# Building Students' Motivation and Learning Skills in Online Courses Transcript

Jessica Mislevy (00:00:00):

Well, hello everyone. We'll get started in just a moment. In the meantime, we invite you to comment in the chat on what you've seen as the greatest needs or challenges in postsecondary online learning in STEM. And be sure to select everyone in the blue drop-down box to share your response with all attendees. And you can also add questions to the chat throughout the webinar and we'll address them at the end during the Q&A.

(00:00:52):

Hi, for those who may have just joined, we'll get started in a moment. In the meantime, we invite you to comment in the chat on what you've seen as the greatest needs or challenges in postsecondary online learning in STEM. And be sure to select the everyone in the blue drop-down box to share your response with all attendees. And you can also add questions to the chat throughout the webinar and we'll address them at the end during the Q&A.

(00:01:18):

All right, well why don't we go ahead and get started. Welcome, everyone. My name is Jessica Mislevy and I'm the principal investigator for the Postsecondary Teaching with Technology Collaborative. Thank you for joining today's webinar on Building Students' Motivation and Learning Skills in Online Courses. The Collaborative is a research and capacity building center funded by the U.S. Department of Education's Institute for Education Sciences that aims to study and improve how faculty teach and use technology to help students apply and strengthen self-directed learning skills to increase their success in online STEM courses. We are a partnership between SRI Education, the Community College Research Center, Achieving the Dream, and nine broad access institutions.

(00:02:43):

So now that you know a little about us, we'd like to get to know more about you, and let's see who's joining us today. We'll be launching a poll momentarily where we'll invite you to share your role, whether today is your first engagement with the Collaborative, and how familiar you'd say you are with the concept of self-directed learning. Thank you for launching the poll. Let's give folks a moment to weigh in. All right, Jodi, have we got a good number of responses from folks?

Jodi (00:03:36):

Yep. We're at 76%, so I'll end the poll in just a moment.

Jessica Mislevy (00:03:48):

Oh, all right. Well thank you for sharing. It looks like we have a good number of instructors represented in our attendees today, several administrators and instructional designers as well, and a number of folks that are playing other roles. I believe I've seen some folks who are representing researchers as well online, and so we're really excited to have you all joining us and weighing in from these different perspectives and roles. Looking at number two, it looks like some folks are new to the Collaborative, and we're seeing some familiar faces as well. So we're excited to get to know everyone better. And we're seeing a bit of a range in familiarity with self-directed learning skills as a concept, and so we're looking forward to diving a bit deeper into that today. All right, thank you everyone.

(00:04:48):

All right, so as we were giving folks a moment to join the webinar, we invited you to share in the chat what in your experience you've seen as the greatest needs or challenges in postsecondary online learning in STEM, and some of the issues I've seen you raise sound all too familiar. Online learning puts more demands on students to manage their own learning, can exacerbate feelings of isolation and is associated with lower pass rates.

(00:05:20):

Further, students face particular challenges and content-heavy STEM courses and may question whether they belong in that space. And these issues can be especially salient for students from groups marginalized in STEM and higher education. So ultimately these challenges are what has led the Collaborative to focus on online STEM courses and on strengthening students' self-directed learning skills, and are likely some of the reasons that brought you to this webinar today.

(00:05:50):

So let's take a look at how we'll use the remainder of our time together. First, we'll introduce the Collaborative's framework for self-directed learning, and the instructional strategies we've designed in efforts to bolster students' SDL skills. This may be a bit of a refresher for those of you who have already been working with the Collaborative.

(00:06:09):

Next, we'll provide an overview of the rapid cycle experiments we conducted to test and refine these instructional strategies. Then we'll share findings from a range of mixed methods data sources we use to gather and triangulate insights about the strategies. We'll start with instructor and student experiences, with insights from our interviews as well as from an instructor who embedded the strategies in her online course. We'll then review findings from our student survey and administrative data, followed by findings from our analyses of clickstream data captured by the learning management systems. Just before the top of the hour, we'll share reflections and what the Collaborative is up to next, and we recognize that some of you may need to sign off at 3:00 PM Eastern, but we're hoping most can stay on for the full 75 minutes to participate in a Q&A discussion with the presenters. And throughout the webinar, feel free to add any questions you have to the chat and we'll address them at the end during that Q&A.

(00:07:11):

All right, let's dive a bit deeper into self-directed learning. So our framework for self-directed learning draws on three main areas of underlying research that focus on how students manage their learning. Motivation, metacognitive processes and applied learning approaches. We'll say a bit more about each of these in a moment, but note that these SDL skills are distinct from and an important complement to the domain-specific problem-solving strategies that are typically taught in STEM courses. So our framework includes three SDL processes. The first are motivational processes, the, "I can," if you will, that provide the foundational emotions and beliefs that energize students' approach to learning. These are the emotions and beliefs around learning such as growth mindset and sense of belonging. The second are metacognitive processes, the, "I plan," that translate those emotions and beliefs into an action plan. And this includes understanding how to manage learning and actively adjust to the demands of any learning tasks, like setting goals and evaluating your progress.

(00:08:26):

Finally, there are applied learning processes, the, "I do," that put that plan into action and adjust it as needed. These are learning techniques and self-discipline strategies that help students take greater

ownership of achieving specific learning goals. This includes time management and help-seeking, for example. Now, as to how to bolster student self-directed learning and online STEM courses, the Collaborative embarked on several years and phases of research and development. As a part of this work, we identified candidate instructional strategies with promising evidence from literature reviews and a systematic database review, and then worked collaboratively with instructors at four of our partner institutions to fully flesh out or adapt the strategy for online learning contexts. And ultimately, we co-developed and tested the three strategies you see here on the slide, videos, prompts, and SPIN. Let's take a closer look at each.

(00:09:30):

So the video series consists of three videos each focused on a particular SDL skill or mindset. Sense of belonging, time management, and growth mindset. Each video follows a consistent structure including concrete strategies to develop that SDL skill or mindset, and each video also includes a reflection activity to help students think about how to put what they learned into practice. Next are the prompts. These reflective prompts consist of four questions focused on goal setting, task planning, and reflection. Three of the four are intended to be administered on a weekly basis with a fourth administered after each major assessment. There are options to adapt the number and frequency of these prompts, including how to adapt the pacing for asynchronous courses to be more unit-based than time-based, as well as options to supplement the standard prompts with prompts that may be more specific to the course content.

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And finally, designed to promote sense of belonging and help-seeking, the SPIN strategy consists of an introductory survey in which students share non-academic information about themselves, which instructors in turn share in aggregate form and used to create an activity around students' shared interests. Second, this includes a group work activity facilitated by instructors, and finally, weekly or small or whole-class discussions in which students talk about concepts they understood or struggled with, and share resources. And you can visit the events page for today's webinar on our website at postseccollab.org/events to access the draft versions of the instructional strategies and implementation guidance.

(00:11:27):

All right, now to the rapid cycle experiments, or RCEs. The RCEs allowed instructors of online or hybrid STEM courses to test a specific strategy or combination of strategies designed to help students develop self-directed learning skills. So these RCEs were really intended to be formative studies, not stand-alone efficacy studies, that we are triangulating with other sources to help identify promising strategies to include in our final culminating resources. Each participating instructor taught multiple sections of the same course within the same term where possible or across terms if need be. At the beginning of the term, instructors chose one section for each course to receive the intervention, and another to serve as a comparison group. And they additionally chose which strategy or combination of strategies to implement. Thus, the RCEs were quasi-experimental in nature.

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As a high-level overview, four of our partner institutions participated in the RCEs, testing the three instructional strategies we co-developed alone or in combination. These RCEs took place over four semesters from fall 2022 and fall 2023, including the summer term, and a total of 24 instructors participated, teaching 105 core sections that were included in the study that enrolled more than 2000 students. We administered pre and post-surveys comprised of validated self-report scales to students in treatment and comparison four sections, and we worked with institutional research offices to collect

administrative data, and with IT departments to collect data from each college's learning management system.

(00:13:24):

Collectively, these data sources help us understand the effect of the instructional strategies on students' self-directed mindsets and skills and course outcomes, and how these effects may vary based on student characteristics. Select instructors and students also participated in interviews to help us understand their experiences with the strategies and to gather formative feedback for refining the strategies. And so with that, I'll turn it over to my colleague and co-principal investigator, Krystal Thomas, to share our first set of RCE findings related to instructor and student experiences.

Krystal Thomas (00:14:03):

Thank you, Jessica. So we were able to interview 24 instructors that engaged or participated in the study using one or more strategy. And so at the end of each term, instructors were invited to interview with us so that we can learn some insights in terms of their experiences with using the strategies, and ways in which they not only used it, but ways that it was beneficial to them. And so one of the things that we came across was how instructors used the strategies to engage their students. A number of instructors found thoughtful ways to integrate the strategies with existing activities. So someone may include videos at a time point where students might be a little bit more vulnerable. So for example, they might do a growth mindset video around the time of the midterms or post midterms when students kind of need that motivational boost.

(00:14:59):

Instructors also used the strategies as an incentive. So oftentimes, many would either assign the strategy as extra credit, or in a number of cases, using it as an actual... towards their course grade so that it was actually meaningful for students to do the strategy rather than just kind of like a one-off kind of busy activity, or some might perceive as a busy activity. And then more notably, instructors also tried to vary the pacing of the strategies, especially for instructors that did, for example, videos plus prompts. They would alternate the weeks when students were doing prompts in between videos to make sure that it was a variety of activities that students were engaging in throughout the term. And in terms of time and value, instructors found that embedding the strategies were worth their time and also easy to embed into their LMS software.

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It also was informative to their insights in terms of students understanding, especially the prompts. So I was just going to highlight it. There was a question that asked students, "What concepts are you having a difficult time with?" That prompt in particular, instructors noted, gave them a real-time understanding of students' struggles and allows them to be able to provide resources either through student announcements or reaching out individually to the student to provide them with further supports to ensure their understanding of the course materials. At times, instructors were less sure if the videos had an impact, and this was often the case that instructors were less likely to use the reflection guide. For instructors that did use the reflection guide for the video, they did find that their students provided meaningful responses in terms of how they responded to how they might integrate the strategies into their own personal day-to-day experience and lives.

(00:16:48):

And then related to adjustments and adaptations, for instructors that had continued to participate in our study, so we had some instructors that started way back in fall 2022 and worked with us across three terms. We have others that worked with us for two terms. For those that continued to engage

with us, the more comfortable they folks can make adjustments to the strategies. So whether it was prompts in particular, where maybe now instead of asking what course causes do you have a difficult time with, they might embed questions that we had encouraged them to perhaps include related to more subject-specific questions that, again, would be both insightful for the instructor as well as meaningful for the students to reflect on their understanding about a specific concept rather than just asking more broadly.

(00:17:33):

And then these adjustments could also include changes to pacing as well. So some instructors were concerned that doing weekly prompts could be a bit repetitive. And so for those, especially those that continue to participate over time, they would have the first three or four weeks, students would do the prompts weekly and then they would space it out so then it was maybe bi-weekly or every few weeks, just to kind of encourage students to keep that practice of prompts and doing that planning and time management throughout the time of the course.

(00:18:04):

And then lastly, related to data, instructors often noted that they were attuned to looking at differences in students' course grades in comparison to their control class or classes that they had had, that's similar to the one that they had used for the intervention. They were also attuned to looking at rates of withdrawal and completion where some instructors noted that students were... It was varied in terms of whether students were more likely to withdraw, because maybe they might've had more of an awareness of where they were at in the progression of how they were doing in the course and just more willing to take a W than to fail. And then other instructors noted that in some cases students were more likely to persist and not withdraw from a course in comparison to other terms.

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And then as noted before, especially with what I noted about engagement, again, the data was really helpful for instructors to be able to identify students' learning needs. And so again, those strategies were not just meaningful for students, which we'll talk about soon, but was really meaningful and important for instructors in terms of their practice. And I think the best way to describe one's experience, we have Paige Roseman who's joining us today on our panel, she's a psychology instructor at Wake Tech Community College, next slide, and Paige will be able to share her insight of doing these strategies across two terms. And as noted here, she did videos, prompts, as well as SPIN. Paige?

Paige Roseman (00:19:35):

Thank you so much. Thanks, Krystal. Y'all can hear me okay? Yes. So I just wanted to start off by sharing with y'all really quickly, I have been at Wake Tech here for nine years, and in addition to being the psychology faculty, I also work as part of our teaching and learning team. So I get to partner with faculty and really empower them to help students be successful. So I think that's where the magic happens, when you combine those faculty supports and empowerment with what works for students, and helping them develop those self-directed learning skills. So really briefly, I did hear about this work that the Collaborative was doing through a colleague. I think that's how a lot of us here about great work that is going on. So Kim Breivogel, who is within my department, as well as folks across our teaching and learning team, so folks who are working with math and chemistry and some of our other STEM courses here at Wake Tech.

(00:20:34):

So very briefly, I wanted to share with y'all just my experiences embedding the videos, prompts and the collaborative SPIN strategies. So to begin with, the kind of overall theme is just that I found it in the

original Blackboard, and now of course we've updated to Blackboard Ultra, learning management systems are always changing, but from the faculty perspective, with larger student loads and all considered, each of these strategies that y'all may be exploring using the link that was provided earlier, they are incredibly well-thought-out, they're easy to implement, the videos, for example, are accessible, they have the transcripts that are included in multiple ways for students with different disabilities, for example, to be able to still access that information. So that's a huge deal here for us from the learning management side, is making sure that that implementation is really easy, consistent, and accessible. So that was one big theme I wanted to point out, especially amongst the videos on the belonging, time management and growth mindset.

(00:21:52):

Jumping into prompts, the first semester that I worked with the Collab, I was doing videos and prompts. And in order to get students to do those. I did embed the prompts as part of a kind of discussion portion of a grade. I was able to use a couple of different survey tools, one that was embedded in Blackboard. And for me in particular, asking students about the concepts, especially in a fully online asynchronous course that they were still struggling to understand, that gave me a lot of direction in terms of providing some themes, following up with students individually as needed. Today I continue to use the prompts, and I really like doing pre and post exam wrappers. So getting students to focus in as we get a little closer to those higher stakes assessments on the time that they're creating to prepare the things that they feel most confident in and still need some supports in.

(00:22:57):

So as the co-PI's have shared here with y'all, I think something that's really important too is that the questions that are given, they're easy to adapt to the content and also add. So I found that something that helps students a lot was adding a question that essentially also shared campus resources. So say folks are approaching an exam and I really want to share, in yet another place, if you struggle with test anxiety, for example, here's a couple of workshops that are being offered, come see me in office hours if you have these types of questions, so I did find those prompts really easy to use and adaptable within that context as well. And again, still use the exam wrappers.

(00:23:46):

Last but not least, I wanted to jump in on the Collaborative SPIN strategies. I think this was something that a couple of folks shared in the chat or maybe in that original poll. In online STEM courses, I think as an instructor and as faculty, it can be so tough when students aren't engaging with each other and getting that kind of back and forth, and that really helps them to share resources, share ideas that you would more naturally have in a more seated environment.

(00:24:18):

So I really appreciate it and still use a version of the Getting to Know You survey. I loved being able to share themes with the class, what folks are interested in, how many students are working and are parents, in the community college there's lots of fun things that we can share to help bring people together as well. So another thing that that survey was really useful for was grouping students. So I might ask questions about when folks have time to do work or they're available to work. And then I would be able to more effectively partner them a little later in the semester to work in small groups based upon shared availability.

(00:24:59):

So I think something that I really appreciated about this team is that in trying to encourage student collaboration, I worked within tools I was already using. At the time, a discussion forum used through Flipgrid, and now just a discussion forum used through our typical Blackboard. But one thing that I really

noticed a lot of improvement in student engagement on was help seeking forums. So discussions very early in the semester, week two, after we've gotten to know each other a bit and establish some belonging, we would work on sharing content resources around something difficult, say something like research methods in psychological science, something students typically struggle with. So they would share resources with each other, ask questions, and it was really empowering to see as a faculty member, to see students working together, sharing resources and truly encouraging that help seeking, but also seeing it in action.

(00:26:07):

So last but not least, just getting to see some of those outcomes with improved participation in the discussions and improved student outcomes was a really big deal. So I want to make sure... I have a couple of big things I just wanted to wrap up with, but from the faculty side, I think that whether you are looking into the prompts or the SPIN strategies or the videos, these are easy to implement, they're accessible for students, they're adaptable to your course content, and there have been so many good insights that have been shared and will continue to be shared throughout this presentation. So I'm always looking for strategies that kind of meet that magic middle, that empower faculty and students to work together in our unmanageable lift. And I'm still using some of the strategies today. Thanks for just giving me the opportunity to speak and I'll be happy to answer any questions too.

Krystal Thomas (00:27:16):

Thank you so much, Paige. Next slide. All right. So we also were able to, across three terms, interview 25 students that had engaged with one or more instructional strategy. And so we identified some themes that actually map on really well to our framework. And so the first quote that you see on your left is a way in which a student was kind of talking about one of our motivational processes. So for example the student shared, "Learning about other people and what they experience, and like finding myself in that same boat." And so this student, they were reflecting in their interview regarding the video related to sense of belonging, they had noted that one of the vignettes was helpful for them to be able to identify themselves in that video. And more importantly, being able to understand that they are not isolated in the experiences that they have and that there are actual ways that they can be able to feel like they are a part of that learning experience even though it's in an online setting.

(00:28:25):

And so again, we were able to identify another theme related to metacognition where in the middle quote here, I'll note the second one here, "What didn't you understand so well this week?" So that was the prompt. "When I got asked that question, I realized, 'Oh, I really need to study this, because I didn't really understand it that well this week.'" So again, when students were engaging in these prompts, again, it helped them to be able to use insights that they might not have otherwise asked themselves regarding their understanding of the concepts for the course, but also drove that student to try to figure out, "Okay, what do I need to be able to understand this?" Which is really remarkable in terms of instructors and students often noting that they know they need to do more, but they don't know how to do that. And so the prompts being able to help get the students to think about, "Okay, well what next do I need to do better?" Was really great to hear in that interview.

(00:29:29):

And then the last one, which was really encouraging, related to applied learning strategies. Applied learning strategies is often related to students not only reflecting on how they're approaching their learning, but being able to make adjustments if something isn't working. And so in this third quote you see here, "I started a WhatsApp group for the class, only I think with eight or so people. I was inspired by one of the videos to start the group." One of our student interviews, the student was noting the sense of

belonging video where one of the suggestions or one of the resources was either creating a study group or joining maybe perhaps an existing study group that is offered on campus or going to tutoring services. And so it was really great to hear that what this student did, or what their instructor actually did first was, the students were responding to the sense of belonging video in a discussion board.

(00:30:21):

And the student had asked other classmates, like, "Hey, do you want to start a WhatsApp group?" And so what's interesting is the student was like, "It was only just eight students." And I was like, "That's actually remarkable that eight other people, which does not typically happen in many discussion boards, eight of those people responded to your post, were willing to share their information, and be able to work together outside of class to really support each other in content in ways that we don't often see students being able to do in an asynchronous space." And so as Paige noted, one of her activities was using the discussion board for students to be able to talk about their learning and sharing resources with each other. And this student was at a different institution, and was also able to leverage the discussion board to build community for herself in an asynchronous online setting. Next slide.

(00:31:14):

And we've also learned a great deal from students' experiences to help us to be able to make important iterations and improvements to how we approach the strategies as well as the guidance that we give instructors related to their implementation. So the first was adaptations to prompts. So in the very first term of deploying prompts, many students were like, "I like it, it was great, it was helpful, but it was really repetitive to answer the same questions every single week and just keep doing it for the rest of the term." And so that enabled us to, again, encourage instructors and also think about suggested adaptations that they could use to the prompts to kind of add variety to it. And as I noted earlier, we encouraged some instructors that after a few weeks you could begin to pace it out to make it bi-weekly or again, make some prompts that are a bit more specific to the course content itself.

(00:32:15):

And then in other interviews, we also learned that students were looking for some feedback from instructors. So it was varied in terms of how instructors had used what they learned from the prompts or from SPIN in terms of how students did their group activities in terms of whether instructors actually gave feedback or just kind of acknowledged students' responses. So getting this feedback from students encourages us to think about, how can instructors provide meaningful feedback that's constructive for students, but also helping students to, again, get that immediacy in terms of getting that faculty support, and then therefore encouraging the students to want to reach out more to the instructor because they had some kind of form of communication from the instructor that acknowledged either the struggles that they were having with through the prompts, or perhaps some of their efforts that they put into their group assignment.

(00:33:08):

And then thirdly, we learned from many students, they were looking for connections with peers. And so SPIN, the strategy that we described related to that peer collaboration among each other, that strategy was developed in our third term. And this was a combination of, one, learning from students in what ways they wanted to connect with their peers. And we also have a student fellowship program where the student fellows really also help to drive home how one in those intro surveys is really important and how you can actually leverage it so it's not just a fun icebreaker, but something that can be used throughout so that it has some meaning and purpose to it. And then also being able to do that collaborative activities where we could either... Where the strategies could be... Not the strategies, but the group activities could be used either asynchronously or synchronously so that instructors could

leverage it regardless of the type of class that they have for online learning. And I believe Paul will talk us through findings related to survey and administrative data.

Paul Burkander (00:34:14):

All right. Thanks so much Krystal. So before getting into our findings from surveyed and administrative data, we wanted to give you some sense of the characteristics of the students included in our study. So on this slide we're showing the share of students who are first generation, the type of major students had, the students' race and ethnicity, and the number of people for whom the student was the primary caregiver. So there are just a few minor caveats here on this slide. The student's major and number of people for whom they were a caregiver, those come from our pre-survey data. So we only have those measures for those respondents. We had about 1300 respondents to the pre-survey, but we had administrative data on more than 2000 students. And for that first measure, first generation, one of the four institutions that we were working with was not able to provide information on that measure.

(00:35:13):

But more than a third of the students in our sample were first generation college students. Among those for whom we had data. And not surprisingly, given our focus on STEM courses, more than half of the students were enrolled in some type of STEM major. Though our sample also included students in social or behavioral sciences, liberal arts, other majors or students who had no declared major. About half of our sample was either black, Hispanic, Asian, or multiracial, and about 40% of the sample was white. And while most of the students were not caregivers, nearly 30% were caring for at least one person. And to give you some sense of the courses too, about 20% of the courses were hybrid, whereas the rest were completely online.

(00:36:05):

So our analyses examined whether being in one of the sections using any of our strategies affected students' SDL skills and achievement. We confirmed that prior to participating in any of the strategies, the students in sections using a strategy had similar prior achievement and similar SDL skills compared to students not in a section using one of the strategies. And then we also statistically adjusted for the relatively small differences that we did see between sections using strategies and those not using them. Our outcome measures fall into four buckets or domains. These are applied learning strategy, which included students help seeking, the number of learning strategies they used, and their time management, metacognitive outcomes, which included comprehension monitoring, that's things like for example, whether students analyze the usefulness of the strategies they use, students debugging strategies, such as whether they stop and reread when confused, their evaluation, such as whether students summarize what they've learned after finishing a task, and goal setting. And then we looked at motivational outcomes, including students' self-efficacy, their sense of belonging and growth mindset. And finally we looked at students' academic achievement as measured by their end-of-course grades.

(00:37:37):

So in this figure, we're showing results for each of our outcomes, where the gray horizontal bars are confidence bounds. So if any of those intersect with that red line, which is for zero, that means we did not find a statistically significant effect. So we did not find a statistically significant impact on academic achievement. Among the outcomes in our applied learning strategy domain, we did find a significant impact on the number of learning strategies that students used. And this effect was really driven by an increase in students' use of diagrams or mental pictures, and an increase in students' reviewing of their lecture notes. For outcomes in the metacognitive domain, we found a significant impact on students' evaluation. And this effect was driven by an increase in students knowing how well they did after

finishing a test and asking themselves if they'd considered all options solving a problem. Among outcomes in the motivational domain, we did not find any significant impacts.

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We also looked at differences in effectiveness across different student groups, but we didn't find any evidence that the strategies were more effective for some students compared to others. But one of the challenges that we faced, and which is a common challenge among rapid cycle evaluations, is that we really didn't have a large sample, so we were only able to detect very large effects. An increasingly common way of addressing this challenge is to conduct analyses that draw on prior similar evidence to estimate the probability that an intervention was effective. So on this slide, we're showing the results of that analysis, which draws on evidence from prior high-quality studies conducted in postsecondary settings. This figure is showing the probability distribution for the true impact on students' end-of-course grades. So when we consider our estimates in light of prior evidence, we estimate a relatively high probability that there was some positive effect on students' end-of-course grades. About a 78% probability of a positive effect.

(00:39:54):

So this slide then summarizes all of our estimates, showing both the traditional p-values and the probability of a positive effect. For learning strategies inventory, whereas I mentioned, we had found a statistically significant impact, the probability of a positive effect in light of prior evidence is very high at 83%. And then for evaluation where we also had a significant effect, the probability of a positive effect is very large, at 98%. The probabilities of a positive effect for outcomes in a motivational domain, however, were relatively low at 23% on average across those outcomes. Okay, so now I'm going to pass it on to my colleague Renzhe, who's going to talk about some of the findings based on the clickstream data from learning management systems.

Renzhe Yu (00:40:49):

Okay, thank you, Paul. So this part, I'll present some insights from the analysis of learning management system data. So first, let me introduce what LMS... Learning management system data or LMS data is. So it is basically the log data from the backend of learning management systems, which tracks every single action taken by a student. And this data is also sometimes known as clickstream data. In other words, we can tell when the student is doing what within the system. So here is a synthetic example of clickstream data, where in the first row, for example, we can see that user, or student 1, 2, 3, 4, 5 viewed a content page within module... Where the module ID is 704 at this specific time.

(00:41:44):

Next slide, please. We analyze this kind of LMS data across 19 core sections that actively use LMS for the instruction. These 19 sections encompass both comparison and intervention groups of the RCE. From this table, you can see that on average there are 24,000 student click actions on average per course section in the comparison group, and 28,000 click actions in the intervention group, which is a lot of data that allows us to get more insights about student behavior. So LMS data mostly helps us in two ways. The first thing is that for course sections in the intervention group, which deploy any testing strategies within these LMS, the collection data will help us assess students' engagement with strategies per se. Here we develop three measures of that engagement for each student in each section, which deploy one or more of the strategies. So the three measures are action count, total time and reaction time. Note that reaction time here labeled with a minus sign is reversely defined, where lower levels would suggest more active engagement. Next slide, please.

(00:43:15):

So here in the plot, each bar shows the distribution of one specific engagement measure in one specific core section. And these sections are grouped by the specific combination of strategies that are deployed. So overall, we see that student engagement with these strategies differs notably across courses and strategies. And meanwhile, within the same course, students will show diverse engagement patterns with the strategies. So these observations indicate that both individual differences and course context jointly shape how students engage with these strategies.

(00:43:58):

So another way that LMS data helps us is that we can look into students' SDL processes through their actual behavior throughout a course. So here we draw on the decade of learning analytics research and identify eight specific behavioral indicators of different SDL processes. Note that one variable here is reversely defined on the second to the last average session gap, where lower value would suggest more prominent time management process. So with this framework, we calculated these measures for each student in each course section, and also in each week because we have time stamped action records in the collection data. So this time we calculated these measures for both students in comparison and intervention course sections.

(00:44:57):

So then we are able to analyze, similar to what Paul was presenting, we're able to analyze whether being exposed to any test strategies is related to more prominent SDL processes. Here we show the estimated relationship for each of the eight behavioral indicators, which combined, provides moderate evidence that the tested RCE strategies are positively associated with every single SDL process that we are capturing here. When we further break this down by different combinations of strategies, we have a total of four unique combinations. We see that the positive relationship is evident in three out of the four implemented combinations, with the exception being video plus prompts. But all other three show moderately positive relationships.

(00:45:59):

So I just showed our insights from LMS data for all students. We also did the same analysis and looked into students from different populations. There's so many results, but here I want to point out a few takeaway messages. First, we find that compared to their peers, systematically marginalized students of STEM, such as racial minorities, female students, first generation students, they show higher levels of engagement with the tested strategies per se. This is especially true for women and racial minority students. And also when it comes to the relationship between exposure to the testing strategies and their behavioral indicators of SDL processes, we find that the positive associations we just observed across all the students are somewhat stronger for racial minority students, which is good, which is promising, but they are somewhat weaker for first generation students compared to their peers.

(00:47:09):

So the broad implications of what we find through LMS data analysis is, first, overall all these statistical analysis and the results show some promise that technology-based strategies that we tested in RCE may be especially motivating for systematically marginalized students, and also, not only motivating, but also beneficial for their SDL skill development. In addition, while we are pulling this kind of data from the back end of the system, we show that student behavior might be a good source of information to understand student engagement and SDL processes. And fortunately, many LMS products do provide dashboards or some other kind of functionalities that makes it easy for instructors to examine the student behavior in real time.

Jessica Mislevy (00:48:07):

All right. Well, thank you so much to my colleagues Krystal, Paige, Paul and Renzhe for sharing these insights. I wanted to take a moment now to reflect on what we've learned and how these learnings are informing the Collaborative's next steps. So the goal of the RCEs was to iteratively improve the strategies and inform our development of this culminating set of resources. As Paul mentioned, it's common with early stage tests and development research like these RCEs to have relatively small sample size limit our statistical power to detect significant effects. And though each of our analyses has its own limitations across the rich variety of data sources included in the RCEs, we're generally seeing encouraging effects across the metacognitive, applied learning and end of course outcomes.

(00:49:10):

And since iteratively testing and refining the instructional strategies through the RCEs, we've been working with instructors and others from our partner institutions to integrate these individual strategies into a more cohesive and comprehensive set of resources, which we plan to pilot test next spring. We're also building out wraparound supports that instructional designers and other administrators can use to support uptake and scalability across the institution. So as you come away from today's webinar, here are some questions you might consider: What do you see as key takeaways from the RCEs that may have implications or applications for your work? How do these instructional strategies resonate with your work or the approaches you take to support students online learning? In your experience, in your online courses, do these instructional strategies seem feasible? How might you implement these strategies in the context of your online course? And finally, how does your institution support instructors in their efforts to address development of self-directed learning skills and mindsets?

(00:50:30):

And recognizing that some of you may need to sign off soon at the top of the hour before we open up to questions, we wanted to thank you all for joining us today and for contributing to our shared goal of better helping students succeed in online learning. You can use the QR codes that you see on the screen to visit our website, subscribe to our newsletter, or find the resources with details on the instructional strategies and how to implement them on the events page for today's webinar. All right, with that, I think we're a few minutes ahead of schedule and can go ahead and get to the Q&A. Next slide. All right, and next one. So we invite you to enter any comments or questions you have for the presenter into the chat and we'll be excited to discuss more.

Krystal Thomas (00:51:52):

Jessica, I just wanted to note, we have a number of instructors that have participated with us [inaudible 00:51:57] terms, and so I just want to give many of you that are here, thank you for coming, thank you for engaging with us and trying out these strategies these last few terms, and we are really grateful because we obviously could not have done this presentation without you all, so thank you so much.

Jessica Mislevy (00:52:21):

Melissa, I see your comment about the QR code for the strategies. Those documents are the same strategies that we're referencing today. They can be found both on today's event webinar page and on the November 9th conference web page.

(00:52:56):

And we're happy to take any questions. I know Paige is still on as well, if folks have more questions about her experience implementing the strategies, or if you're interested to unpack some of the various analyses that we conducted for this research.

(00:53:32):

I'll give it just another minute, but I'm also happy to give folks some time back in their day if there are no further questions. And we really want to thank you again for joining us today and we hope to see you again at upcoming events for the Postsecondary Teaching with Technology Collaborative.

Jodi (00:54:20):

Jessica, there is one question in the Q&A. I don't know if you can see it, or if you have access to it or if you just want to-

Jessica Mislevy (00:54:30):

Okay, thank you. Thank you very much. It looks like Amanda asked... She shared, "I work in dual enrollment. Do you have any guidance or input for how this applies or doesn't apply with high school students?" One thing I will say is that a number of the courses in the RCEs did have students who are dual enrollment students. And so these strategies were definitely deployed in classes that did support dual enrollment students. One important context for our research is that due to consenting processes, we involved just students who were 18 and over in our data collections and analyses. But as mentioned, a number of these students may have been first time college enrollees as well. And I invite my colleagues to join in about ways that these strategies may be helpful to or adapted to dual enrollment students.

Keena (00:55:39):

Jessica, I believe we had some students when we did interviews with students, mention some of the SDL skills that they brought from high school, and then these strategies building upon those at some point. I can't specifically remember the data, but I do think it is an area where these strategies can build upon certain SDL skills that students do in fact develop or at least initiate the beginnings of these skills in high school. And so I think that's something worth noting.

Jessica Mislevy (00:56:22):

Thank you, Keena. Agreed. And I think similarly sometimes you find some of these concepts and strategies more in an introductory student success course in college. And one of the unique things about our work at the Collaborative is really this idea to more directly infuse these supports for self-directed learning in an academic course itself. So there is a bit more of that just in time support and reinforcement of some of these strategies and concepts that may be harder to directly connect or figure out when or how to apply in the context of a STEM class. Thank you, Amanda, for sharing that question.

(00:57:41):

Any other questions for folks, or make sure that I haven't missed something in my view? Ah, thank you. Someone shared a question about, "Have you seen any adaptations of your findings in non-STEM courses?" So one thing to note is that for the RCEs, we did include STEM courses as well as courses and the social behavioral economic sciences such as Paige mentioned being an instructor in psychology. And so our results do apply across that range of courses. And we do think our instructional strategies would have applicability and usefulness in non-STEM courses outside these disciplines as well. Our focus specifically on STEM was thinking about having seen some of the greatest needs as we shared earlier in this webinar for student support. But we do believe that our strategies could have usefulness and applicability outside these disciplines as well. I'll invite my colleagues to share any more thoughts on that question.

Krystal Thomas (00:59:08):

Yeah, I agree with your sentiments, Jessica. I think that they could be applied in non-STEM settings, especially given how a couple of our... We had another instructor in addition to Paige that was also a psychology instructor, and I think we saw some meaningful ways that they were able to still embed those videos in particular, and prompts. I'm trying to recall if the other instructor had did SPIN as well, but I could also see how, especially a class like psych, how you could do collaborative group activities.

Jessica Mislevy (00:59:42):

One thing we also heard from a few students who participated and used these strategies is that they actually applied them in their other courses even though they were formally being tested in one course, but they found them helpful, and actually carried over some of those strategies and learnings to their other courses. And so to me that's also perhaps indicative of some of the generalizability of these strategies in different course contexts.

(01:00:31):

Thank you. Amanda shared another question saying that I think what we just talked about was going to be your next question and you're thinking about the impact across the student's college experience. Is there any exploration planned for measuring this? So as I alluded to, we're preparing for a pilot test in the spring to test the adoption of these strategies in a larger set of courses across several institutions. And one of the outcomes that we've added to our research plan that was beyond what was included in these rapid cycle experiments is actually an outcome measure looking at whether the student re-enrolls in the institution the following term after engaging with the strategies in the spring. So looking at being retained for the following fall semester.

(01:01:31):

One other thing that we did see some instances of within the RCEs, but it was too rare really to do any analyses or draw conclusions, is that we did have some students in our sample who actually enrolled in multiple courses that used these strategies and perhaps received them over multiple semesters or across more than one course within a semester. And so that is something that we've wanted to explore a little bit more about what could be some of the cumulative effects of these strategies and just weren't able to answer that question with the few occurrences we had within our RCE sample. Again, always invite my colleagues to chime in with other thoughts.

(01:02:46):

And I see in the chat as well that Melissa shared the value in the looking at retention for the following semester. So we are glad to incorporate that in our next stage research design. I think one of the other things that's of interest in our upcoming pilot is, as we mentioned in the RCEs, instructors had the option to pick one or more of the strategies or which combination of strategies they were interested to test. As we've really spent our last year formally integrating these strategies into a more cohesive and comprehensive set of resources, we will be asking instructors who are participating in the spring to test the full set of strategies. So again, we're interested to explore that question around greater dosage or exposure to these multiple strategies in combination.

(01:04:11):

Thank you, Amanda, for sharing another comment in the Q&A that the impact on retention and persistence and repeated engagement is intriguing. You shared, "I would be interested in also learning qualitative feedback from students and how they have applied their diversified learning strategies over time. Does anyone have any input on this?"

Krystal Thomas (01:04:35):

Thanks, Amanda. So we haven't interviewed students that had an instructor that... Or engaged in strategies over multiple terms. So typically a student that we interviewed was only once in terms of their engagement with the strategy itself, but as Jessica shared, we do at least have insights that students were applying them across multiple courses that they were taking. Another notable interview I can think of is, we had one student that was a parent to three kids and was taking a number of classes, and so they were able to actually integrate particularly time management and planning to their own personal life in terms of being able to better schedule when they were going to do their coursework in relation to when their kids were in school, and then finding more availability to then spend time with their kids after school and especially on the weekends. So instead of trying to get to that Sunday midnight crunch deadline, they were trying to get their work done sooner so then they could think about how to engage more with their family.

(01:05:43):

So I think we can look at a number of ways that students are integrating the strategies across the various ways that... things that they engage in their day-to-day lives, but I don't think we necessarily have yet considered looking at over time what that might look like. So it's only usually within a term.

Jessica Mislevy (01:06:06):

Yeah. Thank you, Krystal. As mentioned, of the nearly 2000 students that were enrolled in courses as part of the RCEs, I think we had something around maybe 20 instances of students who were in multiple courses that used the strategies. And of those nearly 2000 students, we interviewed about 20 of those students, and so didn't have a strong overlap in both those smaller samples and instances.

(01:06:43):

Thank you, Amanda, too for your comment and then the chat about how students are applying these skills to multiple areas of their lives. I'll welcome any last questions, comments, or reflections. Paul, maybe we can go back to our thank you slide again, just one more time, if folks wanted to capture any of these QR codes for our resources. And I wanted to thank you all so much for your time and interest in joining us today. And again, we hope to continue our engagement with you in the Postsecondary Collaborative and our upcoming events, activities, and research. Thank you.