from

Supporting All Learners Using Active Learning Pedagogy

WEBINAR HELD: Thursday, October 25 from 3:30 - 5:00 p.m. EDT

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0:00:00 Jennifer: Okay, welcome. Thanks so much for joining us in our second ARISE event in our Community Webinar Series around evidence-based transformative and teacher preparations. We at AAAS are very excited about our presenter lineup for today's program, and it seems like you are too. As again, we've had about 340 registered signup for the live event, or to receive a later recording. Thanks also to those of you who attended our kickoff webinar last month on STEM teacher retention. If you missed it, the archive is available on the nsfnoyce.org website, just click on 'ARISE Community Research Webinars'. It's up in the right-hand corner, in red on the right navigation. We appreciate your support of this work and hope that you will continue to be involved with us as both participants and contributors as we launch more ARISE programming in the coming month. Before we dive in, I'd like to review a few housekeeping items. First, we're gonna do a couple of polls, so I'm gonna launch the first poll here for you to see. So if you would take just a couple of minutes and answer that poll, and as I'm talking I'll be switching to a few more polls here to cycle through and get a sense of the audience and this budding ARISE community. This session is being recorded and will be distributed via email to all registrants next week and accessible via the nsfnoyce.org website.

0:01:46 Jennifer: So I'm gonna go ahead and close this first poll, and I'm gonna switch over to our next poll. If you would please take a moment and answer that poll, about where you're located so that we can get a sense. All participants are muted to minimize background noise, however we welcome your engagement. Please type your questions into the question box and we will address as many as possible at the appropriate sections. Contact information for all facilitators and participants will be displayed later in the presentation. So I encourage you to follow-up with me or with presenters directly if we are unable to fully address your question within the time allotted for this webinar. So I'm gonna close our second poll and switch over to our third poll, if you'd take a moment to answer. Also please note that two resources have been uploaded for you and are in the handout section of GoToWebinar. So if you take a look at your control panel, there is a gray section called "Questions" that's around the third from the bottom. I'm sorry, that handout is the second from the bottom where your handouts are. The first is slides from today's webinar, the second is relevant resources that have been recommended by our presenters.

0:03:13 Jennifer: So, please take a moment to download those for your future reference, and just above the handout to the question. So thanks to everybody for answering the poll. I'm going to close those now so that we can to continue to move over to our next slide, which is about Active Learning Week. This webinar coincides with both Active Learning and Disability Awareness Month. AAAS is proud to partner with leading organizations to bring active teaching and learning strategies to the forefront of national STEM teaching conversations. So I'm gonna go ahead and launch our last poll, which ask you to indicate your experience with active learning. Also, when I switched back to the other screen, and in the handout of the slide that you're downloading, there's a link for the active learning flash, so that you can go there and demonstrate your commitment to active learning. Don't worry if you aren't sure what activity to to pledge, our presenters today will be sharing some great tips with you. So thanks for indicating your experience here regarding active learning. I'm going to close this poll for now. I know this is a little quick, but we have a lot of programming to get to. So there's that link for you.

0:04:48 Jennifer: Just want to tell you a little bit, speaking of our presenters will be providing those tips about the agenda today. So right after the introduction, we will jump into Dr. Jiwon

Hwang who will be sharing her research with us, and as she is speaking, if you would please type your questions into the question box that way when we get to the Q&A period that's directed just at Dr. Hwang will be able to take some of those questions, so you can get more information directly from Dr. Hwang.

0:05:25 Jennifer: When we finish with her question and answer period we'll go next to national researcher, Dr. Jose Blackorby. And again, while he is speaking, if you would send in questions to direct, just to Dr. Blackorby, then we can share some of those questions and get some of them answered for you during his question and answer period. And right after that, we will move on to our STEM teacher leader, Dr. Richard Eitel, and he will give his presentation and again, during that we send in your questions into the questions tab, not be a chat tab, so that I can monitor that and direct your questions to Dr. Eitel. And then we'll move into some of the closing takeaways, and we'll have an opportunity to do more of a discussion with our panelists and get some more of your questions answered, so feel free to keep them coming so that we can have a vibrant Q&A session.

0:06:34 Jennifer: So, just going to share the results of the poll. So for a primary role type on the screen, you can see the results, we have about 40% faculty, 12% administrators, 11% researchers, 10% teachers, and a lot of people that do a lot of other things. And I'm sure many of you wear many of these hats. So I'm going to switch over to our next poll which was about regions and share the results. So we do have coverage of all the regions with our North East and Mid-West leading attendance today. Thanks to everybody for joining. And next, the question asked about your funding experience. So a lot of you have never submitted to NSF, some of you have current or past Noyce funding and this project is associated with a AAAS's work with NSF and Noyce. And some of you have funding from other NSF sources.

0:07:57 Jennifer: And finally, what we're here for today, your experience with active learning, and to get more tips and tools to implement active learning more regularly. A lot of our audience are seasoned users with regular implementations, we have some who almost always use and a little over a quarter of the audience that is waiting for us to get through to our guest presenters, so that they can find out more about the topic. So now that we know who is here, let me tell you just a little more about what you signed up for before we jump into our first presenter.

0:08:48 Jennifer: So founded in 1848, the American Association for the Advancement of Science, is an international non-profit organization dedicated to advancing science, engineering, and innovation for the benefit of all people with more than 120,000 individual members in more than 91 countries, AAAS is the world largest multidisciplinary scientific society, and a leading publisher cutting-edge research through the Science family of journals. You can learn more at www.aaas.org. ARISE organized by AAAS's Education and Human Resources programs department seeks to provide resources, tools and a community to foster research in evidence-based innovation in STEM pre-service teacher education and leadership development programs.

0:09:40 Jennifer: The ARISE network builds on AAAS's provision of technical assistance to the Robert Noyce teachers scholarship program since 2009, and collects and shares information about topics and strategies for research in evidence-based approaches to prepare STEM teachers for the future, it does advocacy and STEM teaching and understand effective ways to recruit, train, and retain high quality STEM teacher workforce. In particular, this ARISE community webinar series intends to encourage...

0:10:13 Jennifer: Encourage experimentation and engagement with current research to advance knowledge and solutions to persistent challenges in STEM teacher preparation, particularly in high need school districts. All of the webinars just like this one feature multiple stakeholder perspectives. Each session topic, is presented through lenses of dissemination of research findings from cutting edge prominent researchers, evidence-based results of innovative STEM teacher preparation programs and teacher leader voice-to-ground discussions. I've mentioned that at the beginning in case you missed it, webinars will be recorded and archived for your usage, sharing and you'll receive that link next week. This particular session focuses attention on evidence and best practices around Universal Design for Learning or UDL which is a research-based framework that addresses the wide range of variability found in today's learners, also effective instructional approaches to promote STEM achievement for students with disabilities and inquiry based engineering design.

0:11:19 Jennifer: It hopes that all of you as participants will seek to implement these active learning pedagogies in your own practice and contribute to this growing and exciting field. So we'll move on without further ado to our first presenter, Dr. Jiwon Hwang, she's an assistant professor of Special Education in the Department of Advanced Educational Studies at California State University, Bakersfield and her research interests include effective instructional approaches for teaching mathematics and science, curriculum adaptation, and STEM education for students with mild and moderate disabilities. Dr. Hwang believes this research focus can enhance student's mathematical and science literacy as well as teachers capability to provide evidence-based instructional practices and ultimately bridge the gap between research and practice. So, I'm now going to pass the screen to Dr. Hwang. She's taking the controls now...

0:12:27 Dr. Jiwon Hwang: Okay. Alright. Hello everybody. Thank you, Jennifer, for the introduction. So, my name is Jiwon Hwang currently working as an assistant professor in Special Education Teacher Preparation Program at California State University, Bakersfield. So today, I'm gonna talk about appropriate ways to approach and conceptualize STEM education to teach students with disabilities and those who are at risk for disabilities. I hope this presentation could be useful for both pre-service teacher, in-service teacher as well as researchers who are interested in investigating STEM.

0:13:04 Jennifer: Jiwon, we can't quite see your screen yet.

0:13:08 Jiwon: Oh, really? Do you see the outline? My slide?

0:13:15 Jennifer: Not yet. I'm gonna take control back for just a moment and then pass it back to you, and we'll try again.

[pause]

0:13:33 Jiwon: Is it working now?

0:13:36 Jennifer: Not yet. So, if you just want to tell me to change slides, everybody can now see your outline slide.

0:13:45 Jiwon: Okay. I'm in the outline slide. I'll let you know whenever I wanna move on to the next one then.

0:13:51 Jennifer: Perfect, thank you.

0:13:53 Jiwon: Okay, so first I will start off briefly talking about why it is more getting important to teach STEM in special education. And the second, we will examine what would be the educational perspective towards STEM. In here, I will provide an overview of reconceptualizing STEM education to emphasize instruction in STEM content knowledge and generalization of the knowledge to better promote student engagement and performance in STEM disciplines.

0:14:20 Jiwon: And then lastly, I'm going to briefly introduce the grant project that I'm currently working on regarding STEM education for students with disabilities and which will give you some ideas about how to develop effective lesson plans to teach STEM disciplines along with the best practices. Next slide.

0:14:42 Jennifer: Okay?

0:14:43 Jiwon: Yeah, next slide.

0:14:45 Jennifer: Yeah, it's that.

0:14:47 Jiwon: Okay, alright. So now, why is it getting more important to teach STEM? So recently, people across diverse fields of research and practice, increasingly started to pay attention to science, technology, engineering and mathematics. As you see in the figure, these disciplines have been banded together under the same umbrella and framed as an acronym STEM. It now has become a common language, more generic label of a higher category spanning four areas. A lot of time, STEM refers to one or several areas of four disciplines. Many studies emphasize how important it is to learn and be proficient in STEM disciplines because it'll highly likely enhance the quality of daily life because you might have already recognized it or not, math, science, engineering, and technology are fully embedded in our every day life. For example, we use smartphone, iPad, most of our day and then we use chemicals such a shampoo, conditioner, hand soap, most of every day. And we calculate tips in the restaurant.

0:15:54 Jiwon: So a student who have advanced knowledge in STEM are more likely to have greater work-related opportunities and ultimately, teaching and learning STEM will prepare the nation to be a global leader in a global economy. So for all of these reason, it is never enough to emphasize STEM education, especially for a student with disabilities. But however, national reports and statistics such as American College Testing and National Report Card indicate that students tend to avoid majoring STEM disciplines. And it show continuous difficulties in STEM areas. As you might have imagined, this a situation is even more severe for a student with disability the achievement gap between with and without disabilities are getting more and more wider. So some of the reason underlining this crisis could be negative view and experiences built on learning STEM. So this really brings the questions that, then what are the effective ways to approach teaching STEM from earlier grade for a student with disabilities?

0:17:05 Jiwon: So we are moving to the next slide. So before talking about how we can implement STEM education, we first need to think about how we should approach and conceptualize STEM education and I think that this is the first step. As I mentioned earlier, STEM education has been referred as a broader education category, therefore, teaching any one of four disciplines, 'cause simply referred as STEM education. With this point of view, there are pretty good lines of research

already out there about how, what are the best practices in each subject. What are the best practices in math, science, engineering and technology? And more teaching time having already been allocated to each subject domain in an effort to increase each of the STEM content knowledge proficiency. And the model you see summarizes this view point. But regardless of all this effort, student with disabilities still significantly struggle, which is a red light signal that tells us that new approach is needed to break out the current academic crisis.

0:18:19 Jiwon: Students, particularly student with disabilities, that we are working with, have a wide spectrum in academic and behavioral characteristic and oftentime, lack a motivation and self-competency in learning. This place a key factor for STEM learning which needs to be accommodated. Therefore, I post the questions that how should teachers teach and approach STEM education effectively? And as the first step, I propose that STEM education needs to be re-conceptualized as a integrated approach. Instead of being considered as generic label of a higher category spanning four areas. Alright, we are moving on to the next slide: Educational Approaches, STEM for student with disabilities. Okay, so here I suggested how STEM education could be re-conceptualized. Looking at the second bullet, STEM education needs to be understood as an interdisciplinary approach when teaching between or among any two or more of the STEM disciplines, or teaching any of the STEM disciplines integrated with other school subject that is designed to prepare a student to be quick with the knowledge and skills to solve complex real-world problems.

0:19:42 Jiwon: So looking at the definition here, the key words are the integrated and to solve complex real-world problems. The notion of STEM education does not limit STEM education as mere integration of four disciplines, but to provide a student with disabilities the best practices to increase their ability to apply their content knowledge to their real life situation.

0:20:09 Jiwon: Also integrated instructional approach emphasizes that instead of teaching and learning STEM disciplines through isolated and de-contextualized facts. This integrative approach breaks down a solid boundary among the disciplines and recognizes STEM as one unitary idea. Therefore teachers should not only focus on the STEM content knowledge what you know, but how student make good use of their knowledge what you can do with what you know. So this approach of education will also satisfy the ultimate goal of the learning STEM disciplines that is building a well integrated knowledge base that will benefit not only a student's career but also in their quality of their daily life. Can we move into the next one?

0:21:00 Jennifer: Yeah.

0:21:01 Jiwon: So now you see the the suggestive model in the slide which schematizes the, reconceptualize STEM education. And you'll notice a little difference between this model and the previous model that I showed you a while ago. Instead of considering all disciplines on the horizontal line, this new model suggests all disciplines should be integrated and it taught in the same contexts. When you see the model, you see other subject domains also integrated. The reading and arts and also it could be writing in addition to science, technology, engineering, and math because within this new approach STEM education does not have to be limited to four disciplines. Integration of arts could be highly could be highly considered... Should be highly considered particularly when you're teaching students with disabilities because most of students with disabilities have like a motivation from their unsuccessful experiences and frustration in learning STEM.

0:22:07 Jiwon: So integrating arts component also promotes accessibility of STEM learning. Arts, the arts could include performing arts such as dancing and music, and presenting art, visual arts, and producing art such as media arts. With similar perspectives, reading can also be integrated and taught in the same context with STEM disciplines as well. So along with previous studies, I expanded STEM to STEAM by adding arts in the study that my colleague and I published in 2016. And then I expanded STEAM into STREAM by additionally adding reading component in the current project. But basically STEM, STEAM, STREAM indicate the same thing, the same idea because all of these represent the integrated teaching approach across disciplines, not just about specifically what subjects are integrated. Okay, we are moving onto the next one.

0:23:11 Jiwon: So for the remaining time I'd like to just provide a quick overview of the project... The grant project that I'm currently working on just in order to give you some ideas of what you can do as the first step. The title of the project is Bringing STREAM Education on Stream which takes the same approach that I have been talking about today. The overall goal is to develop a packet of lesson plans that aligns mathematics, science and reading objectives with integration of technology and arts component. The develop integrated lesson plans will promote students' content knowledge and motivation towards STEM learning. Inability and also ability to generalize the content knowledge to a real life situation through hands-on mini project in engineering classroom. So now I think that you are looking at the example integrative lesson.

0:24:09 Jiwon: So this is an example that I came up with. So, for example, very first you need to... First thing you need to do is to sign on the main topic area. It could be Halloween. I know the Halloween meets next week. It could be Halloween, it could be Thanksgiving weather seasons snow anything that you want to focus on. For this example I decided on my topic as fraction. You see the bar on the fraction that's my main topic area. The contents of all disciplines will be related to fractions. Senders will be all aligned. The senders I use the Common Core C sender and next generation science senders for this example. The senders will be all aligned and as you see all red and blue arrows are pointing each other which indicates the contents across disciplines will be supporting each other. Okay, so in math class, for example, let's say lesson objective is developing understanding of fractions as numbers. And this could include indicating fraction in a number line and knowing their relationship to whole numbers.

0:25:20 Jiwon: Teachers provide a real-life context where fractions are used to increase students' intrinsic motivation and engagement. And then in a science class, understanding of fraction will be actively used and applied to read temperature, to understand weather condition. In a reading class reading lesson, teacher can use reading passage about weather to teach informational text. Maybe there's opportunities that students get to read fractions in the text, so everything's integrated. And arts and technology will be also integrated throughout the lesson. That concept of fraction can be first introduced by playing drum, playing instrument with various beats and speed. And also virtual representation with iPad, the technology that can aid students understanding of fractions.

0:26:19 Jiwon: Arts and technology could take any form, based on a student's need. So after all the lesson, student will work on a hands-on mini project, mini project, hands-on activity in engineering classroom where they integrate and apply what they have learned in math, science, and reading lesson to solve a real-life, real-world problem. For example, student will be given a contextualized problem and they get to read the problem, understand the context with science knowledge background and solve the problem with mathematical skills, a combination of mathematical

reasoning, computation and others. And then they get to make something, they make or simulate something to solve a real-life problem. So this project is in progress and we are at the lesson development stage, so hopefully, we can distribute our work in all the practical avenues for teachers in the next few years. Okay, moving on to the last one.

[noise]

0:27:28 Jiwon: Okay, so the last slide, I provided three sources regarding STEM education for a student with disabilities, which will give you some useful information and if you have any further questions about my presentation or my research, please do not hesitate to contact me with my email address provided at the last slide. Thank you for your participation and any questions will be welcomed.

0:27:55 Jennifer: Great, thank you so much, Dr. Hwang. And please, if you haven't already typed your question into the question box for Dr. Hwang, so we can direct the questions to her now. And while you're typing them, I apologize, there was a glitch that allowed the outline slide to stay up longer than it should. So I apologize for that, but you do have all of Dr. Hwang's slides in the handout tab in the slide resource, so you can go back and check them out yourself to see her diagrams on any slides that were missed so... Do you want me... Just had a question come in from Ruth Cozy and she says, "How do you teach fractions and temperature?"

0:28:45 Jiwon: How do you... Excuse me, pardon?

0:28:48 Jennifer: How do you teach fractions and temperature?

0:28:51 Jiwon: Oh, so I think that's the person's talking about the example that I gave in the last slide. So temperature, when you're reading temperature, it could be, it's not always a whole number to read the temperature because always a ratio, rational number. They need to have a understanding of rational number to read the temperature. So for example, like temperature indicating between like 40 and 60, so anyway, student need to read fraction or it could be type of ratio number or percentage to read the temperature, something between any whole numbers. I don't know if that answered that question.

0:29:33 Jennifer: Great, so we received another question. This one comes from Rose Pringle and she asks, "What kind of school structure or grade level structure would support such integration across the disciplines?"

0:29:46 Jiwon: Right now, our grant project is targeting elementary school, fourth to fifth grade. This is a pilot study, but this design, this structure will be useful for all grade level. But right now, we're targeting elementary school. Because one, first reason is because in the elementary setting, one teacher has all the control and teach everything and that he really has a control to a make accommodations and integrate all the contents. But it'll be expanded to middle school because if there's a collaboration with teachers across disciplines, there is a chance that we can expand this project to middle and high school grade.

0:30:24 Jiwon: Great, and I think we have time for just a couple more quick questions. Steve Turley wants to know, "does the addition of art and reading to STEM dilute the depth into which you can study the STEM areas themselves?"

0:30:42 Jiwon: Oh, I think I have a lot of issues with the audio. Can you please re-read the question, I'm sorry.

0:30:48 Jennifer: Sure. Does the addition of art and reading to STEM dilute the depth into which you can study the STEM areas themselves.

0:30:58 Jiwon: Yeah, any arts component will be effectively used for... Especially when you're teaching students who have a disabilities, because a lot of times, they are like, a motivation but if we can get students into arts activities and making something, showing them visuals and let them play music, it really increase their motivation to engage in learning situation. It's not just for the STEM, but in general arts is really effective component to be integrated in teaching STEM.

0:31:32 Jennifer: Great and last question, this one comes from Theresa Slater and she asked "do you think the same framework can be applied to post-secondary school as well?"

0:31:43 Jiwon: I do think so. So as I said, this is a pilot study and we are starting from the elementary grade but the structure is anyway, all the content knowledges should be integrated across disciplines and of course, this should be expanded to post-secondary level. And even when you're teaching college level, yes, all the knowledge has to be integrated because just... We are just looking at the one unitary idea, and it's not just separate things. When we are living every day life, all the knowledge are integrated together to solve one real world problem. So, yes, it should be expended to post-secondary level as well.

0:32:22 Jennifer: Okay, great. Thank you so much, Dr. Hwang, and we're going to go to our second presenter. So for our second presenter today we are pleased to have Dr. Jose Blackorby who is the Director of Research and Development at CAST and a lecturer as a Harvard Graduate School of Education contributing to the field through publications, products membership on national advisory boards as well as teaching at the Harvard Graduate School of Education. Current work focuses on on next generation applications of Universal Design For Learning and Instruction and Assessment such as development of a UDL player for open educational resources and advocacy study of UDL based inquiry science notebook called SNUDLE which you'll get a nice preview of today and a Google application called CORGI to support higher order thinking skills for struggling learners. I am now going to pass the controls to Dr. Blackorby. And we can see your screen so please proceed. Thank you.

0:33:37 Dr. Jose Blackorby: Thank you very much. Thanks for the nice introduction. My name's Jose and I'm gonna be talking about Universal Design for Learning and how we can use UDL to meet the diversity of students that that we have in our schools today. First thing I wanna say is, it's actually a kind of a good time in American education. You won't meet anybody nowadays, who is willing to say, everybody learns the same way, we have to teach everybody the same way. However, what we've learned over the last 15 years through the neurosciences and learning sciences, is that the variability is actually far far greater than we ever thought it was. The way that we perceive information, the way that we respond to what were engaged by and how it shapes our experiences far, far more variable than we ever anticipated than it was.

0:34:26 DB: So for example, through brain imaging now we can actually watch children and adults in real time as they are performing academic activities. These images on the left show, compared

dyslexic students to typically developing students, and we can see that they're using their brains very, very differently to accomplish the same reading task. We also differ tremendously in the amount of connections that we have in our brains. Many people on the autism spectrum have lots and lots of connections, lots and lots of connections and people with Attention Deficit disorder frequently have fewer connections. That also has tremendous implications for education.

0:35:06 DB: So for example this gentleman here is, his name is Stephen Wilshire, he sometimes called the human camera. He's on autism spectrum, he has this unique gift, he could fly over a city, for a half an hour or an hour and then without any further information, faithfully represent that city in a drawing with the correct proportions, everything from memory. At the same time, however, that great strength in social situations or in complex and loud situations, that amount of sensory information can actually be a disadvantage. So, a strength in one context, a disadvantage in another.

0:35:46 DB: If you haven't read Todd Rose's book called "The End of Average", it's something that you should put on your reading list. Todd actually takes on this idea of an average and how we apply it in education, in higher ed, in recruitment, in the military and in the workforce, and he makes this argument that the average student, worker, learner, may not actually exist. It may actually be more of a mathematical, statistical concept, rather than something that we see in real people, and that when we design our systems that way we're actually designing a system that doesn't meet anybody's needs. Here's a key concept, this idea of jaggedness. If you look at these two gentlemen, you can just see visually that they are very different from one another. They differ in height, weight, chest size, their legs. But you can see that actually, they're not average on anything. Similarly, in education, we can see the same thing. This young woman has a lot of background knowledge, she's curious, she has a lot of interests, but she also has some challenges in reading and vocabulary. But again, she's not average on anything either. When we design for the average, we miss a lot of students.

0:37:01 DB: Social-emotional learning, grit, motivation, engagement, lots of different words. These are things that in the past were kind of considered nice if you get to sort of window-dressing to motivate. What we're learning now is that is actually the wrong way. It is essential. It's actually one of the things that we have to start with. Engagement is critical. Context. Context measured in lots of different ways, makes a huge difference. That means background knowledge, that means language, that means culture, that means the community, that means what happened on the school ground today, that means what happened at home last night. All of those things fit into the educational equation, and we need to design systems that address that. So in comes Universal Design for Learning. Universal Design for Learning has been around for about 20 years. It's based on neuroscience. It's based on three networks that we have in our brain, the recognition network, which is the "what" of learning, the strategic network, which is the "how" of learning, the affective network, which is the "why" of learning. We need all three of those sectors of our brain to work together, and we actually use them in very different ways.

0:38:20 DB: So within each of those, multiple means, multiple means of action and expression, multiple means of engagement. And it starts at the bottom level, which is basic access into each of those, and they move progressively to higher order thinking, more self-directed goal-setting and monitoring, and greater executive functions. This is the most recent version of the UDL framework. I introduce it because it is something that changes over time. One of the big things to notice here is that the engagement principles are on the left side, that we're reflecting again this importance of having students engaged and motivated and moving towards self-regulation. And also that we want

students ultimately to be expert learners, who are purposeful, resourceful, and strategic and goal-directed. Okay, so where do I get UDL? Can I get it at Walmart? Where do I get it? And the reality is, it's not a product, it's not a checklist, it's not something that you can simply go out and buy. It's a framework that you can use to think about educational problems that you face. All of these organizations are using UDL to fit into their solution for the problem that they're trying to solve.

0:39:39 DB: That includes small companies like Texthelp, big ones like Houghton Mifflin, learning management systems like Itslearning, and the State of California, in its Inclusion Collaborative, and even PBS. So UDL is kind of out of the barn now. It's a field onto itself. It is included in the Every Student Succeeds Act, it's included in the Higher Education Opportunity Act, and it's being embraced by educators, professors, content developers, and technology developers. So I'm gonna give you a little example of a project that we're working on, funded by the Institute for Education Sciences and the Offices of Special Education Programs. It's a digital version of a paper notebook, a science notebook that you remember, perhaps when you were in school, and we call it "SNUDLE". And SNUDLE is intended to support students as they go through an inquiry science process. So in some sense, it's kind of simple. We have five pages within SNUDLE. We start with a big focus question, we walk students through collecting data, analyzing data, explaining it, and then trying to display it. In this case, its focus question, "Is flipping a coin a good way to decide who starts a game?"

0:40:57 DB: We support the students in collecting the data, we provide background knowledge and vocabulary as necessary; we provide analysis tools for the student. In this case you can see that they can answer the question by writing, drawing, uploading a picture or creating a table. And then, we provide UDL supports throughout. So there's text-to-speech, there's vocabulary, there's vocabulary support. Students love picking their SNUDLE avatars. In this case, it's a robot. We have drawing tools, sentence-starters. All of these things are built in throughout the application.

0:41:34 DB: And I wanted just to show you some student work. So here is the explain page, the display page, where a student is going through a magnetism experiment. She has a claim. She presents evidence. She presents reasoning, and she reflects on her learning. And she even uses UDL to support her thinking. Teachers too like Schnoodle, right? They have found that it's useful for students who are bilingual who are just learning, who are just learning English. The fact that the combinations are embedded have been helpful for students with disabilities, and that the drawing tool actually provides an alternative way of students presenting what they know. So that is Schnoodle.

0:42:16 DB: Okay, let's move from, by the way, SNUDLE is for fourth graders. Let's switch to the other end of the spectrum. I teach a UDL course here at Harvard, we call it T560. It meets for three hours every week. And I wanted to just share with you how we try to implement UDL in that class, and it's an ongoing process. And we're facing a number of common problems in higher ed. So here's a lecture hall. We all know that this is the most common way of delivering information in colleges and universities. And it's very good for a lot of things, but it does present barriers, right? You have to be able to listen. You have to be able to take notes. It makes a lot of demands on learners.

0:43:00 DB: Similarly, it's very text heavy, right? We still have a lot of text. Whether it's a paper or digital, it's complicated text, vocabulary rich. It's a lot, and it creates barriers for college students and pre-service teachers, just like it does for kids in the K-12 system. So we want to think about our class in terms of UDL, in the same way that architects think of universal design in architecture. This

is a picture of the Louvre showing multiple ways into the public space. It's essential for some, and good for all. We like to think of it the same way in education. It is essential for some, and good for all. And we wanna encourage all educators to be designers and try to use UDL in their classes.

0:43:45 DB: So, I wanna just share how we organize the class. The first hour, we're not always against lecture, we do present some lecture. We use it to provide background knowledge, we always try to bring in the student voice if there are questions from the, from pre-class materials. And we do use PowerPoint, but we try to limit the amount of text. We use images, and we use video, but importantly, we also use technology to try to make it possible for other ways for students to participate. So we run a back channel in Canvas, which is monitored during class. Some students are just more comfortable communicating in the back channel. We also run a Padlet. We used to run TodaysMeet, before it went out of business. And then we use polls, frequently to get students' reactions, to collect formative data so we can improve our teaching.

0:44:36 DB: We also use a robot, a double robot, which allows us to sometimes bring in speakers from outside and they can actually move around the class. Sometimes students use it, sometimes I use it when I'm on the road, it's a nice way to bring in people who are remote into the classroom and have them feel like they are participating. For the second hour of class we have what we call workshop. And during this period of class, it's generally a hands-on activity. It is linked to the topic of the day but also intended to build skills towards the semester project, which I'll be talking about in a moment, but the idea is to explore, to examine, and to create, and to actually work with others to build their skills. And some examples, I'll just show you in a minute.

0:45:23 DB: We have a collaborative, what we call the marshmallow challenge, which comes from IDEO. We have image description. There's a circuit activity, a music activity as well. We do debates, and we do an escape room. Here's an example about what the class looks like. This is very different than what a lecture-style class looks like. You see the debate here. You see the marshmallow challenge. We have an external speaker. It's a very different kind of experience, and I also actually wanna encourage all of you to actually take some risks. We actually did a escape room just last Friday. Oh no, the double was missing. Students had to work in teams to solve puzzles that were related to content, and they had to race in order to find where the double was hidden, and they had to hack into it, and then drive it back to the classroom.

0:46:10 DB: Harvard students, they were able to do it, but it was a great activity. So I encourage you to take some risks. They don't, won't always work, but it's worth trying. And here they are working on the escape room activities. We also spend the third hour, which we call section, but that's really flexible time for students to interact with the teaching staff or to interact with each other around project activities to actually discuss readings or to pursue other interests, in trying to create a classroom community. So, the way we structure our assignments in 560, everything is leading towards a semester project, which I'll talk about in a minute. We also spend a lot of effort on reflections and feedback.

0:46:54 DB: They have to do them every week when there is an assignment done, and those reflections come in all kinds of forms, text, audio, video. We had one just today, which is actually a poetry lab. It was fabulous. We also actually let students self-grade, right? . We actually believe in self-monitoring, self-motivation, and so certain aspects of class participation, they get to grade themselves.

0:47:18 DB: So the semester project just finally, it's an opportunity to apply UDL and it's intended to be a real thing, or a prototype or an educational intervention, and then a paper that articulates the rationale forth. And students come up with all kinds of really, really interesting projects. So we've had a new way of training officers for the Marines, a new way of teaching phonics, a nutrition program for Boston Public Schools, a mobile application for use in rural India, a game for learning language; UDL for museums, cultural identity supports for refugees; even prison education, and UDL for introverts. We have a summit of activity at the end of the class, which we call "Sharatorium" where we invite the entire Harvard community, and those around the community people come and see the work that we've been doing; students share their work, get feedback from each other before they complete their final project.

0:48:18 DB: And this is just another example of the Sharatorium. We see the game, universally designed meetings and so on. And then this is our class from last year. It was a very good class. It's a great group. Each year it gets a little bit better, and we just wanna... This is what we live the class by, We rely on Lev Vygotsky who says, "Impairment is socially determined, a cognitive-physical difference is just a difference until we make it an impairment." So we say, "Let's drive to make design learning environments where differences are different, and not impediments to learn us," and we say, "Join us." So, thank you very much.

0:49:00 Jennifer: Thank you, Dr. Blackorby. And that's a good segue for all of you to join us in the discussion and enter your questions there. And we've received a few so far. So the first one is, "Is SNUDLE available to educators? And is it free?" This comes from Irina.

0:49:25 DB: So the answer is, it will be, it is right now in an experimental test right now, and so we can't release it to the public until the experiment is complete; but the intent, yes, is to make it available to anyone who wants to use it and to make it free. That's our intent.

0:49:46 Jennifer: Great. Our next question is from Scarlett Chan. And she asks, "How do you balance accessibility for participation I.e. Using a back-channel and teaching essential communication skills such as public speaking?"

0:50:05 DB: It's a great question. Our position on that is that, providing options is more important than having everybody present what they know or what they're interested in, in the same way. The exception of it is, you're right. If the goal of the class is to have improved oral communication, then obviously then you would need to focus on oral communication. So it really depends on the goal. If the goal requires that everybody do something in a particular way, then that's the way you do it. If not, then we think options are better.

0:50:47 Jennifer: Great. So our next one is from Cammy Newmeyer and she asks, "How are you specifically addressing culturally relevant education, and what is your advice for cultural relevance?"

0:51:01 DB: So we run a symposium every summer, and last year the focus of it was on a culturally sensitive education. We think UDL is a great framework for introducing that into classes because UDL is, focuses on the context, it focuses on background knowledge. So we view it as an excellent tool for actually doing just that. I will also say there is a lot of work that remains to be done in that area. I think the opportunity is there for enterprising young people who wanna push that, take that on and make that part of their professional identity. It's very neat.

0:51:51 Jennifer: Great. And I think we have time for one more question here in this portion here. And let me scroll down to it here. So, this one comes from Dale Perizzolo, and Dale asks, "As always time is an issue when pressured to cover all course material in high school. How do you combat the idea of cramming materials versus better understanding of material?"

0:52:22 DB: Well, from a UDL perspective, we are always gonna lean towards what gets you closer to expert learning and I think so you want deeper, richer understanding. We also recognize we live in a real world where there are accountability tests and so where people are held accountable for performance n the tests. We believe of course it would be better for a system to move in the direction of more self-regulated learning, but until we get there it would be a balancing act to make both of those things happened.

0:53:01 Jennifer: Okay, great, and there's a few more questions that came in and keep them coming 'cause we'll have a group answer session later with both Dr. Blackorby and Dr. Eitel but I think that last question is a perfect segue here, to our third presenter, who is Dr. Richard Eitel and I saw him nodding and smiling as that last question came in as he is a first year science teacher at Bryan High School in Omaha, Nebraska. He teaches physical science, physics and AP physics. Additionally, Dr. Eitel is currently working to develop and implement increased unit on engineering design practices into the high school science curriculum. This past summer, he graduated from the Mast or Master of Arts in science teaching program at the University of Nebraska-Lincoln. During the math program Dr. Eitel was supported by the National Science Foundation Robert Noyce teacher scholarship and the JA Woolen Foundation Fellowship. So we're very pleased to have a former Noyce recipient with us and I will change the presentation over to you Rich.

0:54:20 Dr. Richard Eitel: Oh okay, thank you. Okay, so first of all, I like to start off by thanking AAAS for this opportunity today to share some of my experiences and my plans as I set off on the first year of my teaching in a high school setting. I did wanna just introduce kind of the setting that I'm teaching in. So Bryan High School is in Omaha, Nebraska. Which is actually a fairly urban school district. In Bryan High School about 68% of our students qualified for free and reduced lunch. About 65% of them identify as Hispanic. And my real goal today, I guess it's to share my approach using my background as a faculty member at university performing research, looking at active engineering design curricula to really improve opportunity to increase access for this diverse group of students that I have the privilege of teaching here at Bryan High School.

0:55:26 DE: So a little bit of personal background about myself, and I think a lot of it was in there but I come from an engineering background, I have a PhD in Material Science, I taught for about 10 years at the university level, first at University of Kentucky and then later at Stevens Institute in Hoboken in New Jersey.

0:55:47 DE: So I kind of embarked on my own kind of personal, had a laugh when I saw the picture in the big lecture hall right. I had certainly my own personal journey to leading me to start implementing research-based instructional strategies as maybe a lot of faculty have. At University of Kentucky I was really fortunate to be a fairly small program, really only a handful of students per class. So in the traditional lecture format where I was able to provide some personal attention, it works really well for me and then I found myself at Stevens Institute Technology, about four years ago, maybe five years ago now and suddenly I was thrust into one of these giant lecture halls with 150 students per section and I immediately struggled to connect with students, to engage students in

a lecture hall setting is a real challenge is I'm sure a number of you are familiar with.

0:56:49 DE: Luckily about that time my department head at Stevens had encouraged that I joined this Spiritual Community of Practice Program at NSF and also sponsored by the American Society of Engineering Education, and it was really to start bringing a research-based and structural practices into the engineering classroom. So the majority of engineering faculty NSF are aware of research-based in structural strategies.

0:57:18 DE: Many have tried it, but only about 25% reported themselves as frequently using research-based practices in their own classroom. So, this BCP program was supposed to be... Was instrumental for me and the purpose of it was to support faculty members in engineering learning about research-based instructional strategies, developing strategies and then actually implementing and assessing those strategies in their own classroom over the course of the year. And it was really an online community of educators all working in the same area to develop these research-based practices in their own classroom.

0:58:00 DE: So during this time while I'm struggling in my own lecture hall, one of the strategies that I was introduced to was the POGIL approach. So this is Process Oriented Guided Inquiry and Learning, and on the screen is an example of a potential POGIL worksheet. So these worksheets typically start off some type of a drawing. It could be a graph, could be some data in tabular format. And then a series of guiding questions and the students work in teams of three to four students to kind of analyze the data, the questions kind of guide them through and help them construct their own knowledge. We then went through some formative assessments, usually using Socrative or learning catalytics or one of those tools to do some whole-class polling and used BYOD devices, and we went through that cycle three or four times per class, with maybe in mini lecture to focus on some misunderstandings based on the formative assessment.

0:58:58 DE: Using this approach ended up being hugely successful to me. So I was able to... Part of the BCP program, I got to present the results of this work at the American Society of Engineering Education meeting in 2015, and assess students' reactions to this type of lecture, this type of educational setting. And when asked to compare this to their lecture courses or their other course work, students said that they practiced critical thinking at a higher rate, and were better participants in classroom discussions, had more interest in the topic and more motivation to learn. So I think most of us as educators who are able to hit even one of those areas in their classroom and see an improvement would be pretty happy, but to see across the board improvements really changed my world and my perspective, on teaching.

0:59:55 DE: I set out to do this in a lecture-based course, and after my first POGIL activity I re-developed the whole course. I had been working in this course for a number of years but that year, it turned out that I couldn't go back, I couldn't consciously go back to lecture after seeing how much the students embraced these activities. So that was kind of my personal journey into starting to implement some of these strategies and what are my experiences in doing that.

1:00:23 DE: So that led me eventually, to decide to make the transition to teaching high school, teaching physics and science in high school. So as was discussed in the introduction, just last year, completed my Master of Arts and Science teaching at University of Nebraska, Lincoln. That program really has a strong focus on implementation of the NGSS science, the new NGSS science standards of Nebraska, as a state has adopted those standards wholesale basically. And Omaha as a

district has also gone and done that. And part of that my master's program was a Capstone Research Project. And certainly that appealed to me as a former university researcher to continue collecting data and using that to improve my own teaching. So this was a project that I really enjoyed and kinda dove into during my student teaching, which was also in kind of an urban setting.

1:01:28 DE: So for those of you... And I think this group is probably pretty familiar with it, but just in case this concept of teacher action research isn't familiar to everybody, teacher action research as a really different slant than traditional educational research where education research, we're really looking at the same purposes as other scientific research, where we're looking to make a conclusion to improve upon theory, and the standard is really developing truth or finding truth on as much as we can. Practitioner research really focuses on making decisions in the classroom, on this idea of that specific settings, that there are specific problems in specific settings, and the real standard of this type of research is, is it useful to the teacher in the classroom for their own practice?

1:02:18 DE: So I adapted to this and was able to participate and carry out a project during my student teaching, and also build upon... One of the big focuses of this was to bring my background from engineering and developing engineering design curricula into the science classroom. And again this comes at a great time for me, because this is exactly what the NGSS science standards expect us to do, to be combining science investigation and engineering design...

1:02:55 DE: To help reach more students and different students, and a big part about that in reaching different students is how scientists feel about themselves and their own self-efficacy in science. So this was kind of the methodology that I approached in my research project. And I just wanna spend a minute or two defining a couple of these terms before we jump into the project. So self-efficacy this idea, in this context, what I mean is it's domain specific, alright? A student who has high self-efficacy in reading doesn't necessarily have high self-efficacy in science. So we don't expect these efficacies to transfer across domains. Really important in education is that high self-efficacy is associated, not just with students' performance, but also their persistence in the task. In science we see, in engineering we see large numbers of drop-outs of minority students and female students, and that frequently is correlated with low self-efficacy in that domain.

1:04:07 DE: The really disturbing thing or concerning thing about self-efficacy is that there's a huge bias based on initial anchoring. So early experiences, which cause students to believe that they might develop a low self-efficacy, can be hugely detrimental for their future success, and irregardless of the levels of feedback that they receive to the contrary, later in life they're self-efficacy will almost always be biased towards those initial experiences. So back to my own classroom. Integrating kind of these design principles in the classroom has been shown. The National Academy of Engineering sees this as critically important. Same for the National Research Council. And at the same time, there's this concern about low self-efficacy in science for female and minority students in particular. So this case for integrating engineering design, how this can support diverse learners. Number one, it has the potential, especially in science, we're linking the topics that we're learning in science to students' daily experience. We're stressing this idea that science isn't a list of rote knowledge. It's a process that's undertaken.

1:05:34 DE: Engineering, I require that when we teach engineering design, we teach it as a circle; as a cyclical process. You're always continuously improving your idea and more and more know that's how we're seeing science; is that our ideas are constantly being revised, tested and assessed and based on new evidence, and as new scientific evidence gets developed new knowledge gets

developed we're continuously improving our science. And moreover the integrating engineering design into a science classroom has the opportunity to act on student self-efficacy across diverse groups, because it has multiple nodes of performance. Some students might do very well standing up in front of a group and presenting and performing a task. For students from more collectivist cultures, however, they might develop a self-efficacy better due to vicarious experience of others, seeing their classmates succeed in a challenge.

1:06:35 DE: So having multiple opportunities for feedback is really one of these opportunities that engineering design affords that might not be in other forms of classroom settings. So the project that I developed during my student teaching was integrated into my energy unit in my physics course and it reached into a kind of topic in the news. So we went back to Hurricane Maria, was still in the news recently last spring when I was developing this module, and a lot of the residents of Puerto Rico were still without power at the time. So the design challenge that we laid for the students was to develop a device that would transform energy to provide an off-grid, affordable lighting solution to meet the needs of the residents of Puerto Rico until electrical power on the grid could be restored.

1:07:36 DE: So the students, we had these great engineering kits from the teacher geek websites. This was one of my resources that had I suggested you take a look at. Lots of gears, lots of motors, wires, all sorts of pulleys, things like that. The students did some research and did some inquiry into what makes electricity, a little bit into electro-magnetism was integrated into this topic, and in over the course of the eight week energy unit in my physics course, they had about five, 90-minute design days to design and build this gravity-powered lighting solution. And this was not entirely my original idea. So Christine Schnittka, I believe was at Auburn, has some really nice engineering design modules, so I based a lot of this on her work. So that's the reference there.

1:08:33 DE: And at the end of the day I found this project to be really very successful. Students all universally struggled. A lot of students today don't have a lot of hands-on knowledge in building things or experience in building things working with tools. So it's kind of a struggle to everybody there were a handful of students, however that really did have that background and were able to flourish whereas maybe they didn't succeed another classroom or didn't initially take to a lot of classroom activities. There're also kind of surveyed students self-efficacy over this time I can't share the results of those data, but what we did see is that self-efficacy was malleable at least at this stage. Students' self-efficacy did evolve a bit over the course of the study and also what we really found was how important it was to really if you're in "duties engineering practices" to really I think integrate it day in and day out, in the classroom, so integrate it from the very beginning and make sure that there's a clear way to assess the engineering knowledge as well as a scientific knowledge and you know "NGSS" provides for high school teacher is a great opportunity for in primary and secondary teacher is a great opportunity to really assess those things because that's all part of that, these new teaching STEM standards.

1:10:09 DE: You know in my classroom currently really the first activity we did was a design activity the first day of classroom building spaghetti bridges. So that's one of those things that I found and I've taken that I've tried to adopt in my practice this semester as my first semester as a high school educator. So that's my experience. There's some of the research that I cited early in my presentation. I know I ran through a lot of things pretty quickly. So if you wanted to look back at some of those things there's where that is and I'd be pleased to answer any questions that you might have about my experiences in this effort.

1:10:52 Jennifer: Thank you so much for sharing your work and we did have a shout out during your presentation that said, "Yay P-R-G-I-L", but we also had another question that says: "How do you get buy-in from students for it?" This is from Michael Vias and he said when his college students hear that they groan and ask for more lecture. So what did you do to get buy-in?

1:11:22 DE: So I showed them the data. I'm a researcher so I like the data. I assessed it the first year and I showed them that grades went up in my class. I also show them the data about typical attention span for students is 15 minutes and things like that. Especially at the college level but I think even at the secondary level. Let's be honest with the students and let them know why you're doing that because if they see you're coming from a good place I think they're more likely to buy into it.

1:12:03 Jennifer: Our next question comes from Justina Agato and Justina says "What are the major challenges that you have experienced as a first year teacher in a college setting?

1:12:22 DE: Yeah, everything I guess. I think certainly time. The biggest challenge I have is time and developing now 15 hours of classroom contact time a week, coming from the college setting whereas developing 3:00 to 6:00. So that's one of my big challenges is where you find the time to develop these things. Luckily there's some great resources out there for doing it. So yeah, I think that that's probably the big one.

1:13:01 Jennifer: Great, and related to that, John Harvard Nelly asked what training opportunities are available for teachers to help them integrate STEM activities into their lessons in a meaningful way.

1:13:18 DE: So that one, I might have to defer to others on. Yeah, certainly the POGO has an active community, and website for doing some of that and I'm not sure what the other opportunities for teacher training are. I definitely think that... If you have the opportunity, I had the opportunity this summer to take an Inquiry based summer course in Geology and to actually take a course that is offered using the inquiry mode, as a student is I think maybe the best way to learn that... So, yeah, that was also an amazing opportunity for me to have the tables turned a little bit and be on the other side.

1:14:09 Jennifer: Great, so I think we'll end this portion there. Thank you, Dr. Eitel and we're going to move into our summary portion of the webinar, so we will go into our group question and answer, so keep the questions coming. And they could be directed to Dr. Blackorby or Dr. Eitel to answer. I'm going to kick off this first one, by sending it to Dr. Blackorby. How do you motivate faculty to get interested in UDL?

1:14:58 DB: I think that's when faculty see student engagement and see student work, that that's really, really motivating. I got to say the escape room that we did last week, it was a huge risk. We had no idea if it was gonna work, and it worked really, really fabulously and that experience of seeing some students really kind of delight and have some joy in learning was fabulous. And that by itself is motivating to educators and not everybody is going to buy-in, but of course you don't have to buy-in to do a escape room. There're lots of things that you can do that are, that move in the direction of UDL. It's not like Canvas is in lots of campuses now doing a back channel, it's not hard to do and so I always try to tell faculty to start where you are, try something, a little incremental improvement makes a big difference at the system level over time. So you got to start somewhere.

1:16:12 Jennifer: Thanks, and that question came from Mammo. And I'll just ask a follow-up to you, Dr. Blackorby. What do you recommend as an entry point for some of our more newbies to integrating active learning pedagogy?

1:16:33 DB: I think that there are good resources available for faculty and for students both to actually try out and implement these kinds of active learning strategies. The problem is, is they're kind of distributed, it's kind of hard to find them, it's the nature of the internet, Google and YouTube, and Teachers Pay Teachers, and all of that, but I actually think on average that those sort of distributed intelligence systems for getting word out there on average are better than not. And I think that as more and more faculty who work in institutions of higher education try these strategies out, I think they'll find out that, we get different outcomes. I also I just going to say, "I want to be in Richard's class".

[chuckle]

1:17:32 DE: Thank you.

1:17:38 Jennifer: Well, thank you. And we do have the resources handout that's available, and if you are having trouble downloading it would be sent next week. But our presenters, as they mentioned, shared some resources and some of our AAAS staff who do a lot of work in this area shared some examples of lessons where they took commonly used lessons and re-worked them, to make them more appropriate for a wider range of students and more accessible. And another resource shared is the do-it-center that that's a lot of that the resources handout. For our next question, I'm going to move over to Dr. Eitel and the question comes from David Ericson and he says, "large lecture classes pay the bills in higher ed. Does anyone incorporate active learning and lectures without switching to teaching high school?" So maybe you could talk a little bit about your previous experience in...

1:18:46 DE: I'm sorry, what was the end of that question?

1:18:50 Jennifer: So the end of that question, was large lecture classes pay the bills in higher ed, does anyone incorporate active learning in lectures without switching teaching to high school? So I think they're looking for more information on your experience with higher ed faculty incorporating active learning.

1:19:11 DE: Yeah, absolutely. The classroom that I had was 160 students at the college level in a large lecture hall, in those cramped awful desks. You know it's a little table that then I had students turn around and do their best to kind of make groups of four, it was awkward at times, but I had kind of these POGIL activities as a good maybe way to start, like people looking for an entry point. To hear a classroom of 160 students erupt in discussion, it's pretty powerful and... Yeah, it was definitely hard to go back. So that's definitely an easy entry point, I think, for a lecturer in one of these pay-the-bill courses. And what we did do to get some more direction in personal interactions, is that we actually hired about three student helpers who had taken the class previously who during those POGIL activities would wander around the classroom with me, and stop in and check in with each groups to direct them a little bit. So, that was hugely... I see the thumbs up from Dr. Blackorby. So that was hugely successful. That was some advice from a colleague from the VCT to do that. So that's possible, and that pays the bills, which is sometimes an issue.

1:20:38 Jennifer: This one is for Dr. Blackorby and comes from Lin Ding. And Lin asks "what is the age range for whom UDL is suitable?"

1:20:48 DB: So UDL is a framework for thinking about learner variability and identifying barriers in the learning experience associated with them. So that means it's really it applies across the age span, from early childhood through adulthood. Truth is we spent the most of our time thinking about it in K-12 settings because that's what we were trying to do. But there's really an active community of people thinking and applying UDL in higher ed. Same is true in early childhood. We have a project with PBS evaluating the scripts and game behaviors in their games from a UDL perspective and even in the workforce, there's room for thinking about barriers to learning and performance in the workforce as well. So that's kind of the reason I think that it has taken off, is because wherever you sit, in the human development world, you can see that there's an interaction between individual strengths and challenges and the demands, affordances and barriers in the environment. And so that's what makes it powerful, and I think it's a good thing that it can be applied throughout the age span.

1:22:16 Jennifer: Great. And this one is for Dr. Eitel, "What self-efficacy survey are you using?".

1:22:31 DE: So it was for my physics courses where I started which was the physics self-efficacy survey. It was SOSECP. Survey of Self-Efficacy in Science Physics and it's available on the, I think the website that I provided has a whole bunch of different types of surveys, and it is available on that site, but I can also provide that information if anybody would be interested offline.

1:23:00 Jennifer: Thank you. And for our last question to either of you that's come from Manish Sharma and Manish asks, "When using UDL can online learning and technology assist with providing the breadth of content that typically needs to be covered by educators? And are there examples of such work you can share?" So whoever wants to take it. I see Jose leaning in.

1:23:27 DB: Yeah, I'll take it. I think the reality is, is that it's still a little bit early days, right? I think there are good examples of applications at the variety of grade levels, but there's some question about like... Well, there's always a question of how UDL... How UDL is enough UDL. And that's in some sense an empirical question and it's also true that since we really do believe in context, what works in Omaha might be really different than what works here in Boston, and from a UDL perspective, that would be really okay.

1:24:16 Jennifer: Great. Thank you so much. And we did receive a few questions that we're not able to get to in this time. So please feel free to follow up with me afterwards or the presenters. And each of our contact information is in the slide hand-out. So I just want you to take a moment and reflect on your takeaways from this session and if you could in the question tab, instead of sticking in a question, identify an action step you will take based on your participation today. And this could relate to the active learning pledge as well that was mentioned earlier. So think about it and we'd love to see your action steps coming in in the question tab. So as you are entering your action steps move to a closing summary of webinar key points. And up here on the screen is some of the key points that our speakers wanted you to take away.

1:25:18 Jennifer: So, we'll start in the middle with our first speaker from today, Dr. Jiwon Hwang. And she wants you to remember that STEM education breaks down the solid boundary of multi-

discipline and needs to be understood as an interdisciplinary approach when teaching two or more STEM disciplines integrated with other school subjects, or as she shared with us, STREAM. And she thinks teachers should focus on how students make good use of their knowledge, what you can do with what you know to increase students' ability to apply their content knowledge to real life situations. I see some great action steps coming in, so please keep them coming. We'll move to some of the key points from Dr. Blackorby.

1:26:09 Jennifer: As he just recently mentioned in answer to the question, of a question that came in here beyond the framework that can purposefully address learner variability and reduce barriers that is being used in K-12s as well as higher education context. Learner variability is even greater than previously believed, which is one of the main reasons that these types of teaching strategies are so important to integrate. And object motivation and context are central to learning. And I'm still thinking about that elephant picture slide that he showed. And finally, we heard some great tips from Dr. Richard Eitel, who has walked this walk in both higher ed and K-12 settings. Action practitioner research can be an effective way for teachers to formalize efforts to improve their own practice. And finally engineering design experiences provide multiple modes of performance and engagement for diverse learners while driving home real world applications of science content.

1:27:21 Jennifer: Thank you. And keep those action steps coming. Again, check out your resources that we've mentioned throughout the webinar. Just a little coming attraction. Our third webinar in this series is, Culturally Relevant Pedagogy in the Preparation of Teachers to Work in High Needs Schools District. And that will take place on November 28th at 3.30 PM Eastern Time. So mark your calendars. And we have a treat with Dr. Adam Holland, a recognized expert at advancing knowledge of teaching and learning for urban and underserved students. So we hope to see there and that you will join us again.

1:28:09 Jennifer: And next, just some quick words of thanks. We want to thank NSF, especially our program officer lead Sandra Richardson and co-lead Kathleen Bergin; AAAS PI, Yolanda George and Shirley Malcom; our illustrious AAAS Noyce advisory board; and of course our engaging presenters, and my other colleagues working on our Noyce and ARISE projects, Donna Behar, Tarrick Clayton, Betty Calinger, who was instrumental in securing our speakers; and particularly, Quincy Brown who spearheads AAAS's involvement in Active Learning Week. So thank you for facilitating the connection of the ARISE webinar with Active Learning Week, Quincy. And we want your feedback. So, housekeeping items, please complete the evaluation survey that you will receive following this webinar. We appreciate that all of you took the time to complete the pre-survey as part of registration and we look forward to your comments and suggestions.

1:29:16 Jennifer: There's a space for you to indicate if you would like us to follow-up with you regarding sharing your work with the ARISE community we are building with all of your help. And again, you will receive the recording of today's webinar next week, in a separate follow-up email, so watch out for that. It will also appear as in the archive on the nsfnoyce.org site. And finally, our contact information is up here, send suggestions, contribute, let us know all the wonderful work that you are doing. Consider writing for us. We're looking for blog authors, and we'd love to help you disseminate your work or share events you want highlighted or other upcoming opportunities. Finally, thank you so much to all of you for participating today and sharing your action steps with us. We look forward to working with you to progress research and evidence-based innovation in STEM pre-service teacher education and leadership development programs. Thank you very much and have a great evening.