





Piloting a Self-Directed Learning Instructional Model for Online College Courses: Technical Report

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The Postsecondary Teaching with Technology Collaborative (the Collaborative) is a U.S. Department of Education, Institute of Education Sciences R&D center, co-led by SRI Education and the Community College Research Center at Teachers College, Columbia University, in partnership with Achieving the Dream. The Collaborative uses research findings to build the capacity of institutions and instructors to establish inclusive learning environments and incorporate technology in ways that improve learning and success in postsecondary online courses. Our research analysis aims to contribute to knowledge and understanding of how instruction can support students to employ a constellation of motivational and metacognitive processes and certain applied learning processes—which we refer to as self-directed learning (SDL)—to manage their learning more effectively in online courses and increase their postsecondary success.

Postsecondary Teaching with Technology Collaborative

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CONTENTS

I. Introduction	1
II. Conceptual Framework	3
III. Study Design: Data, Sample, and Methods	6
IV. Results	19
V. Limitations	44
VI. Summary of Key Findings and Next Steps	46
VII. References	47
VIII. Appendix	50



I. INTRODUCTION

This technical report describes the methodology and results of a pilot study of the Self-Directed Learning (SDL) Instructional Model conducted by the Postsecondary Teaching with Technology Collaborative in spring 2025. The pilot study used a variety of qualitative and quantitative methods to examine the model's implementation, impact, and costs with 24 instructors and more than 1,300 students across four community colleges and one four-year university.

This report is intended for researchers and other technical audiences interested in understanding the methodological details that underlie the pilot study and comprehensive results. It complements a research brief (Bickerstaff et al., 2026) that summarizes and discusses key study findings and implications for practice.

Section I of this report introduces the Collaborative, the SDL Instructional Model, and the pilot study. In Section II, we review the conceptual framework and theory of change that guided the development of the Instructional Model and our research, respectively. In Section III, we describe the pilot study design, including the setting and sample, quantitative and qualitative data sources and data collection, and analysis methods. In Section IV, we present results organized by research question. We conclude with a discussion of limitations (Section V) and key findings and implications (Section VI).

The Postsecondary Teaching with Technology Collaborative

The massive shift to online learning during the COVID-19 pandemic amplified concerns about student success, particularly in science, technology, engineering, and mathematics (STEM) courses. College students continue to sign up for online courses at increasing rates, but they also pass them at lower rates than face-to-face courses (Altindag et al., 2024; Bawa, 2016). Online courses put more demands on students to manage their own learning and on faculty to use technology to foster student learning (Antonelli et al., 2020; Yarnall et al., 2023).

The Postsecondary Teaching with Technology Collaborative (the Collaborative) is a federally funded research and capacity-building center aiming to help faculty support students' skills for managing their learning in online introductory STEM courses. The Collaborative is a partnership of SRI's Education Division; the Community College Research Center at Teachers College, Columbia University; Achieving the Dream; and nine broad-access colleges and universities.

Over the last five years, the Collaborative developed and tested focused instructional strategies that STEM instructors can embed in their online courses to support students' development of learning habits, including motivation to learn, planning and monitoring learning tasks, and selecting applied learning strategies—together called *self-directed learning* (SDL) skills.

Developing the SDL Instructional Model

Working with partner colleges, the Collaborative drew from SDL concepts to design, develop, and test three instructional strategies for online learning that together compose the **SDL Instructional Model**:

- **Self-directed learning videos**: 10-minute videos with a corresponding set of reflection questions. These videos, informed by real student experiences, focus on sense of belonging, growth mindset, and time management.
- **Self-directed learning prompts**: A series of prompts embedded throughout the course. The prompts encourage students to plan and reflect on their learning in the course. The prompts include short-answer questions that can be assigned at any point during the course, an assessment wrapper tied to a major graded assignment, and an end-of-term message to a future student.
- **Student-peer interaction and networking (SPIN)**: Instructor-integrated activities for online students to support one another. SPIN activities include introductory questionnaires and group assignments or online work sessions.

Using our SDL framework and the body of rigorous literature on effective interventions as a guide (Yarnall et al., 2023; see Section II), researchers at the Collaborative partnered with faculty, administrators, and students at seven community colleges and two broad-access universities on a series of iterative research and development activities. First, the team adapted evidence-based interventions for use in online postsecondary contexts. They tested these early versions of the three SDL strategies through rapid-cycle evaluations (Burkander et al., 2024; Mislevy et al., 2026). Then, they conducted a feasibility pre-pilot study at three of the nine institutions to understand if faculty could use all three strategies in one course (Yarnall et al., 2025). Finally, the team conducted a pilot study of the SDL Instructional Model across five of the nine institutions. After each phase of the research, the Collaborative refined and improved the model.

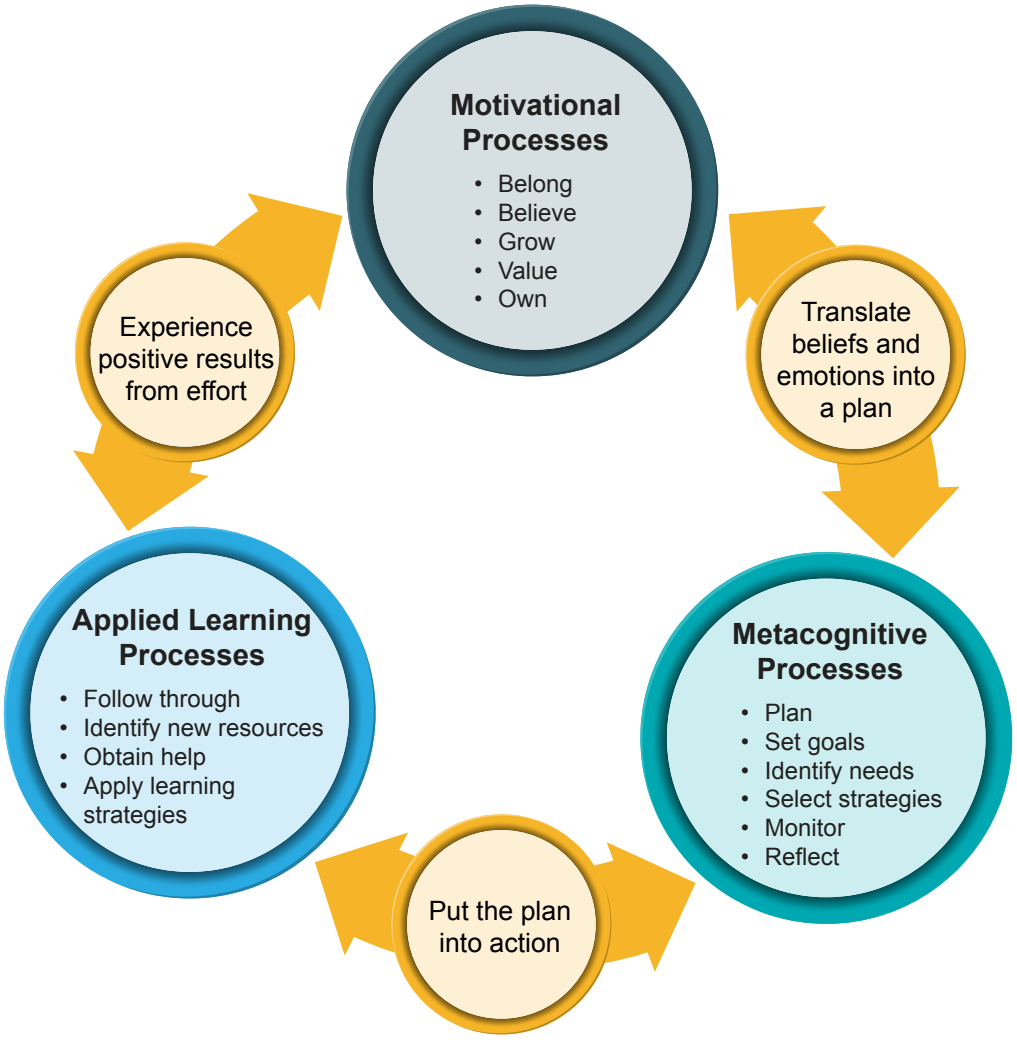
Pilot Study Overview

In spring 2025, the Collaborative conducted a large-scale pilot study to examine the usability, feasibility, and potential impact of using the SDL Instructional Model in online and hybrid STEM courses, as well as the resources needed for implementation. The pilot study included five institutions—four community colleges and one four-year university—that varied in size, geography, and student demographics. Across these institutions, 24 faculty implemented the Instructional Model in 25 intervention course sections. The Collaborative also recruited comparison sections of the same courses taught in the same modality, often by the same instructor. In total, the study included 50 intervention and comparison course sections and 1,338 students across those sections. Study activities included interviews with faculty, students, and administrators; surveys of faculty and students; and analysis of course outcomes.

II. CONCEPTUAL FRAMEWORK

The Collaborative's SDL Instructional Model is informed by a framework for self-directed learning that establishes how three core psychological constructs interact with one another to promote student success: motivation, metacognition, and applied learning (Yarnall et al., 2023; Exhibit 1).

Exhibit 1. Conceptual Framework for Self-Directed Learning



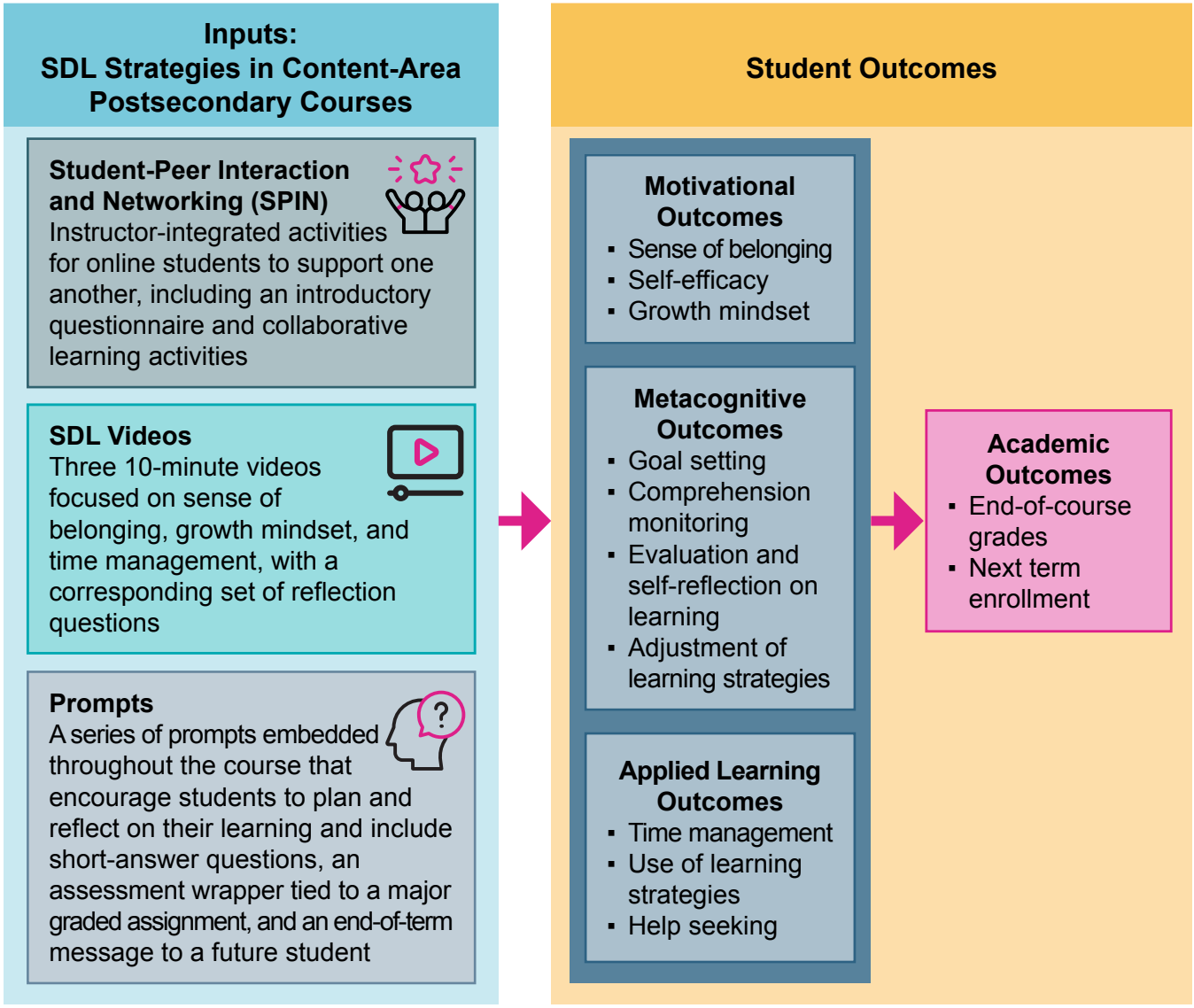
Our SDL framework adapts concepts from theories of self-regulated learning (SRL; Pintrich & Schunk, 1996; Zimmerman, 2002), self-directed learning (SDL; Garrison, 1997; Merriam, 2001; Morris, 2024), and self-determination (Ryan & Deci, 2000) and further delineates multiple subprocesses within the constructs of motivation, metacognition, and applied learning that can help college students effectively manage their learning. While SRL theory describes subprocesses used to achieve learning goals, SDL theory focuses on how students develop the motivation to initiate and manage the learning enterprise (Garrison, 1997). Self-determination theory frames motivational constructs of agency, personal relevance, and relatedness as processes that help initiate and maintain motivation during learning tasks (Garrison, 1997; Graham et al., 2023; Lazowski & Hulleman, 2016; Merriam, 2001; Ryan & Deci, 2000; Zhu & Doo, 2022). To broaden the framing for college students, we shifted away from the more subprocess-focused and developmental terminology reflected in SRL theory and toward the more agentic language focus in SDL.

The framework also describes how the three processes function dynamically and mutually to motivate learners to engage more independently in metacognitive habits of reflection and to exercise more proactive applied learning capabilities such as seeking social support and resources. The learning success that results from actively using metacognitive and applied learning processes feeds positive emotions and refuels students' motivation, starting the cycle anew. Thus, in our framework, motivation is both a leading and lagging indicator of SDL.

Theory of Change

Exhibit 2 depicts the Collaborative's theory of change. We posit that integrating a set of strategies designed to address the spectrum of SDL constructs (i.e., the strategies that compose the SDL Instructional Model) will improve students' SDL mindsets and skills. These include affective outcomes around motivation (e.g., sense of belonging, growth mindset), as well as behavioral outcomes related to metacognition (e.g., goal setting, progress monitoring) and applied learning skills (e.g., time management, help seeking). Ultimately, we hypothesize that these increases in SDL skills and mindsets will improve academic outcomes such as course grades.

Exhibit 2. SDL Instructional Model Theory of Change



III. STUDY DESIGN: DATA, SAMPLE, AND METHODS

The Collaborative conducted a convergent mixed-methods quasi-experimental pilot study that drew on interviews with faculty, students, and administrators; surveys of faculty and students; and administrative data to answer six research questions (RQs).

Research Questions

- RQ1. Does use of the model show promise for improving student SDL and course outcomes?
- RQ2. To what extent is the model implemented as intended? What are the barriers to implementation with integrity?
- RQ3. How and to what extent does the model differ from typical classroom practices?
- RQ4. What are student, instructor, and other user experiences with the model? What are their perceptions of value? What contextual factors are associated with these perceptions and experiences?
- RQ5. What resources, tools, and supports are needed for instructors to take up and implement the model with integrity across diverse settings?
- RQ6. What resources (staff, time, and materials) are required to implement the model as intended?

Setting and Sample

In the spring 2025 pilot study, 24 faculty in five postsecondary institutions across the United States (four community colleges and one 4-year institution) implemented the SDL Instructional Model in 25 online or hybrid course sections, with one faculty member implementing in two sections. These institutions varied in geography, student demographics, local community context, and institutional setting. All course sections were at the college level (not remedial), and most courses were introductory and would be taken by students as a first course in a given field or major. We identified comparison sections of the same courses taught in the same modality, for a total of 50 course sections and 1,338 students across intervention and comparison groups.

Exhibit 3. Summary Table of Intervention Course Section Characteristics

Characteristic	Percentage of Intervention Course Sections	Count of Intervention Course Sections
Section modality		
Asynchronous online	64%	16
Synchronous online	12%	3
Hybrid	24%	6
Section length		
8 weeks	32%	8
15 weeks	16%	4
16 weeks	52%	13
Section subject		
Math	44%	11
Psychology	12%	3
Biology	8%	2
Chemistry	8%	2
Nutrition	8%	2
Physics	8%	2
Computer information technology	4%	1
Geology	4%	1
Economics	4%	1
N sections		25

Intervention and Comparison Conditions

At the beginning of the semester, participating faculty chose one section for each course to receive the intervention and another to serve as a business-as-usual comparison. Students were not informed of the intervention/comparison condition of their course section during the enrollment process.

Researchers and staff from the Collaborative provided faculty with strategy and implementation materials and technical assistance, including ready-to-use text and video links, a planning template, synchronous virtual training, regular email communications, and assistance through email and virtual office hours.

Faculty participated in the study voluntarily and received a modest stipend as compensation for their time and effort. Several intervention faculty had prior experience implementing some of the strategies from the model in earlier phases of the research.

Quantitative Data Sources

Quantitative analyses for the study drew on quantitative data from administrative records, student surveys, an instructor survey, and a cost survey administered to a subsample of implementing faculty. Quantitative data were used to assess the impacts of the strategies, assess implementation and costs of the strategies, and capture student and faculty experiences with the model.

Administrative Data

Student-level administrative data included student demographics, first-generation college status, Pell Grant eligibility, enrollment status, baseline achievement measures including cumulative GPA and cumulative credits prior to participation in the study, end-of-course grades as a measure of achievement, and retention status in the next fall semester as a measure of persistence. Administrative data were requested from institutions' institutional research offices three times: at the beginning of the term for rosters, at the end of term for final grades, and at the end of the following term for retention records. Data requests were made after the official add/drop period to preserve the integrity of the course roster.

For first-year, first-semester students who did not yet have a college GPA, we imputed their college GPA as 0 and created an imputation flag for first-semester students. Course-level records linked students to specific courses and included course and section identifiers, instructor information, final course grades, and credits completed. Student achievement outcomes were measured using end-of-course grades, which were converted to a standardized 4-point grading scale (e.g., A = 4, B = 3). For retention measures, we defined retention (i.e., successful persistence) as students who graduated, reenrolled in the subsequent fall semester at the same institution, or transferred to another postsecondary institution.[1]

Baseline Equivalence for Administrative Sample

Because we used administrative data to assess the impact of the strategies using a quasi-experimental design, credibility of the causal analyses depends on the degree to which intervention and comparison students are similar at baseline on measures correlated with the outcomes. To assess baseline equivalence between intervention and comparison groups in the administrative analytic sample, we calculated effect sizes following the What Works Clearinghouse Standards (WWC) *Procedures and Standards Handbook* (Version 5.0; WWC, 2022), Hedges' *g* for continuous variables, and Cox's Index for binary variables. All observed baseline differences were below the WWC threshold of 0.25. This indicates that for the overall administrative sample, intervention and comparison group differences were within the range where statistical adjustment can account for those differences (Exhibit 4).

[1] Four of the five institutions included in these analyses were community colleges, a setting in which transferring to another postsecondary institution is a positive outcome.

Exhibit 4. Baseline Equivalence, Administrative Sample

Characteristic	Intervention	Comparison	Difference	Effect Size
Female	60%	61%	−1%	–0.03
Race				
Asian or Pacific Islander	5%	4%	1%	0.21
Black or African American	23%	26%	–3%	–0.09
Hispanic or Latino	30%	33%	–3%	–0.09
Multiracial	3%	3%	1%	0.14
White	36%	31%	4%	0.12
Pell recipient	48%	49%	–1%	–0.01
First generation				
Yes	12%	12%	0%	–0.01
No	20%	18%	2%	0.08
Unknown	68%	70%	–2%	–0.05
First semester	6%	7%	–1%	–0.10
Cumulative credits	31.65	28.57	3.09	0.13
Cumulative GPA	2.93	2.81	0.12	0.12
N students	642	696		
N sections	25	25		

Source. Administrative data.

Student Survey

To measure students' self-reported SDL skills and mindsets, capture student background information, understand students' experiences with the Instructional Model and their perceptions of its value, and collect formative feedback, we administered a student survey.

Survey Administration

The survey was administered via Qualtrics to students enrolled in any of the 50 study sections at five participating colleges toward the end of the spring 2025 term. Participating instructors invited students in their intervention and comparison sections to complete the survey through email communications and learning management system (LMS) announcements, which included a brief description of the study and a link to the online survey. In most sections, the survey remained open for two to three weeks before the final exams. One to two reminder messages were sent during the survey administration window to encourage participation, and a survey gift card incentive was increased from $40 to $80 to further encourage participation.

Students under 18 were excluded from the survey based on their response to a self-reported age question on the informed consent form preceding the survey, which provided a message indicating that they were not eligible to participate and ended the survey. One paired section primarily served dual enrollment students, so the instructor did not administer the survey in both intervention and comparison sections.

The overall survey response rate was 26% (395 students), defined as the proportion of students who provided informed consent and completed the survey among all students in all study courses. Seven comparison sections had response rates of 0% and were therefore excluded from the survey analytic sample, along with their matched intervention sections, to align with our matched design.

Survey Items

Survey data included validated scales in the motivational, metacognitive, and applied learning domains. Several exploratory measures of student behaviors (described below), developed by the study team, were also included on the survey. The survey additionally included items capturing students' demographic characteristics, their experiences with and perceived value of the strategies, suggested improvements to the strategies, household characteristics, employment status, and parental or caregiving responsibilities. Student survey data were linked to administrative data.

Previously validated scales

The domain of applied learning processes included two measures of students' help seeking and a measure of students' learning strategies. Help seeking was measured in two approaches. One focused on help-seeking behaviors in online learning contexts using the Online Self-Regulated Learning Questionnaire (OSLQ; Barnard et al., 2009). The other assessed students' general orientation toward instrumental help seeking and preferences for formal versus informal help sources (Karabenick, 2001). Learning strategies were measured using the Learning Strategies Inventory (validated in McGuire et al., 2015). Reliability of all survey scales was above .60 in the survey sample (Exhibit 5).

Validated measures in the domain of motivational processes included students' growth mindset, self-efficacy, and sense of belonging. Growth mindset was measured using a scale from Dweck et al. (1995). Self-efficacy and sense of belonging were measured using scales from the Project for Education Research That Scales (PERTS) survey (Hanson, 2017). The domain of metacognitive processes included students' comprehension monitoring and evaluation. Both were measured using items from the Metacognitive Awareness Inventory (validated by Schraw & Dennison, 1994).

Exhibit 5. Reliability of Previously Validated Scales

Source	Scale	Domain	Number of Items	Cronbach's Alpha
McGuire et al.	Learning Strategies Inventory	Applied learning	12	.684
OSLQ	Help Seeking	Applied learning	5	.821
Karabenick	Help Seeking – Instrumental	Applied learning	2	.818
Karabenick	Help Seeking – Formal vs Informal	Applied learning	3	.632
Karabenick	Help Seeking – Strategic/ Adaptive	Applied learning	2	n/a
Metacognitive Awareness Inventory	Comprehension Monitoring	Metacognitive	7	.854
Metacognitive Awareness Inventory	Evaluation	Metacognitive	6	.764
Dweck et al.	Fixed Mindset	Motivational	6	.830
PERTS	Self-Efficacy	Motivational	4	.912
PERTS	Sense of Belonging	Motivational	4	.930

Note. Cronbach's alpha is not reported for Help Seeking – Strategic/Adaptive because this scale is the average of the other two Karabenick scales.

Study-Generated Behavioral Indicator Items

The study team created retrospective self-report items for students to report how frequently they engaged in behaviors related to each aspect of the SDL framework throughout the term. Students responded to 10 items on a 5-point scale from 1 for "very rarely, if ever" to 5 for "always or very often." Exhibit 6 lists each behavioral indicator item with the SDL skill it is intended to capture.

Exhibit 6. Behavioral Indicator Items by SDL Skill

SDL Skill	Behavioral Indicator Item
Setting goals	Set personal learning goals (for example, I set a goal to achieve a certain grade or set a goal to learn more about a specific content area)
Planning	Prepared to study (for example, gathered study materials, set time aside to study)
Progress monitoring	Kept track of my learning progress (for example, while studying, I tracked my grades across assignments, I evaluated content that required more studying)
Reflecting	Evaluated my performance (for example, talked about my grades/performance with another student or my professor, reflected on what I had learned well and what I still needed to learn better)
Adjusting strategies	Adjusted the way I study (changed the way I study for this class after realizing that I needed to approach learning differently than I initially thought)
Identifying needs	Looked for resources like charts, animations, diagrams, videos, or anything that helps me understand the contents of this class
Motivation (task interest)	Maintained my interest in the course content and weekly activities throughout this term
Help seeking	I used tutoring, the writing center, or any other university resource to better understand or figure out something related to this class
Help seeking	I found my own resources to better understand or figure out something related to this class (like YouTube videos, Khan Academy, Quizlet, Pearson+, outside of resources provided by my college)
Help seeking	I used resources to get the answer or save time to get the work done (like Chegg, Brainly, Course Hero, Photomath, Mathway, ChatGPT, etc.)

Baseline Equivalence of Survey Sample

To examine baseline equivalence between intervention and comparison groups, we calculated effect sizes following the WWC (2022) handbook, Hedges' g for continuous variables, and Cox's Index for binary variables. Observed baseline differences were below the WWC threshold of 0.25 for prior achievement measures (cumulative GPA and credits), gender, and Pell and first-generation status (Exhibit 7). However, differences between the intervention and comparison groups exceeded the WWC threshold for certain race/ethnicity categories.

Although the student survey was administered at the end of the semester and therefore cannot provide true baseline measures, we explore differences in employment and caretaker status between intervention and comparison students. Caretaker status is likely to remain stable over time, so it can be interpreted as a baseline measure despite being measured post hoc. Employment status may fluctuate throughout the semester in response to factors such as time management and motivation, but we include it to describe student life experiences during the semester.

Exhibit 7. Baseline Equivalence, Survey Sample

Characteristic	Intervention	Comparison	Difference	Effect size
Female	66%	73%	–6%	−0.19
Race				
Asian or Pacific Islander	6%	3%	3%	0.43
Black or African American	21%	19%	2%	0.06
Hispanic or Latino	31%	43%	–13%	–0.33
Multiracial	2%	2%	0%	0.13
White	37%	27%	10%	0.28
Pell recipient	57%	50%	7%	0.18
First generation				
Yes	14%	13%	2%	0.08
No	17%	17%	0%	–0.01
Unknown	69%	70%	–1%	–0.03
First semester	11%	9%	2%	0.14
Cumulative credits	31.48	30.06	1.42	0.05
Cumulative GPA	2.89	2.94	–0.05	–0.04
Hours employed[a]				
1–10	10%	8%	1%	0.10
11–20	14%	8%	6%	0.41
21–30	14%	17%	–3%	–0.12
More than 30	34%	40%	–7%	–0.17
Caretaker for[a]				
None	58%	68%	–10%	–0.27
1 person	17%	11%	5%	0.26
2–3 people	13%	14%	–2%	–0.09
4 or more people	8%	3%	5%	0.58
Major				
STEM	37%	39%	–2%	–0.05
Social or behavioral sciences	12%	10%	2%	0.15
Liberal arts	4%	3%	1%	0.14
Other	35%	37%	–2%	–0.06
No declared major	13%	12%	1%	0.07
N students	134	166		
N sections	17	17		
N courses	17	17		

Source. Administrative data, student survey.

Note. Items in red indicate baseline equivalence > +/−0.25.

[a] Hours worked and number of individuals for whom respondents were caretakers were reported at the end of the semester and may not reflect pre-implementation differences.

Instructor Survey

To better understand implementation of the SDL Instructional Model, collect formative feedback on the model, and measure instructors' perceptions of the value of the model, we administered an instructor survey to all implementing faculty and a cost survey to a subset of those faculty. The instructor survey was administered toward the end of the semester, in April–May 2025, and all implementing faculty responded to it (n = 24). The instructor survey used researcher-designed items to measure faculty's experience with the strategies, including their use or intended use of each, changes made to the strategies, and time spent implementing the strategies. It also measured their perceptions of student experience with the strategies, perceived value of the strategies, and the potential usefulness of the strategies to other faculty.

Cost Survey

Five purposefully selected instructors (one per institution) completed weekly cost surveys to capture implementation of the SDL Instructional Model for the duration of their course. Each institution had one instructor who participated in the cost survey. The courses included one 8-week course (all others were full semester); three asynchronous online courses, one hybrid course, and one synchronous online course; and courses in computer information technology, physics, biology, math, and psychology. To account for the different lengths of courses that respondents taught, and to determine whether time on the strategies was front loaded in the beginning of the semester, the weekly data are collapsed into use of resources or hours on an activity per week in the first half of the course (e.g., within weeks 1-4 of an 8-week course or weeks 1-8 of a 16-week course), and in the second half of the course. Cost survey items were designed by Collaborative researchers and included questions about time spent seeking support from institutional or Collaborative staff or faculty, time spent each week setting up and implementing strategies, and equipment and software used.

Qualitative Data Sources

Qualitative analyses for the study drew on qualitative data from instructor interviews and course tours, student interviews, administrator interviews and interviews with faculty not familiar with the SDL Instructional Model, instructor survey open-ended responses, and student survey open-ended responses. Qualitative data were used to explore faculty and student experiences with the model, their perceptions of the model's value and usefulness, implementation supports and challenges, and perceived supports needed to promote broader adoption.

Data Collection Approach Across Interviews

The study team used the same data collection approach across all interview populations: intervention faculty, students, administrators, and faculty not familiar with the Instructional Model. All interviews were conducted from March through June 2025 via Zoom. Interviews were audio-recorded with the participants' permission. All 33 participants across all interview populations consented to audio-recording. A notetaker took detailed running notes during the interview and the interview audio files were transcribed after the interviews. Intervention faculty were compensated for their time in the interview through their pilot study stipend; students, administrators, and faculty not familiar with the Instructional Model were compensated with a gift card incentive.

Interviews with intervention faculty and students were conducted in the second half of the term so that respondents had the greatest chance of experiencing as many of the strategies as possible. However, given that (in some cases) several weeks were still remaining in the term, some students and faculty could not yet speak to the effects of some strategies, particularly the second collaborative SPIN activity and the message to a future student.

Instructor Interviews and Course Tours

During the spring 2025 pilot semester (March through May 2025), the study team conducted 11 interviews with intervention faculty. The instructor interview protocol asked participants to describe how they implemented each strategy while sharing their screen to show their course materials.

Student Interviews

The study team conducted 14 interviews with students enrolled in pilot sections in April and May 2025. The student interview protocol asked participants about their perceptions and experiences with the Instructional Model, challenges with and helpful features of the model, and how this course compared with other online STEM courses they had taken.

Administrator Interviews and Interviews with Faculty Not Familiar with the Instructional Model

The study team conducted five interviews with administrators (April 2025) and three interviews with faculty not familiar with the Instructional Model (April through June 2025). These interview protocols asked participants about their perceptions of the model, connections between the model and their institution's educational priorities, potential faculty interest in the model, factors that could influence implementation, broader institutional supports needed to support implementation and scaling, and suggestions to improve the model and implementation supports.

Instructor Survey Open-Ended Responses

The instructor survey was administered in April and May 2025, and faculty could answer up to 14 open-ended questions on the survey. Early in the survey, faculty were asked about any adaptations, changes, or omissions they made to each of the strategies (three questions). Midway through the survey, faculty were asked how they would describe students' engagement with strategies, what factors may have impacted how much students were able to engage, and their thoughts about the usefulness and value of the strategies for their students (three questions). Faculty were also asked about their implementation experience, including facilitators and barriers to implementing the strategies and the usefulness and value of the strategies for them as an instructor (five questions). At the end of the survey, faculty were asked to suggest supports that would be needed to enable implementation of the strategies across multiple courses and to facilitate implementation among groups of instructors at their institution (three questions). The dataset is not linked to instructor demographic or course information.

Out of 24 total intervention faculty surveys submitted, nearly all faculty responded to most open-ended questions in the survey. Nine of the 14 open-ended questions received responses from 22 or more intervention faculty. The early survey open-ended questions (about adaptations made to each of the strategies) had smaller numbers of responses, ranging from four to 12 responses.

Student Survey Open-Ended Responses

The student survey included five open-ended response questions that appeared toward the end of the survey, in the following sequence (with some close-ended items between). The first open-ended question asked students to compare their experience in their current course with previous online or hybrid courses (including aspects they found to be effective or challenging) and offer suggestions to improve their learning experience online. The remaining four open-ended questions asked students to offer suggestions to improve each of the SDL strategies (three-part video series, prompts, questionnaire, group assignment) so they are better suited to their or their classmates' needs.

Out of 212 total student surveys submitted by students in intervention sections,[2] we received text-based responses to the open-ended questions from the following numbers of students, by question topic: experience, 194 students; videos, 114 students; prompts, 130 students; questionnaire, 122 students; and group assignment, 143 students. Because the five open-ended response questions were predominantly focused on students' suggestions to improve the SDL strategies, their responses only provide partial insights into the study RQs. Other data sources more directly address students' perspectives on usability, helpfulness, and value.

[2] This sample is larger than the number of pilot students included in impact analyses because impact analyses exclude students in courses for which only pilot students or only comparison students responded.

Quantitative Analysis Methods

Impact Models

To estimate the effects of the SDL Instructional Model, we estimated regression models that controlled for a set of student-level covariates including students' baseline achievement. To account for grouping of students within courses, we estimated hierarchical linear models. For each outcome, we estimated models of the following form:

$$y_{isc}=\alpha+\tau T_{isc}+X_{isc}\beta+d_c+\rho_s+\epsilon_{isc}$$

In this model, y_{isc} represents the survey or administrative outcome for student i in section s of course c; T_{isc} is an indicator for enrollment in a section implementing the Instructional Model; $X_{isc}\beta$ is student characteristics; d_c captures course fixed effects; and ρ_s represents a course-section random effect. For administrative outcomes, student-level covariates included baseline cumulative GPA and credits earned, gender, race/ethnicity, Pell Grant eligibility, full-time enrollment status, first-generation college student status, and an indicator for first-semester enrollment. All analyses were conducted using complete cases only.

Moderator Analyses

To examine potential heterogeneity in intervention effects, we conducted moderator analyses using the same model specification as the main impact analyses. Specifically, we added interaction terms between the $T_{isc}\times S_{isc}$ indicator and prespecified subgroup indicators. The model therefore included terms of the form S_{isc}, where S_{isc} denotes the subgroup characteristic of interest.

To further examine heterogeneity in intervention effects across student subgroups, we employed causal forest methods to estimate conditional average treatment effects (CATEs) as a function of observed student characteristics. For each outcome, survey or administrative, the causal forest was trained using the specific outcome, an indicator of treatment condition, and a set of pre-treatment covariates, which were the same covariates in the primary impact models. The algorithm recursively partitioned the covariate space to estimate CATEs for distinct student subgroups. Subgroup differences were evaluated by comparing estimated CATEs across student characteristics and testing for systematic variation in treatment effects.

To support mixed-methods analyses, we documented findings from the impact and moderator analyses in a memo organized by RQs, and a separate memo documented the descriptive analysis results.

Qualitative Analysis Methods

Data Analysis Across Interviews

After each interview, notetakers and interviewers collaborated to complete an interview summary sheet that organized key takeaways from the interview according to the study RQs. The study team coded data from each interview transcript according to the RQs. Intervention instructor and student interviews were also coded for recommendations to improve the SDL Instructional Model. Intervention instructor interviews were analyzed for fidelity of implementation. Strategies were coded as meeting fidelity if the instructor described or showed the strategy implemented with or without adaptations described in the support materials. If the instructor did not implement (or plan to implement) the strategy or if they made modifications that were not aligned with the implementation resources, they were coded as not meeting the criteria for fidelity.

Data Analysis Across Instructor and Student Survey Open-Ended Responses

Two researchers coded (and in some cases tallied) data from the instructor and student survey responses according to the RQs.

Mixed-Methods Approach to Integrate Quantitative and Qualitative Data

From October 2025 to March 2026, 10 study team members drafted seven data source-level memos (impact analysis, instructor implementation survey, instructor open-ended response, student open-ended response, qualitative interview, fidelity of implementation, and cost survey) that described each data source (e.g., number of observations, number of institutions, description of respondents, length of data collection, topics covered on instrument, any other noteworthy items such as missing data) and provided details on the findings from that data source organized by themes within each RQ. Then, from March to May 2026, pairs of researchers synthesized findings across the data sources in six triangulation memos, one for each RQ, which included analytic interpretations and researcher discussion of implications. During both phases of memo drafting, researchers received feedback from other team members on the memos and discussed the findings in weekly team meetings.

Mapping Data Sources to Research Questions

Exhibit 8 summarizes the mixed-methods data sources utilized in the pilot study, aligned to the RQs that each data source informed.

Exhibit 8. Mapping Data Sources to Each Research Question

Data Source	RQ1 Outcomes	RQ2 Fidelity	RQ3 Contrast	RQ4 Experiences	RQ5 Supports	RQ6 Costs
Administrative data and student survey	X			X		
Instructor survey		X		X	X	X
Cost survey					X	X
Instructor interviews and course tours		X	X	X	X	
Student interviews		X	X	X		
Administrator and non-pilot instructor interviews			X		X	
Instructor survey open-ended responses		X		X	X	
Student survey open-ended responses			X	X		

IV. RESULTS

RQ1. Does use of the model show promise for improving student SDL and course outcomes?

SDL Outcomes and End-of-Course Grades

Among the survey sample, estimated treatment effects were small and not statistically significant for SDL outcomes, with estimates ranging from –0.19 to 0.05 standard deviations (Exhibit 9). This result contrasts with the corresponding findings in an earlier phase of the Collaborative's research during the iterative design and development of the strategies, when we observed a positive, statistically significant effect on the Evaluation scale and Learning Strategies Inventory (Mislevy et al., 2026).

Exhibit 9. Impacts on Self-Directed Learning

Scale	Intervention (Adjusted)	Comparison	Difference (Adjusted)	Effect Size
Growth Mindset	3.19	3.20	−0.01	−0.01
Learning Strategies Inventory	16.42	16.28	0.14	0.05
Comprehension Monitoring	27.69	28.51	−0.82	−0.19
Evaluation	22.31	23.20	−0.89	−0.23
Help Seeking (OSLQ)	16.23	16.63	−0.40	−0.09
Help Seeking (Karabenick)	3.72	3.69	0.03	0.05
Self-Efficacy	3.84	3.98	−0.13	−0.15
Sense of Belonging	4.02	4.15	−0.14	−0.16

Source. Student survey.
Note. No differences were statistically significant at the 5% level.

Among the administrative sample, the estimated impact on students' end-of-course grades was small, positive, and not statistically significant (ES = 0.03, p = .59; Exhibit 10). This result is similar in magnitude to the effect on end-of-course grades found in the rapid-cycle evaluation study (Mislevy et al., 2026). The estimated impact on students' retention the following fall was small, negative, and not statistically significant (ES = −0.03, p = 0.70)

Exhibit 10. Impacts on Student Achievement

Outcome	Intervention (Adjusted)	Comparison	Difference (Adjusted)	Effect Size
End-of-course-grade	2.32	2.28	0.05	0.03
Next fall retention	74%	75%	−1%	−0.03

Source. Administrative data.
Note. No differences were statistically significant at the 5% level.

Given the small size of the survey sample, **the statistical power of the study to detect meaningful differences in SDL outcomes between intervention and comparison groups was limited**. As an interpretable measure of the statistical power of the pilot study, we calculated the minimum detectable effect size (MDES) based on the realized standard errors for each intervention effect estimate. Based on conventional power standards (80% power at α = .05), the MDES for the survey sample exceeded 0.25 for all survey scales, with values ranging from 0.34 to 0.47. Because effects of this magnitude are larger than what is typically considered substantively meaningful in similar contexts, the survey analyses were underpowered to reliably detect small to moderate effects. That is, in general the study was not able to rule out a null effect, or meaningfully large positive or negative effects. Despite efforts to boost student participation and increase the gift card incentive to $80, the survey response rate

remained low. Additionally, nonresponse analyses (see Appendix) indicate that the survey sample is not representative of the full administrative sample, in particular with regard to student race/ethnicity, gender, and likelihood of withdrawing. These results therefore may not generalize to the full sample of students enrolled in study courses.

Moderator Analyses

We conducted moderator analyses to explore differences in effectiveness by student characteristics, including by gender, race/ethnicity, Pell Grant eligibility, and whether the student was a first-generation college student. Across the moderator analyses, most interaction term coefficients were not statistically significant. For subgroups represented by multiple indicators, joint *F* tests likewise failed to reject the null hypothesis that the interaction terms were equal to 0. Although a small number of interaction effects reached marginal levels of statistical significance, these findings were not robust to adjustments for multiple hypothesis testing. Taken together, the results provide **no reliable evidence of meaningful heterogeneity in the treatment effects across the subgroups examined**. Causal forest analyses, which use machine learning to explore general patterns of heterogeneity, indicated no statistically significant heterogeneity in treatment effects across student groups for end-of-course grades and all SDL outcomes.

Exploratory Outcome Analyses

In addition to examining impacts on validated SDL measures, we conducted analyses exploring **impacts on SDL skills using study-generated behavior scales. We did not find significant impacts** on these measures (Exhibits 11, 12, 13, and 14).

Exhibit 11. Impacts on Behavior (Frequency)

Behavior	Intervention (Adjusted)	Comparison	Difference (Adjusted)	Effect Size
Set personal learning goals	3.82	3.94	−0.12	−0.13
Prepared to study	4.02	4.02	−0.01	−0.01
Kept track of my learning progress	3.87	3.98	−0.11	−0.12
Evaluated my performance	3.53	3.55	−0.03	−0.02
Adjusted the way I study	3.65	3.82	−0.17	−0.17
Looked for resources, like charts, animations, diagrams	3.78	3.96	−0.18	−0.17
Maintained interest in the course	3.84	3.90	−0.06	−0.06

Source. Student survey.
* $p < .05$. ** $p < .01$.

Exhibit 12. Impacts on Resource Use (Frequency)

Resource Use	Intervention (Adjusted)	Comparison	Difference (Adjusted)	Effect Size
Used tutoring, the writing center, or other university resource	2.56	2.57	0.00	0.00
Found my own resources	3.76	3.66	0.10	0.09
Used resources to get the answer or save time to get the work done	2.22	2.10	0.13	0.10

Source. Student survey.
* $p < .05$. ** $p < .01$.

Exhibit 13. Impacts on Response to Not Performing Well (Likelihood)

Response	Intervention (Adjusted)	Comparison	Difference (Adjusted)	Effect Size
Ask someone who could help me understand the general ideas	3.97	3.89	0.09	0.09
Getting help would be one of the first things I would do if I were having trouble in this class	3.90	3.84	0.06	0.06
I would ask the professor rather than another student	4.02	3.98	0.05	0.05
I would prefer asking another student for help in this class rather than the professor	2.62	2.67	−0.05	−0.05
In this class, the professor would be better to get help from than a classmate	3.87	3.89	−0.02	−0.02

Source. Student survey.
* $p < .05$. ** $p < .01$.

Exhibit 14. Impacts on Perceptions About the Course

Perception	Intervention (Adjusted)	Comparison	Difference (Adjusted)	Effect Size
The course was engaging	4.06	4.11	−0.05	−0.06
This course had structures to support my learning process	4.00	4.14	−0.15	−0.16
There was a sense of community among students in the course	3.71	3.82	−0.10	−0.10
My instructor knew/cared about me in this course	4.07	4.17	−0.10	−0.11
I am satisfied with my performance in the class	3.70	3.68	0.02	0.02

Source. Student survey.
* $p < .05$. ** $p < .01$.

RQ2. To what extent is the model implemented as intended? What are the barriers to implementation with integrity?

Fidelity of Instructor Implementation

We defined "fidelity of implementation" as embedding or planning to embed all activities for a given strategy, including customizations consistent with the model guidance. These allowable customizations included combining and/or customizing activities to align with other course activities, adjusting or adding questions or prompts, implementing activities more often than the minimum amount, or offering students multiple ways to access the content (e.g., sharing video transcripts instead of videos, producing video reflections instead of written ones). Deviations from the model guidance count as "partial fidelity" and could include not implementing the activities with the required minimum frequency, not including all components of the strategy (e.g., all three types of prompts), or fundamentally changing the content of the activity (e.g., changing the introductory questionnaire to ask course content-related questions).

Data from the instructor survey, interviews, and course tours suggest that instructors largely implemented the strategies with fidelity, including making customizations consistent with the model guidance. On the instructor survey, 100% of instructors reported implementing all activities with fidelity. Some instructors on the survey reported customizing individual strategies, which is discussed in more detail under "Customizations Consistent with the Model Guidance" below.

Deviations from Fidelity

However, **data from interviews and course tours suggest that some instructors did not implement SPIN and SDL prompts with fidelity** (i.e., they made changes that deviated from fidelity). Of 11 instructors interviewed, six revealed some deviations from fidelity in their approach to implementing SPIN and/or the prompts. These changes to the model were mostly unintended, with four of these six instructors sharing that they believed they had implemented the model as designed.

In interviews, instructors described several ways their implementation diverged from the original design. Two instructors only implemented the SPIN collaborative activities and/or prompts once instead of twice; in these cases, these deviations appeared to be an oversight. Two instructors said they chose to implement prompts and/or SPIN collaborative activities only once because they could not fit additional strategies into the course. These deviations reflected efforts to manage grading load and fit the reflective activities more feasibly within their course structures.

Two instructors made changes to SPIN that deviated from the intention of the strategy, but their interviews suggest they did not realize these changes were significant. For example, one instructor did not use the SPIN collaboration rubric and instead used a content-related rubric, while another changed the SPIN introductory questionnaire significantly by including questions about using features

in the LMS rather than nonacademic questions. Overall, these changes reflected unintentional or small adjustments instructors made to fit the SPIN activities within their courses.

For the SDL video activities, **all instructors implemented the videos with fidelity**.

Customizations Consistent with the Model Guidance

Instructors commonly made customizations that were consistent with the Instructional Model guidance. For each strategy, using the instructor survey results, we calculated the percentage of instructors who reported making changes that were consistent with the model guidance and reflected instructor choice. Half of instructors reported making customizations to SPIN, about a third (29%) reported making customizations to the SDL prompts, and just under a fifth (17%) reported making customizations to the SDL videos. This finding was corroborated by interview data: About half of interviewees said they made some customizations to strategies consistent with the model guidance.

SPIN Customizations

Instructors made a range of modifications to the SPIN activities to better fit their course contexts and student needs. Most commonly, as reported on the survey, they tailored the introductory questionnaire and the structure of how it was administered to align with course content or existing introductions (*n* = 4), ensuring the activities felt relevant and discipline-specific. Several instructors adjusted the format or delivery of the introductory questionnaire (*n* = 3) by incorporating live (if teaching a hybrid class) or group-based components and using tools such as Padlet or online forms to support collaboration. For instance, one instructor scheduled an extra-credit synchronous session to watch one of the videos and reflect on it via group discussion.

Other instructors enhanced engagement in both the introductory questionnaire and group assignment (*n* = 3) by adding personal videos, role-play scenarios, or icebreaker questions to foster connection and participation. Finally, some instructors made logistical or structural adjustments to both SPIN activities (*n* = 3), such as adding questions about scheduling, using rubrics or templates, or including ungraded reflections to streamline group formation and feedback. For example, one instructor used a preexisting teamwork rating form in place of the SPIN collaboration rubric, and in a course without quizzes or tests, one instructor tied the assessment wrapper to one of the collaborative assignments.

Prompt Customizations

Instructors made light but purposeful adjustments to the SDL prompts to improve alignment, tone, course relevance, and student engagement. A few instructors customized or reworded prompts (*n* = 3) to better fit the week's content or specific course topics, ensuring stronger contextual alignment. Others revised the structure or framing (*n* = 2) by creating surveys or adding introductory "wrappers" with supportive language to guide reflection and motivation. A small number of instructors

replaced or adapted prompts (*n* = 1–2) with alternative tools or measures, such as substituting a teamwork rubric or rearranging questions to match subject matter including physics concepts.

Video Customizations

Instructors made only minor adjustments to the SDL video-based activities, primarily to enhance comprehension and engagement. Two instructors added surveys or new response questions for students to complete after viewing the videos, while one introduced participation requirements by asking students to post their own reflections and reply to classmates. Another instructor made a small accessibility update by posting video transcripts separately but otherwise kept the original activities intact.

Level of Student Participation/Dosage

This section describes the level of student participation in the SDL strategies as reported by faculty and students.

Instructor Reports of Student Engagement: Instructor Survey and Open-Ended Responses

Instructors completed the survey in April and May 2025. As shown in Exhibit 15, instructors were asked to indicate the percentage of students completing each activity, with "Activity not completed at time of survey" as an option in case an instructor had not yet assigned the activity at the time they took the survey. The percentages in the table indicate the percentage of instructors that answered within each category.

Exhibit 15. Instructor Estimates of Students Completing Each SDL Strategy

Strategy	0%–24%	25%–49%	50%–74%	75%–100%	Activity Not Completed at Time of Survey
SPIN					
Introductory questionnaire	4%	0%	4%	92%	0%
Collaborative activity	4%	13%	17%	50%	17%
Videos					
Sense of belonging	0%	4%	21%	75%	0%
Time management	4%	0%	17%	79%	0%
Growth mindset	4%	4%	17%	75%	0%
Prompts					
Reflective prompts	4%	0%	21%	71%	4%
Pre-assessment wrapper	4%	0%	21%	75%	0%
Post-assessment wrapper	4%	4%	8%	71%	13%
Message to future student	8%	4%	13%	25%	50%

Source. Instructor survey.
Note. *n* = 24.

At the time of survey administration, 100% of instructors reported implementing all three videos. **The videos received high participation rates**, with 75%–79% of instructors indicating that three quarters or more of their students watched each video. Instructors were also asked to assign four prompts throughout the semester. For the earlier prompts, 87% or more of instructors answered that they implemented the activity in their courses, with 71%–75% of instructors indicating that the rate of participation from students was 75% or higher. All instructors assigned the SPIN introductory questionnaire, and 92% of instructors indicated that 75% or more of their students completed the questionnaire.

Instructors' responses to open-ended survey questions corroborated these findings. **Most instructors reported high student engagement in completing the strategies and high quality of student responses** (*n* = 14, 58%). For example, one instructor shared, "The responses I have read shows that students are taking the assignments seriously when they do them. It seems to be helping them reflect over themselves."

Half (50%) of instructors had not yet assigned the last prompt, the message to a future student, although this may be explained in part by the instructor survey being administered before the end of some courses, given the varied term lengths and start/end dates. Among those instructors who did assign this prompt, half indicated that 75% or more of their students completed the prompt. Additionally, the SPIN collaborative activity had a slightly lower implementation rate at 83%, and only 50% of instructors indicated that 75% or more of their students completed the activity.

In their open-ended survey responses, **instructors often noted higher participation in the video reflections and prompts overall and lower engagement with the reflective prompts specifically and group assignments**. Some instructors attributed these differences to the amount of time and effort it took to do reflective activities and group work, compared with "straightforward" video reflections and individual work. Finally, a small number of instructors reported that they perceived low student engagement with the SDL strategies (*n* = 3, 12%). Two instructors shared that students' engagement was the highest the first week or two and then significantly declined during the term. Another reported the students' engagement was high but felt that students gave "short answers" and that it seemed like "students rushed through them."

Instructor Reports of Student Engagement: Interviews

Although instructor survey data (both closed- and open-ended responses) reveal that student participation and engagement was high, instructor **interview data suggest that student engagement with the SDL strategies was mixed**. About half of instructors reported that they were impressed with students' engagement with and/or rates of completion of the strategies. Two instructors reported overall low or disappointing levels of student participation and engagement with the strategies, while the remaining instructors had mixed or unclear perspectives on student engagement. Three instructors noted that the students who did not engage with the strategies were

those who also had stopped engaging with other course content. One noted that completion rates of the strategies were higher than completion rates for course content assignments. Interview data do not suggest any clear trends for differential engagement or completion across the strategies.

Student Reports of Their Engagement: Student Survey

On the student survey, students were asked to indicate whether they had completed each strategy by answering "yes," "no," or "I don't know." As shown in Exhibit 16, **the majority of students reported completing the strategies** (ranging from 64% to 74%), although some students reported not completing or being unsure about completing the strategies.

Exhibit 16. Student-Reported Completion of Each SDL Strategy

Strategy	Did you complete the strategy?		
	Yes	No	I don't know
SPIN			
Introductory questionnaire	68%	12%	20%
Collaborative activity	74%	17%	9%
Videos	64%	18%	18%
Prompts	71%	8%	21%

Source. Student survey.
Note. n = 212.

Around a fifth (18%–21%) of students reported that they didn't know if they had completed the SPIN introductory questionnaire, videos, or prompts. It is unclear whether the survey administration at the end of the course may have affected how well students remembered the strategies administered earlier in the course (including the introductory questionnaire and videos). Another possibility is that more-involved strategies, such as the collaborative activity, were more memorable to students than the video activities were.

Student Reports of Their Engagement: Interviews

We also interviewed students and asked about their engagement with the SDL strategies. Of the 14 students we interviewed, **most recalled completing the videos and the SPIN introductory questionnaire** (two did not recall) and at least one collaborative activity (one did not recall). **About half (eight) did not recall participating in at least one of the strategies**; most often, they did not recall participating in the SPIN collaboration rubric and the assessment wrapper (four did not recall either) and the message to a future student (six did not recall).

RQ3. How and to what extent does the model differ from typical classroom practices?

Differences from Typical Practice

In interviews, faculty and students were most likely to report that **SPIN collaborative activities were distinct from typical practice** in online courses. Among intervention faculty, group assignments were the most frequently cited departure from typical practice, especially among instructors teaching asynchronously. According to three of the 14 student interviewees, group work was the most distinct from assignments and activities in typical online courses, although one student mentioned another course that was more group-work intensive than the intervention course. Three students highlighted increased interactivity and connection with the instructor and other students in the intervention course, compared with typical online courses.

In open-ended student survey responses, the group assignment was most commonly mentioned as different from typical activities in other online courses. About five students indicated that group-work challenges were exacerbated in online courses (especially asynchronous online courses). The students conveyed that they had not encountered many group projects in other online courses.

Similarities to Typical Practice

In interviews, faculty and students were most likely to report that the **SPIN introductory questionnaire was similar to typical practice** in online courses. Many instructors shared that they typically used introductory activities or ice breakers comparable to the SPIN questionnaire. Two of the 14 interviewed students noted that getting-to-know-you assignments and introductory questionnaires comparable to the first SPIN questionnaire were common in courses. By contrast, one student noted that the SPIN introductory questionnaire was distinct from activities in other online courses and was effective in helping them get to know other students in the course. In open-ended survey responses, a couple of students conveyed that they had encountered introductory questionnaires in other courses.

Interviewees reported a variety of **other similarities** between the SDL Instructional Model and instructional activities they had encountered in other courses. Some instructors said they already used an activity comparable to the message to a future student. One student also mentioned advice-to-a-future-student activities in other courses. Many instructors and three students described miscellaneous cognition-oriented activities in other courses, which overlapped with the prompts and growth mindset and time management videos. One student said that the intervention course was similar to typical online courses in terms of a low degree of interaction with the instructor. In open-ended survey responses, a handful of students seemed to convey that they had encountered similar videos in other courses (with one student noting similar videos in another learning strategies course).

In an interview, one student said they had seen these specific videos before, but that seeing them again was still useful.

SDL Instructional Model as Distinct

Despite these similarities, most faculty and administrators reported that the **Instructional Model is distinct from typical practice**, particularly in **its structure and intentionality**. An instructor who already used reflection assignments noted that their typical reflection assignments were more content-oriented than those in the instructional model, and another instructor specifically called out the pre-assessment wrapper as a novel idea. One instructor articulated that a unique aspect of the Instructional Model was the systematic and structured way it integrates metacognition. An administrator noted that there may be current practices that are comparable to aspects of the Instructional Model, but they may not be delivered with the overall intentionality of the model. Another administrator noted that similarities between typical practice and the Instructional Model may facilitate uptake of the model, and another specifically identified a biology department initiative integrating study skills into course objectives as an area of possible overlap.

In interviews and open-ended survey responses, **students noted several other differences** between the intervention course and other online courses they had taken. Three of the 14 interviewed students described the videos as novel, and three described the reflection prompts as novel. When responding about their general experience in their intervention course on the survey, **nearly half of the students** (*n* = 102) noted that they **had a better experience in this course compared with other online courses** they had taken. Specifically, students noted that instructors provided direct support and helpful resources that benefited their learning and that the pacing of their course and its organization and structure seemed better than other online courses they had taken. These beneficial experiences may or may not have been related to the SDL strategies being implemented in the courses.

Fourteen of the students who responded to the same open-ended survey item reported that they had a worse experience in the intervention course than in other online courses. (As above, these experiences may or may not have been related to the SDL strategies.) Their reported reasons included:

- Available meeting hours not compatible with the student's schedule; challenges with scheduling group work (*n* = 2)
- Vague instructions, unclear communication, lack of organization, misalignment between learning activities and assessments (*n* = 5)
- Challenges with the instructor's teaching style or interpersonal challenges (*n* = 3)
- Material too challenging or not well suited to the online format (*n* = 4)

RQ4. What are student, instructor, and other user experiences with the model?

Usability and Feasibility

Instructors generally perceived the SDL strategies as feasible to implement, particularly because of their easy integration into existing course structures (such as the LMS) and the ready-to-use materials. On the instructor survey, 79% of instructors (19 of 24) agreed or strongly agreed that the SDL videos and prompts were easy to implement in their course. Qualitative findings from open-response survey items and interviews support this finding, with instructors describing videos and structured activities such as pre- and post-assessment wrappers as especially feasible and useful for supporting student planning and reflection. Reflective prompts were valued but introduced feasibility constraints due to the time required for instructors to review and respond to student reflections. Instructors found the SPIN activities to be the toughest to implement, with only 46% of instructors agreeing or strongly agreeing with the "easy to implement" item on the survey.

Feasibility for students to complete the strategies was limited by workload concerns, with some instructors noting that the number of activities and associated deadlines could contribute to student overload and that implementation demands varied by course context and student population. In particular, students with external responsibilities (e.g., work, caregiving) faced greater feasibility challenges, highlighting the importance of flexibility and manageable workload in sustaining implementation. The open-ended response items on the student survey did not directly address usability or feasibility. However, **students did suggest how to improve usability for future students**, including ensuring that the prompts facilitate faculty–student communication and creating communication channels for the groups to use.

Instructor Challenges with the Model

While most instructors reported that the SDL Instructional Model was feasible to implement, instructors identified some challenges (Exhibit 17). Across open-ended responses on the instructor survey, **the most commonly mentioned student challenge was students' non-course responsibilities and external constraints** (*n* = 15). Work, caregiving, athletics, and other obligations made participation harder for students, which in turn affected the ability of instructors to implement the model. When considering how to engage students, instructors frequently described usability and feasibility friction tied to creating or finding suitable materials for group assignments (*n* = 10) and managing student collaboration and communication (*n* = 10). This finding suggests that SDL strategies are easier to adopt when there are ready-to-adapt examples and when collaboration demands are either tightly scaffolded or optional. A smaller set of comments pointed to concerns about student overload, competing courses, and keeping up with the pacing of a course.

While instructors noted several general challenges, such as students having non-course responsibilities, **many of the challenges mentioned on the survey focused on the SPIN collaborative activity**. These challenges included finding suitable material for the assignment, timing the activity alongside other content and assignments, and making sure students coordinated and communicated early enough to complete the work. In addition, instructors of asynchronous courses found designing and implementing the collaborative activity to be a challenge due to technical issues when setting up the activity in their LMS. More generally, a small number of instructors (*n* = 4) reported on the survey that it was challenging to find time in the course to implement all of the activities/assignments.

Exhibit 17. Barriers and Challenges Identified by Instructors

Barriers and Challenges	Count
Student non-course responsibilities (external constraints)	15
Creating/finding materials or examples	10
Student collaboration/communication challenges	10
Student buy-in or engagement	8
Instructor workload/time burden	6
LMS/technology issues	5
Student overload/competing courses	4
Timing, pacing, and sequencing	4
Attendance disruptions/cancellations	1
Course constraints/already built course	1
Modality mismatch (asynchronous context constraints)	1
No difficulty/none	1

Source. Instructor survey.
Note. *n* = 24.

Contextual Factors Related to Usability and Feasibility

We found that **contextual factors, such as a students' responsibilities outside of school, affected usability and feasibility**. To further understand these contextual factors, we collected information from the instructor and student surveys and interviews and compiled it in Exhibit 18. Relevant factors are broken into two categories—whether they promote or hinder usability and feasibility—and descriptions are provided for each.

Exhibit 18. Contextual Factors Affecting Usability

Category	Contextual Factor	Description
Promote usability and feasibility	Low implementation burden	Ready-to-use materials and clear structure for instructors reduce perception of need for course redesign.
	Integration with course LMS	Embedding strategies into LMS and course flow supports usability and sustainability (79% of instructors reported that integration into existing LMS was feasible).
	Accountability structures	Instructors who graded, assigned points, and required participation increased student completion and engagement.
	Simplicity and flexibility	Individual, low-coordination activities and flexible formats (timing/modality) improve usability and participation for students.
Hinder usability and feasibility	Student external constraints	Students shared with instructors that sometimes work, caregiving, and other responsibilities limit participation (most frequent barrier).
	LMS/technology friction	Some instructors faced difficulty setting up group work, managing tools, and organizing content in LMS.

Source. Student and instructor surveys.
Note. n = 24 instructors, n = 212 students.

Perceived Value

In addition to testing the impact of the SDL Instructional Model on SDL and academic outcomes (RQ1), we asked faculty and students for their perceptions of the impact or value of the model. Both noted positive experiences and value from the strategies, compared with faculty and students in business-as-usual (comparison) courses.

Instructor Perceptions of the SDL Strategies' Value and Supporting Evidence

Instructors reported that all three SDL strategies were valuable for their students and worth their students' time. On our survey, instructors were asked to rate, using a 5-point scale ranging from *strongly disagree* to *strongly agree*, whether each strategy was useful or valuable for their students and worth their students' time. The results were distinctly positive: 79%–88% of instructors agreed or strongly agreed that the strategies were valuable and worth their students' time (Exhibit 19).

Exhibit 19. Instructors' Perceived Value of the SDL Strategies

Faculty Perception	SPIN	Videos	Prompts
Useful/valuable for my students	87%	88%	83%
Worth students' time	79%	88%	79%

Source. Instructor survey.
Note. n = 24. Table shows percentage of instructors who agreed or strongly agreed.

Qualitative evidence collected from open-ended survey responses and interviews support this finding and provide more context. **Instructors reported that students seemed to enjoy the strategies**, particularly the SDL videos and prompts. Instructors also shared that the prompts, especially the pre- and post-assessment wrappers, allowed students to provide valuable information to instructors (such as out-of-school responsibilities that may affect their academics). Instructors also indicated **they enjoyed having ready-to-use resources**. On the survey, several instructors said they enjoyed implementing the strategies and planned to continue using them, especially because they support "non-content" skills such as metacognition, planning, and time management. In interviews, instructors called out specific strategies that they believed had particular value for students, namely the prompts (*n* = 3) and videos (*n* = 4).

Student Perceptions of the SDL Strategies' Value and Supporting Evidence

Student survey results suggest that, on the whole, **students found the SDL strategies to be valuable and worth their time**. While perceptions were generally positive, matching those on the instructor survey, **students' perceptions of the value of the strategies tended to be lower than instructors' perceptions**. For example, 88% of instructors found the videos to be worth students' time, but only 70% of students agreed (Exhibit 20). Notably, the prompts received the highest rating from students, despite receiving the lowest rating from instructors. Although the cause of this difference is not clear, contextual factors mentioned below, especially the burden on instructors to read and respond to prompts, may be a contributing factor.

Exhibit 20. Students' Perceived Value of SDL Strategies

Perceived Value	SPIN		Videos	Prompts
	Introductory Questionnaire	Collaborative Activity		
Useful/valuable	70%	69%	73%	77%
Worth my time	70%	63%	70%	73%

Source. Student Survey
Note. n = 142. Table shows percentage of students who agreed or strongly agreed.

Exhibit 21 shows helpfulness counts, which were collected from open-ended response questions on the student survey. Out of 212 total student surveys submitted, we received text-based responses to the open-ended questions from 114 students regarding videos, 130 students regarding prompts, 122 students regarding the SPIN introductory questionnaire, and 143 students regarding the group assignment.

Students indicated that the prompts were helpful (33% of all students providing responses about prompts), **with the questionnaire closely following** (33% of all students providing responses about questionnaires). Students also indicated that the videos were helpful (37% of all students providing responses about videos), although some students held negative views of the videos (e.g., thought they were better for middle or high school students or felt that the content was not new or needed for them). **Students indicated that the group assignment was less helpful** (27% of all students providing responses about group assignments).

In general, the students who viewed individual strategies as not helpful tended to be those students who were required to take the course for their major and were less often students taking the course as an elective or students who had not declared their major yet. This pattern was particularly true for students who indicated they found the group assignment and videos less helpful. Out of 35 total responses indicating the group assignment was not helpful, 30 were from students required to take the course for their major. Out of 10 total responses indicating the videos were not helpful, nine were from students required to take the course for their major.

Exhibit 21. Summary of "Helpfulness" Counts

Instructional Strategy	# of Student Responses Indicating They Found Strategy Helpful	# of Student Responses Indicating They Found Strategy Not Helpful	# of Student Responses with Mixed Experience with Strategy[a]	# of Student Responses with No Suggestions to Improve the Strategy[b]	Total[c]
Videos	39	10	20	37	106
Prompts	43	4	14	62	123
Questionnaire	41	3	7	71	122
Group assignment	33	35	37	34	139

Source. Researcher coding of student survey open-ended responses.

[a] Mixed experience refers to both postive and negative perceptions in a response.

[b] Example responses include not applicable (n/a) or none.

[c] Totals exclude off-topic or unclear responses.

Among the 14 interviewed students, 1**0 students reported finding value in at least some of the strategies**. The remaining four students reported that although they did not find personal value in the strategies, **they could see the value for other students who were younger or who had less college experience**.

Contextual Factors Related to Perceived Value

We found that contextual factors, such as whether a student was comfortable with written communication, affected their perception of the strategies' value. To further understand these contextual factors, we collected and compiled information from the instructor and student surveys and interviews in Exhibit 22. Relevant factors are broken into two categories—whether they promote or hinder perceived value—and descriptions are provided for each.

Exhibit 22. Contextual Factors Affecting Perceived Value

	Contextual Factor	Description
Promote Perceived Value	Student–strategy fit (videos, prompts, introductory questionnaire)	Videos are more valuable for students needing support with confidence, goal setting, and understanding their learning (e.g., mindset).
		Prompts are more valuable for students who are comfortable with written communication and open to reflection and strategy change.
		Students believed the questionnaire was more valuable for students in remote courses who are interested in getting to know their classmates better.
Hinder Perceived Value	Instructor time/workload	Instructors had limited time to implement activities and respond to student reflections.
	Student reason for enrolling in the course	Nearly all students who indicated that the strategies were not helpful were required to take the course for their major.

Source. Student and instructor surveys.
Note. n = 24 instructors; n = 212 students.

RQ5. What resources, tools, and supports are needed for instructors to take up and implement the model with integrity across diverse settings?

Supports and Conditions That Helped Faculty Implement the SDL Instructional Model

In qualitative interviews, when asked what supports or resources were helpful during the pilot study, intervention faculty noted the **training materials and on-demand support provided by Collaborative staff**. Five instructors also described how **collaborating with colleagues** who were also teaching during the pilot period was useful as they were implementing the model. In open-ended survey responses, four instructors described value in having training and examples. Somewhat contrasting these qualitative insights, the five cost survey respondents indicated seeking less than

an hour of total support for implementing the strategies prior to the start of the term and almost no support throughout the term (see RQ6 findings).

In open-ended survey responses, instructors most often described **ready-to-use resources** (e.g., templates and materials) as the key facilitator for implementing the SDL strategies, suggesting that ease of adoption and low burden of preparation mattered most. Instructors consistently signaled that implementation goes best when resources are clear and organized, when they feel well supported, and when the work is light.

In both the closed- and open-ended responses on the instructor implementation survey, instructors highlighted the importance of being able to **embed the SDL strategies into the course or LMS**. On the survey, the majority of instructors found the strategies and supports useful to them as instructors (88%) and believed the strategies could be integrated with existing systems (79%). This finding suggests that institutions seeking to scale the SDL Instructional Model could leverage opportunities to more formally integrate the strategies within their institution's LMS and other existing systems.

In the open-ended survey responses, instructors also mentioned **embedding strategies into the course or LMS** as important for ensuring students actually completed and used the activities, in addition to the use of **accountability structures (grading/points)**. A small number of instructors indicated that, for them, no major modifications to the Instructional Model were needed beyond continued access to the existing resources. Exhibit 23 includes counts of all coded facilitators in open-ended survey responses.

Exhibit 23. Implementation Facilitators Mentioned by Intervention Instructors

Implementation Facilitators	Count
Integration into course/LMS	11
Student engagement and motivation	11
Ready-to-use resources (templates/materials)	10
Accountability and grading	6
Training and examples for instructors	4
Format/modality choices (modifications for particular activities, adjustments for hybrid/online courses)	3
Timing, pacing, and planning	3
Instructor communication and reminders	2
Instructor feedback and support presences	2

Source. Researcher coding of instructor survey open-ended responses.
Note. n = 24.

Supports and Conditions That Were Missing and Needed to Implement the SDL Instructional Model

When considering supports for individual faculty members implementing the Instructional Model, instructors who participated in qualitative interviews and responded to the instructor implementation survey provided similar suggestions for the implementation materials. Exhibits 24 and 25 include counts of all coded missing/needed resources in open-ended survey responses and qualitative interviews.

Exhibit 24. Missing and Needed Resources to Support Implementation Mentioned on Surveys

Missing and Needed Implementation Resources	Count
Plug-and-play materials, including templates, mock assignments, concrete examples, and step-by-step directions to reduce preparation time and increase consistency	16
Training/coaching	7
Flexibility to adapt strategies to course modality and student realities, especially related to collaboration expectations and pacing	6
Practical LMS/tech supports, including how-to guidance, LMS-ready file formats, and easier integration into Blackboard/Canvas	4
Clearer assessment supports, including rubrics, grading/feedback structures	1

Source. Researcher coding of intervention instructors' open-ended responses on the instructor survey.
Note. n = 24.

Exhibit 25. Missing and Needed Resources to Support Implementation Mentioned in Interviews

Missing and Needed Implementation Resources	Count
How-to video or video guide for implementation, with a special focus on collaborative activities	3
Preloaded activities in the LMS platform	2
Earlier training to give more time to plan and integrate the activities before the start of the term	1
Example planners that show implementation approaches for varying length courses	1

Source. Researcher coding of intervention instructors' responses in qualitative interviews.
Note. n = 11.

In terms of implementation improvements to the SDL strategies themselves, instructors made recommendations in open-ended survey responses. Instructors requested **clearer assessment supports** (rubrics, grading/feedback structures) to make implementation more straightforward and sustainable. A recurring missing condition was **flexibility to adapt strategies** to course modality and student realities, especially related to collaboration expectations and pacing. (The instructor survey had somewhat mixed data regarding adaptation, with some instructors finding strategy adaptation to be adequate and others wishing that more flexibility had been built in.) In open-ended survey responses, instructors identified that to facilitate scaling the Instructional Model effectively across faculty, the SDL strategies need **stronger student-facing clarity** (i.e., clear instructions/expectations).

Supports and Conditions That Were Missing and Needed to Scale the Model Across Departments and Institutions

More generally, when asked in interviews what resources or supports institutions would need to provide to promote implementation of the SDL Instructional Model, administrators, non-pilot faculty, and intervention faculty offered a range of suggestions that shared many similarities with the suggestions of instructor survey respondents.

Stakeholders recommended **integrating the model into existing professional development structures or opportunities**, with two interviewees suggesting that faculty could **earn a certificate** for completing training on the model. Similarly, in open-ended survey responses pertaining to implementation of the Instructional Model at the institution level, instructors most often emphasized the need for **structured training and ongoing coaching** to support implementation, with several responses suggesting that **institutional coordination and leadership structures** (such as a "captain" by discipline, a professional learning community/community of practice, or a campus lead) could help support consistent implementation of the strategies and follow-through. Several interviewees recommended offering faculty a **stipend or financial incentive** for their time participating in training or for the time they would need to integrate the strategies into their course.

Interviewees noted that faculty and others at their college would want to see **data on the model's success** before deciding to implement. Some open-ended survey responses specifically recommended creating a **centralized "home base"** (e.g., a Canvas course/site template or repository) that houses tutorials, resources, and recordings so that faculty do not have to search through emails. One instructor suggested "having a Canvas course for all of the examples, tutorials, resources, and trainings. Have a network of support of leaders and other professors who have completed this."

Institution-Level Challenges and Barriers

Instructors and administrators discussed both hypothetical institution-level challenges and barriers that an institution could face if it were to pursue implementation of the SDL Instructional Model, and actual institution-level challenges and barriers they experienced while soliciting interest in and implementing the Instructional Model during the research phases. Many of the challenges and barriers that instructors and administrators highlighted fell into the former category, meaning they likely did not directly experience the challenges (e.g., buy-in, initiative fatigue, limited resources) during the pilot study but would anticipate them if their institution or similar institutions pursued implementation of the model.

Across both open-ended survey responses (instructors) and qualitative interviews (administrators), instructors and administrators noted that it may be challenging to solicit interest in and scale the implementation of the SDL Instructional Model among many competing faculty and college priorities. In open-ended responses, instructors identified that it is **challenging to solicit buy-in for or attention to implementing the Instructional Model amid competing initiatives**. They suggested that professional development led by centers for teaching and learning and targeted faculty workgroups could be used to build adoption (although one administrator talked about the challenge of disseminating new teaching practices across an institution **if a college does not have a center for teaching and learning**).

In interviews, several administrators pointed to challenges posed by **competing demands for faculty attention**. One administrator noted that some faculty will wait for a few years before getting involved in a new initiative (thinking it may go away) and will participate only if it becomes clear that the initiative is part of the fabric of the institution. Relatedly, one administrator reported that because **teaching and learning are not typically prioritized by senior-level administrators**, this type of reform may be challenging to scale up, given all of the **other college-wide priorities**.

Additionally, interviewed administrators noted a range of institutional conditions that could present barriers to model adoption or scaling. Administrators reported that **limited college resources for faculty development** would be a barrier. Several administrators pointed to the challenges posed by **faculty fatigue and burnout**. Finally, administrators noted that **adjunct faculty**, who teach many courses, may be **less engaged** in professional development at the college and have **less time** to implement new instructional strategies.

RQ6. What resources are required to implement the model as intended?

To assess the resources used to implement the SDL Instructional Model, we drew on faculty-reported use of time spent seeking support from other staff (from the cost survey), time setting up for and implementing the strategies (cost survey and instructor survey), and software and equipment used in that implementation (cost survey and instructor survey).

Time with Supporting Staff

Faculty in the cost survey sample required little support from other staff prior to the start of the term. On average, cost survey respondents indicated seeking less than an hour of total support prior to the start of the term (Exhibit 26). When faculty did seek support prior to the start of the term, it was from department faculty or staff on the Postsecondary Teaching with Technology Collaborative. Respondents sought less than half an hour of support from department faculty prior to the start of the term, and less than half an hour of support from Collaborative staff.

Faculty required little support throughout the term, and only in the second half. Respondents reported not seeking any support in the first half of the term. In the second half of the term, respondents sought an average of 0.10 hours (6 minutes) of support from Collaborative staff. Respondents did not seek any support for implementing the strategies from administrative staff, department staff, or IT staff, at any point before or during the semester.

Exhibit 26. Time Spent Seeking Support, by Source of Support and Time Period (Hours per Week)

Source	Prior to Start of Course	First Half of Course	Latter Half of Course
Administrative staff	0.0	0.0	0.0
Department staff	0.0	0.0	0.0
Department faculty	0.4	0.0	0.0
IT staff	0.0	0.0	0.0
Collaborative staff	0.4	0.0	0.1

Source. Cost survey.
Note. n = 5. Faculty provided total time spent prior to the start of course, by source of support. To calculate hours per week prior to start of course, we assumed faculty spent this time over the course of one week.

Time Spent Setting Up and Implementing Strategies

Across all SDL strategies, **cost survey respondents reported spending about 4.5 hours prior to the start of the semester to set up the strategies**. Videos took somewhat less time to set up, at about 1 hour, than either SPIN activities or prompts (1.7 and 1.6 hours, respectively; Exhibit 27). To

account for the fact that respondents taught courses of different lengths, and to determine whether time on the strategies was front-loaded in the beginning of the term, the weekly data are collapsed into the first half of the course (e.g., first four weeks of an 8-week course and first eight weeks of a 16-week course) and the second half of the course. **Time spent implementing all strategies was similar in the first half of the course to time spent in the second half**, at 12 hours in the first half and 13 hours in the second.

Exhibit 27. Time Spent Setting Up and Implementing SDL Strategies Among Cost Survey Respondents, by Strategy and Time Period (total hours)

Strategy	Set Up Prior to Start of Course	First Half of Course	Second Half of Course	Total Across Time Points
SPIN activities	1.7	5.2	4.6	11.5
SDL videos	1.2	2.5	3.4	7.1
SDL prompts	1.6	3.9	4.5	10
Total across strategies	4.5	11.6	12.5	28.6

Source. Cost survey.

On average, instructors reported spending the most time implementing SPIN and the least amount of time implementing videos, in both the first and second half of the course. SPIN activities included an introductory questionnaire intended to be administered in the first week of the semester, and two collaborative activities that could occur at any time during the course. The reported hours suggest that instructors included at least one of the collaborative activities in the second half of the semester.

Two of the three videos (on sense of belonging and on time management) were intended to occur in the first two weeks of the semester, and the third (on growth mindset) after the first major assessment or assignment. However, the reported hours suggest that instructors spent less time implementing videos in the first half of the course (i.e., the first 7–8 weeks) than in the second half, at 2.5 and 3.4 hours, respectively.

Prompts were intended to be implemented before the first major assessment, after that assessment, in the final weeks of the course, and at two other times of the instructor's choosing. Consistent with this intention, instructors reported spending a similar amount of time implementing prompts in both the first and second half of the course, at 3.9 and 4.5 total hours, respectively.

Compared with all implementing faculty, those in the cost survey sample reported spending more total time setting up and implementing the strategies. **Faculty in the cost survey sample spent an average of 28.6 hours in total across all strategies, compared with 15.7 hours for all implementing faculty**. This pattern was observed both for instructors of eight-week courses—for which faculty in the cost survey sample reported spending [value suppressed to protect respondent confidentiality] hours across strategies compared with 12.3 hours in the full implementation

sample—and for instructors of 15- or 16-week courses—for which faculty in the cost survey sample reported spending 31.9 hours across strategies compared with 21.5 hours in the full implementation sample (Exhibit 28). These differences may be because the cost survey sample was not representative of all implementing faculty, or because weekly reporting among the cost survey sample may have been more accurate than retrospective reporting by all implementers.

Exhibit 28. Time Spent on SDL Strategies Among All Implementers (Total Hours)

Implementation Strategies	Total Hours Across Term		
	All Instructors	Instructors of 8-Week Courses	Instructors of 15- or 16-Week Courses
Participating in training	2.9	2.6	3.0
Embedding the strategies into the course	6.3	3.3	7.5
Delivering the strategies to students	2.9	2.5	3.4
Reviewing, analyzing, or grading responses	6.5	3.9	7.6
Total	15.7	12.3	21.5

Source. Instructor implementation survey.
Note. n = 24.

Furthermore, data from the instructor implementation survey showed that, across all instructors, **the bulk of hours were spent on embedding the strategies into the course and reviewing, analyzing, or grading responses** (both over 6 hours). Instructors reported spending about half the time, 2.9 hours, on delivering the strategies.

When we consider instructors teaching the eight-week course versus the 15- or 16-week course, the story changes. Compared to those teaching 15- or 16-week courses, those teaching eight-week courses spent slightly less time participating in training (2.6 vs. 3.0 hours) and delivering the strategies to students (2.5 vs. 3.4). In addition, this gap widens for other implementation strategies. Compared to those teaching 15- or 16-week courses, **instructors teaching eight-week courses spent considerably less time embedding strategies and reviewing, analyzing, and grading responses** (3.3 vs. 7.5 for embedding and 3.9 vs. 7.6 for reviewing, analyzing, and grading responses). This pattern may be because the time constraints of eight-week courses do not afford faculty the opportunity to spend more time on the strategies.

Equipment and Software Used

All cost survey respondents indicated they used a computer prior to the start of the term to set up the SDL strategies, and in the second half of the term to implement the strategies. Four out of five instructors reported using a computer in the first half of the term to implement the strategies. No respondents reported using their cell phone, tablet, or other equipment to implement the strategies.

LMSs were integral to implementation of the SDL Instructional Model. All cost survey respondents indicated using their institution's LMS to set up the strategies, and all indicated using their LMS in the latter half of the course for the strategies. Four of five respondents also indicated using the LMS in the first half of the course. One respondent indicated additionally using Google or Microsoft forms to set up the strategies prior to the start of term. Respondents did not report using any other software to implement the strategies.

Similarly, data from the instructor survey show that all implementers reported using their institution's LMS (Exhibit 29). Among this sample, 8% additionally used courseware or a homework system, and 13% used other software, whereas no cost survey respondents reported use of courseware, a homework system, or other software.

Exhibit 29. Software Use Among All Implementing Faculty

Resource	% of Instructors Using
Institution's LMS	100%
Courseware or homework system	8%
Google or Microsoft forms	13%
Other	13%

Source. Instructor survey.
Note. n = 24.

Across both cost survey and instructor implementation survey respondents, **faculty indicated using equipment and software that are typically used by online course instructors to set up and facilitate their courses**. This finding indicates that faculty did not need to purchase additional equipment and software or use equipment and software they were not already using on a regular basis for their course teaching responsibilities. Therefore, the survey responses indicate that **the SDL Instructional Model appears to be low- or no-cost in terms of equipment and software needed to implement**.

V. LIMITATIONS

While the findings of the pilot study provide meaningful insights into the implementation, impact, and costs of the SDL Instructional Model, several limitations should be considered when interpreting the results.

Study Design

The pilot study used a quasi-experimental approach to estimate the impact of the Instructional Model on student SDL skills and academic outcomes. Although we controlled for observable characteristics, it is possible that the intervention and comparison sections differed systematically in unobserved ways. Results may be attributable, in part, to these unmeasured factors.

Despite best efforts to increase participation, the relatively low survey response rates also affect the degree to which impacts on survey outcomes generalize to all students in study courses. The small sample size also made it difficult to detect an overall effect and identify populations of students for whom the strategies might be most effective. The study may have missed important differences in impacts across subgroups and cannot rule out meaningfully large effect sizes.

The timing of the student survey administration may have affected results. Because some of the SDL strategies are implemented at the very beginning of the term, we were unable to conduct pre/post-surveys. Although this approach eliminated delays in model implementation, it meant we could not examine the equivalence of or control for baseline measures of students' SDL skills and mindsets across conditions. We also accelerated data collections initially planned for late spring 2025 amid changes to the federal funding landscape and uncertainties regarding grant continuations. As a result, students completed surveys earlier in the term, in some cases before all strategies had been implemented. Students having not experienced the full model at the time the survey outcome data were collected may have dampened the model's impact. It is also possible that it takes more than one term for students to apply SDL skills and mindsets to their learning, but our survey focused on a single term.

Logistical challenges limited the degree to which students who may be most likely to benefit from the SDL strategies—including younger students, first-semester students, and withdrawing students—could be included in the study and analyses. It was not feasible to include students under age 18 in the survey data collection because of the resources required to obtain parental consent for those students. Additionally, students who withdraw from a course are systematically less likely to respond to end-of-course surveys because they are likely to have withdrawn prior to survey administration. Therefore, it was not possible to assess the effectiveness among these populations. Lastly, first-semester students lacked the only available baseline measures of achievement; cumulative GPA and credits earned are not available for students in their first semester of college.

Measures

Our measures of SDL relied on student self-report surveys. Though a predominant and efficient method, self-reports may be incomplete or inaccurate because of memory biases. Students may differ in their awareness of their own strategies, their willingness to report them, or their interpretation of the questions. It is also possible that asking for self-reports of SDL skills and mindsets after engaging in the SDL activities accentuated self-awareness of their own limitations and reduced overreporting.

The discrepancy between reported time spent implementing the model by cost survey participants and reported time spent by all implementing faculty (28 hours vs. 15 hours, respectively) raises important questions about measurement and the model's return on investment. These differences may be because the cost survey sample was not representative of all implementing faculty, or because weekly reporting among the cost survey sample may have been more accurate than retrospective reporting by all implementers.

Implementation

Implementation factors may also have contributed to study results. Unlike prior phases of research, instructors were not able select particular SDL strategies and instead were asked to implement all three strategies. Thus, we could not assess the effectiveness of particular strategies that instructors could select to benefit particular students.

The pilot study was the first time many of the instructors implemented the Instructional Model. In some cases, instructors deviated from the intended implementation of the model, leading to simplified or substantially adjusted strategies due to time/course constraints or misunderstandings of key elements. It is possible that implementation would have been more robust if instructors had more practice and experience with the model. As can be the case with course redesigns, it may take multiple semesters of implementation to see effects.

Our data also suggest that student engagement with the SDL strategies varied. Some students were more selective in which strategies they used or how much they engaged with them based on their perceived value of the strategies and other responsibilities or constraints outside the course. While the model as a whole has a strong foundation, it may be more feasible for faculty—and beneficial to students—to select strategies that are aligned with the needs of their course and students.

VI. SUMMARY OF KEY FINDINGS AND NEXT STEPS

The Collaborative's SDL Instructional Model has been—and continues to be—a vehicle for learning about practical strategies that faculty and institutions can use to improve college students' SDL and success in online courses.

The pilot study found that faculty and students perceived the model as valuable and distinct from typical practice in online courses. Instructors particularly liked the videos and prompts and appreciated how the activities supported "non-content" skills. Students favored the prompts and less often indicated that the group assignments were helpful to them. Responses from both groups suggest that the activities may be especially beneficial for specific populations of students, such as those at the beginning of their postsecondary journey.

Students and faculty cited students' external responsibilities as a factor affecting their engagement with the activities. It is unclear whether student time was a particular challenge for the SDL activities because they were perceived as lower priority and thus more likely to be skipped, or because they detracted from student time on other courses activities. Further exploration is needed to better understand what attracts or detracts students from engaging with the activities.

Faculty reported that the Instructional Model was relatively easy to implement, although designing collaborative activities appropriate for an online course was challenging for many instructors. Furthermore, instructors completing weekly cost surveys reported spending an average of 28 hours implementing the model, which is likely to be a large deterrent to scaling without efforts to streamline. Study findings suggest that institutions can promote adoption of the Instructional Model and support faculty to realize its full potential by offering professional development and peer learning opportunities and by embedding the strategies into course shells in an institution's LMS.

The pilot study did not detect statistically significant effects on students' self-reported skills or mindsets or in their end-of-course grades. This result contrasts with the corresponding findings in an earlier phase of the Collaborative's research during the iterative design and development of the strategies, where we observed a positive, statistically significant effect on the evaluation scale and learning strategies inventory (Mislevy et al., 2026). The null effects observed in the pilot may be the result of low survey response rates and the small sample size; they may also suggest opportunities to refine the design and implementation of the Instructional Model.

While the Collaborative's SDL Instructional Model shows promise, further research is necessary to grasp its impact on student outcomes, to identify the optimal combinations of strategies, and to better understand how students allocate scarce time across instructional strategies and academic activities. We encourage readers to explore our Learning Agenda, which reflects on key insights from the Collaborative's five years of R&D efforts, distills implications for research and practice, and prioritizes questions for further investigation.

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VIII. APPENDIX

Nonresponse Analyses

Given the low response rates of the student survey, we conducted nonresponse analyses to assess differences between survey respondents and the full administrative population, in order to evaluate the potential for nonresponse bias in the survey results. Students were analyzed separately by enrollment in a section implementing the SDL Instructional Model. Within each condition, regression models were estimated for each student-level covariate included in the primary impact analyses, with survey response status as a predictor alongside block fixed effects to account for the within-block design.

Survey respondents in intervention sections were largely representative of the full administrative population with respect to student demographic characteristics and prior achievement (Exhibits A1 and A2). The only notable and statistically significant difference is the end-of-course grade (ES = 0.68, $p < .01$), which was measured after both the intervention and the survey. The end-of-course grades of survey respondents were nearly 1 point higher than nonrespondents on a standardized 4-point grading scale (e.g., A = 4, B = 3). Because the survey was administered near the end of the semester, students who withdrew prior to survey administration were unlikely to respond. Consistent with this timing, withdrawal rates differed substantially between respondents and nonrespondents: Survey respondents had near-zero withdrawal rates, whereas nonrespondents had a withdrawal rate of 19%. Because withdrawal was treated as zero in the end-of-course grade analyses, and because nonrespondents were more likely to withdraw, the differences in end-of-course grades between respondents and nonrespondents is partially due to differential withdrawal rates.

Comparison sections showed more evidence of selection. Survey respondents were more likely to be female (ES = 0.64, $p < .01$), be Hispanic or Latino (ES = 0.40, $p = .02$), and have higher prior achievement, including more cumulative credits (ES = 0.16, $p = .10$) and higher GPAs (ES = 0.21, $p = .02$). We observed a similar pattern for end-of-course grades in the comparison sections (ES = 0.64, $p < .01$). As in the intervention sections, these differences are associated with substantially higher withdrawal rates among nonrespondents. Although the survey sample was well balanced on prior achievement, differences between respondents and nonrespondents suggests that any findings in the survey sample might not reflect the impacts that would have been observed among the full administrative sample.

Exhibit A1. Comparison of Survey Respondents to Nonrespondents (Raw)

Characteristic	Intervention		Comparison	
	Survey sample	Nonrespondents	Survey sample	Nonrespondents
Female	66%	59%	73%	56%
Race				
Asian or Pacific Islander	6%	4%	3%	3%
Black or African American	21%	25%	19%	26%
Hispanic or Latino	31%	28%	43%	32%
White	37%	35%	27%	32%
Pell recipient	57%	51%	50%	52%
First generation – Yes	14%	15%	13%	14%
First semester	11%	6%	9%	9%
Cumulative credits	31.48	33.22	30.06	27.78
Cumulative GPA	2.89	2.83	2.94	2.65
End-of-course grades	3.06	1.94	3.11	1.92
Withdrawal	1%	19%	0%	19%
Next fall retention	84%	73%	76%	71%
N students	134	267	166	307
N sections	17	17	17	17
N courses	17	17	17	17

Source. Administrative data, student survey.

Exhibit A2. Comparison of Survey Respondents to Nonrespondents (Model Adjusted Course Fixed Effects)

Characteristic	Intervention		Comparison	
	Adjusted Differences	Effect Size	Adjusted Differences	Effect Size
Female	8 pp	0.20	23 pp**	0.64
Race				
Asian or Pacific Islander	3 pp	0.35	1 pp	0.11
Black or African American	2 pp	0.05	−5 pp	−0.18
Hispanic or Latino	−7 pp	−0.25	15 pp**	0.40
White	4 pp	0.10	−4 pp	−0.12
Pell recipient	8 pp	0.20	5 pp	0.12
First generation – Yes	−2 pp	−0.11	5 pp	0.20
First semester	4 pp	0.34	2 pp	0.11
Cumulative credits	1.65	0.07	3.90	0.16
Cumulative GPA	0.15	0.14	0.24*	0.21
End-of-course grades	0.99**	0.68	0.96**	0.64
Withdrawal	−18 pp**	−2.09	−19 pp	−11.47
Next fall retention	12 pp*	0.46	6 pp	0.19
N students	401		473	
N sections	17		17	
N courses	17		17	

Source. Administrative data, student survey.
Note. pp = percentage points.
* $p < .05$. ** $p < .01$.

Bayesian Interpretation of Estimates

After estimating impacts using the above frequentist approach, we used the Bayesian Interpretation of Estimates (BASIE) framework for interpreting impact evaluations (Deke et al., 2022) to estimate the probability of a positive impact on each SDL outcome and on end-of-course grades. This framework uses an empirical Bayesian approach in which the prior distribution is the estimated distribution of impact estimates from prior postsecondary studies estimating impacts on overall achievement (for our end-of-course grades outcome) and behavior outcomes (for our survey-based outcomes). Prior postsecondary studies include those that were reviewed by the U.S. Department of Education's What Works Clearinghouse and were found to meet standards with or without reservations. Deke et al. (2022) estimate that impacts on general achievement measures from that body of evidence

has a skewed t distribution, with a mean of 0.16 and a standard deviation of 0.11. They estimate that impacts on behavioral outcomes from that body of evidence have a mean of 0.19 and a standard deviation of 0.16.

The BASIE approach allowed us to estimate the probability that the strategies increased students' SDL skills and achievement, given our estimates and this prior evidence on the impacts of postsecondary strategies on similar outcomes. We found that the probability of a positive effect was relatively low for self-efficacy and sense of belonging (17% and 19%, respectively) and was below 50% for growth mindset (47%; Exhibit A3). For all other outcomes, we found that the probability of a positive impact was greater than 50%, ranging from 68% (for end-of-course grades) to 87% (Karabenick's [2001] Help Seeking scale).

Exhibit A3. Probability of Positive Impacts on SDL Outcomes and End-of-Course Grades

Outcome	Effect Size	Probability of a Positive Impact
Growth Mindset	−0.01	46.7%
Learning Strategies Inventory	0.05	72.1%
Comprehension Monitoring	−0.19	72.5%
Evaluation	−0.23	71.5%
Help Seeking (OSLQ)	−0.09	73.9%
Help Seeking (Karabenick)	0.05	86.9%
Self-Efficacy	−0.15	16.6%
Sense of Belonging	−0.16	19.4%
End-of-Course-Grade	0.03	67.5%

Source. Student survey.
Note. No differences were statistically significant at the 5% level.

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