rarely seen somebody go in and sort of point out that like this connection gets made first and then that one song. So I saw that was really cool. Um, I have, I have, I have two questions. One is a selfish one one is actually an interesting one. Let me start with the selfish one first. So, I noticed in the, in the data that you like that first piece of data there was all this I agree, I agree, I agree going on. Was that was that kind of persist throughout the data. Did you like a lot of sort of people just saying agreement, but not elaborating on things.

Yeah, it's kind of in the study cohort scaffolding haha this is kind of a typical patterns because they have kind of guided questions. So they were very focused on these questions, and they kind of have more convergent thinking about these things. So when some students, pop, answer the questions, others, usually they will agrees with these answers. They don't have too many divergent thinking in this way. Yeah.

Yeah, I mean, so, so here's what so here's what was behind that question if it's happening all the time. I'm like, I've wondered for a long time. What to do when somebody says, I agree. Because there's two ways, two ways of thinking about what what to just how to think about that conceptually, do we just say look, I'm not quoting that for anything in terms of like my qualitative codes, because they didn't actually say the thing you know the things that I'm looking for. Or do we say well you just agreed with what the previous person said so that's essentially you saying something similar, right, in which case we should give you credit for the codes from the line before. And we have Brandon maybe you can talk later if there's time but I think you did, didn't you do some look, some looking at that at that problem but I'm just wondering bn how you were thinking about that, because it occurs to me that if you code the agrees, as essentially the same as what was in the previous line, then you would actually see convergence because people's DNA models would move together. If you just code them as

basically zeros, then you're not actually seeing convergence in the DNA, even though that's the thing that you're sort of claiming qualitatively it's happening. So I'm just wondering how you how you if you thought about that and if so what like what your thinking is about.

Oh, I Cody it's like more like her social dimensions. Because I think I see a cake. Yes, I do. Yeah.

Okay. So yeah, because they say more kind of not to change too much to, to make someone lose his face, you know, and they also want to make these paths, working more smoothly. So this is, I think their first concern about why they want to agree with this.

As you see you quoted for directly that was the solution to the problem code of convergence. Good answer. Okay, can I pass it over to Carl, he has a question. You can unmute yourself. You're still muted. Oh, sorry. I thought we had. Okay, you should be able to unmute yourself now.

Okay, thank you. That's a great presentation, and it's a scary one to me. It scares me because I used to be a teacher in a European University in China. When I was a teacher and I taught in colleges I prepare by my lectures just in the freestyle Nether, and I never knew that I need to decide and Neptune is such a complicated way. It seems scary What are you by were a teacher now. Do I have to go through. Just kidding. I mean, yeah, David, this is a teaching it's a very complicated job. And it's kind of interesting David mentioned, a Gregory issue, because we just hours ago. Brandon I talked to, carrying from watch may have this key we will talk about the risk, kind of agreement collected are such kind of things, how do we call that or should we just escape this, I guess this will be a very common problem in the, in the conversation data. So how we should do that. We should have some common office and if they have value in it, like David said, I, if I say I agree, looks like I'm just a represent represent what you said that, which means everything coded in that mind should be coded here or this is completely different events. So these are issues we may need to consider one minor thing I want to raise this I see your, your present the some group differences are. I'm asking classy so that you have a chance to tell us more.

And, but I didn't say the statistics are those differences are significant or just a minor differences, because if you have two groups, you can always say always say two different networks, but how different they are. I'm just curious, again, is he okay thank thank you Jim. Yeah. So, we, we did find significant difference between these two groups, because they actually found both Irene. Chad data's, we find these kind of typical design patterns, and we use DNA which can show their confidence intervals of their centroid point of networks, and we find these significant difference in the overall design networks, about when we look at their design trajectory. we do see that they are becoming more divergent seems that the difference become more larger is at a later stage, because one group is more process oriented way of thinking about the design work, and one other is more outcome based outcome oriented way of thinking so these are quite distinctive features of these two types of scoops. Okay. All right, thank you. So the question.

Hi, thanks for that. Great. Great presentation. I have two questions actually, one was you had this really interesting visual entitled distance between two trajectories and I was wondering if you could walk us through what that actually meant in your specific project. And then I have another question but I'll leave that for later. Okay, so I, I'm just curious about we do find the subject networks have their general design, design tasks to see that one group has aesthetic staff voting groups they focus more on. From disrupting the mortgage and design process wires adaptive scaffolding folks more planning, more coherent integrated project based learning. So these are kind of the general difference between these two cohorts, but we don't know how they developed and we use these measures of central point to actually figure out that the difference is quite like a progressively developed become more and more oriented towards process based design work, and the more outcome based design work. So this is why we use distance measures to see they are developing this trajectory.

All right. Can I ask my other question to do it. Yeah, sure. I, you had, if I saw correctly you had in one network codes that refer to the topics of certain acids, and then you had other foods to represent interaction and that sort of thing. Yes. Did you consider using the topical codes like math and science and I don't know what you had there. Did you consider using them is like grouping variables instead of putting them into the network itself.

Um, this is a very good question because we do have another challenge where we did these kind of work, because in our first round off of the study we actually didn't ask different groups to we allow them to design different stem topics. So they kind of have many different vocabulary, because about their subjects are quite different. So this makes coding process, more, more difficult. Actually, and we cannot find very consistent patterns, either within the same step scaffolding cohort. Because as the topic are quite different. So in our second round of studies, we actually us all groups to design the same topics, but they say they still have different types of design scaffoldings.

And in this way we kinda have to look at the patterns more clearly. So this is what I actually do to address these problems, but I didn't do as you said, I think this is quite a good idea is to see how the tops actually influence their performance, but this relates to my Christian studies.

Sometimes we find it difficult to actually, to give dynamic assessment.

Formative Assessment during their design works. But if we ask them to allow a gives them too many opportunities to two different words, it will be more challenging to give our formative assessment for different groups, using some DNA technologies, it will be more challenging work.

Yeah. Seems like there's a tension there. I like Sylvia I like that idea to have potentially looking at like, do you see different patterns based on what's being discussed and I think it would fit nicely into the style that being used. I kind of want to echo what David said in terms of how you presented different views of of the same phenomenon, by taking different slices and saying, This is what I mean here this is what I mean here really showing us kind of how to go through

and I like, I like what Szylwia was saying too that's another cool way to do it, there would be a nice compliment. I wanted to circle back to something that Carl and David mentioned related to what you were talking about to be and in terms of like the agreement thing I think it is kind of a sticky thing to figure out how to code for, especially given the dynamics of wanting people to be able to say face, trying to achieve a specific goal. And one of the things that David was mentioning in some of the work that we looked at before relates to trans activity. So how much does someone engage with someone else's ideas. So if I say I agree with something I'm engaging with your idea but if I say I agree with this specific thing that's a little bit higher level of engagement I'm being explicit which would get help with David's question of how do you code for it because we'd have that specific thing to code for where I agree with this but not agree with that. And the other thing, beyond trans activity and the levels of engagement that people could have with each other's ideas during his design process could also be this concept of agreeing or disagreeing and we had one study where we were looking at. basically different groups of people discussing a controversial topic. And so, are actually different controversial topics and you could see there's opportunities for people to lose face or for them to be tension and stuff like that. And one of the things that we had two different hypotheses that we're working with one was that it matters when people say they agree or disagree.

And that's really crucial and another one was well it doesn't really matter if they say they agree or not it's more about what are the specific codes that they're the themes that they're talking about the ideas that they're talking about. And the long and the short of that is to cut to the chase, basically in one study it didn't matter, so that hypothesis held that the difference between these two groups was still there, regardless of whether you put an agreement or not, but for one another question it didn't matter. It really didn't matter which specific things they were saying they agreed with or not.

So that's kind of a slightly separate thing. Both of those are related but a little bit separate to what David was talking about in terms of how do we decide to code for the agreement, the trans activity and how deeply they pick up an idea that helps with that, but I think it also depends on the rest of the constellation of codes you're looking at and how they're what level, those are cast at.

So, it, I think it can matter and it's definitely it could be a fun thing to explore. Anyway, so that was a bunch but also just awesome I really appreciate getting to see you walk through everything It was great.

Okay.

Mike you've got your hand up so you still got your hand up. Whether that means you want to come back on something but I'll pass the mic, because I can't I can't lower it. Could you do it for me.

Yeah, Zoom just disables us in certain ways. Okay. Mike, thanks Simon, thanks bionics This is a fascinating topic and one that I'm really interested in and David and and Brendan and others

thanks for raising that the idea about agreeing with somebody else and I want to sort of add an potentially different kind of an idea in this particular example.

So if I'm not sure in China, the histories of educational histories of students but at least here in Australia. Typically we find students will come from a particular discipline area. And then we'll do their teacher education, work so you'll have somebody who's done a science degree or an engineering degree or similar.

And I think you had a really nice diagram as part of your presentation where you were talking about science inquiry technological literacy mathematical thinking and engineering design, and the different ways at different disciplines, think about their content, think about the way in which they present information. And so I'm wondering where we have a situation where somebody says, Yes, I agree. In a stem situation, an integrated stem discipline. Whether disciplinary expertise or nay naivety means that I'd be more likely to agree with David, if it's a mathematical kind of a question or problem that we're trying to solve. And he's the mathematical expert and I have more of the technological side of things, maybe Did you did you think about that at all, in terms of grouping people together or.

Yeah, yeah. Because in these studies, as participants are all recruited from the same majors, so they don't have much a different background, so I I actually, I would like to kind of do is this kind of study, as you mentioned, to include the student from different disciplines background, so we can see that they're challenging each other they have more argumentations, so they agree or disagree will be more related with Davies comments that maybe they are another meaning, their terms. Yeah, yeah. Fantastic. Thank you. So, yeah, it's a it's a great study, I really enjoyed your presentation. Thank you, and good.

Thanks. can I asked you on your on your final slide you talked about the things you would like to do.

Next, the kinds of questions you are raising.

Now one of them which I, which I think is a very exciting question is about how could he na help with dynamic formative assessment to close the feedback loop to these pre service teachers.

Now, in a couple of webinars in this series, people have been wanting to talk about showing DNA diagrams back to the people they were interviewing, or studying.

I wonder whether you have any thoughts about that, or whether you are thinking about DNA, enabling other kinds of feedback but you don't actually show people these networks, or do you have any thoughts about that. Yeah, I do show the networks to some teaching research staff in our specific communities and they kind of understand the whole process of how hive generates these DNA networks, and understand these meaning box they also agrees as major change is about the coding process, it's kind of difficult for the teachers to do these kind of works. And, for example in STEM applications, say, they would like to see if there's a kind of general

assessment truths that can be applied into their classrooms, but they cannot do these kinds of coding works. First and Second is kind of the learning curves for them to interpret their networks, so that safeties may get some trainings, but I think that later part is more easier than the formal part.

Right. Okay, so you've showed it to your fellow colleagues who are doing research into teacher training.

You haven't shown it to the pre service teachers themselves. Not yet. Yeah. Right, right. Yeah. No, I understand what you're saying about the complexities.

David did you have another follow up on some of those future oriented questions beyond was was highlighting.

Yeah, yeah, I, I do want, I was just actually trying to find a paper that came out a little while ago I think it was in I think it was in the learning sciences conference about an in an interface that was designed to make a DNA, make actual DNA result, more consumable for an end user it was for teachers not students but interestingly Simon it sort of did a little bit of just what you were saying, that is it did show the interface, but it also showed what might be actionable from it.

So that you didn't have to do all the work of interpreting yourself, I'll see if I can find the link. That was the lot he heard or. Yes, right. Yes, that's right. If you have a, if you have a link to it handy maybe you could pop it in there but also there is some prior art on that. And it was. What we discovered by the way is that the teachers didn't have enough time in the classroom to use more or less any kind of formative feedback on the fly.

So, that gives us some surprises in terms of that your other question though.

You know one of the things that we never did and I'm trying to wrack my brain now is right we didn't but I mean it does strike me that you have the possibility here of centrally doing a kind of predictive model with the data that you have right so I'm sort of thinking, you know, there are certain moves that the the adaptive facilitators are making they're choosing to ask certain questions at certain points in time. And I'm wondering whether the state of any any network or the trajectory of any app or any network, maybe up to that perhaps in combination with the actual things that were just said recently, like whether that there's a way of of kind of predicting what the, you know what, what question the, The, the mentor is asking, right, and that might be a way of kind of moving towards this this integration but you know I agree with you the coding thing is really problematic and, you know, that's why. That's why we started, you know, worrying about questions and systemic frames and we wound up having to like build coding tools because we realized that he couldn't solve that problem. And you couldn't you couldn't do anything writ large. So I that's absolutely kind of at the center of things. That's why sillies doing you know developing rock and like we clearly need a better way to get a grip on on that.

You know the alternatives of like topic modeling are just are just really problem Matic especially if you're trying to do something in a, in a classroom where there's some stakes involved in the sort of feedback of that's helpful, but that's one thought and something you can do.

Right.

So one question I have, and you've hinted at this already. Beyond that you have been sharing this with your colleagues. I'm wondering Can you can you comment a little bit about what kind of reception this analysis is getting from the different kinds of research communities, or peripheral practitioner communities that you engage with what do people think about this kind of analysis.

We'd like to discuss that in this webinar, because you know, all of us are talking about this kind of work to people who may be unfamiliar with it.

Can you say a bit about that. Yes. I have been also communicate with some other researchers who are curious to know more about QE a una, and they would also want to make comparison between the DNA and a social network analysis, or we we say the transitions state analysis of sequential analysis to see the difference between this new method with a previous related method. So, so these are major concerns, and what, what's the difference, and what is where.

What's the result we are clear about the DNA. So I think this is also another major topic.

How we can compare different research methods, or even complement OR integrates different methods to give comprehensive understanding of the situations.

Yeah.

Okay. Well, that brings us beautifully up to, up to the hour so let's think beyond one more time for for presentation.

I know that.

Thank you very much. Brendan I know you wanted to put in a quick advert for something that may be of interest to everybody.

Yeah. Hold on one second. Let me put it into the chat here and so, um, we are going to be hosting a lot of people from around the world are going to be hosting QE event coming up in about a week and a half I just put a link to the event in the chat. We're calling to curious meet up but basically the hope is to get people to to connect more people across the QE community, develop new skills. So there's going to be workshops and specific events. So you can take a little bit of a closer look there but it should be great. A lot of the people from the early career workshop and the doctor consortium from iq 19 are helping to run it. There's going to be I think Silvia and gj are going to be giving kind of a workshop on rock, which will be cool. And if you're

interested in doing that you check that out for this and then come to ICQE20, and get like a more in depth one. There's going to be one about interpretive like this is related to what David was saying about putting the E in QE, how do we interpret QE models Bian gave a really great example of showing. Look at this connection look at this connection here's where it's happening after he showed us what that looked like in the, in the call. The call data itself. So we're pretty excited about it. We have a bunch of mentors that have signed up to help people it is first come first serve so you might want to jump on the registration, but it's a way to help people prepare for if they're trying to finish a study or submit to the next ICQE conference or whatever it is. That's kind of the hope, connecting each other and helping to continue to develop skills and produce more good research like we saw today.

So that's the chance to get much, much more deeply into this kind of work. Were there any other announcements that I had forgotten, David.

That's just the next we've got the next next webinar right. Yeah, for sure, so that's that's my final point.

The last one of the year is from Roberto Martinez Maldonado who is at Monash University in Melbourne. On the third of December, so about one month from now same time and Roberto will be talking about what happens when we try and take a quantitative ethnography approach to multimodal data, which is studying embodied learning, rather than online learning. So, adds a new layer of trust and complexity.

All right. So thanks very much for coming, everybody thanks again to Bian who's gotten up very early for this presentation to us all, we really appreciate it.

Thanks very much, everyone. Thank you for coming. We'll see you in a month.