education northwest

IMPLEMENTATION FIDELITY REPORT

Louisiana State University's Introduction to Computational Thinking Course

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About Education Northwest

Education Northwest is a nonprofit, nonpartisan organization dedicated to helping all children and youth reach their full potential. We partner with public, private, and community-based organizations to address educational inequities and improve student success. While most of our work centers on the Pacific Northwest, our evaluations, technical assistance, and research studies have national impact and provide timely and actionable results.

This report presents implementation fidelity findings from Education Northwest's research on Louisiana State University's proposal A Modern Approach to the Integration of Programming and Mathematics, which outlines an Introduction to Computational Thinking course and was funded by a federal Education Innovation and Research early-phase grant (U411C190287).

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SUGGESTED CITATION

ACKNOWLEDGMENTS

Executive Summary

Louisiana State University (LSU) received a federal Education Innovation and Research (EIR) grant to develop and implement its Introduction to Computational Thinking (ICT) course from fall 2019 through spring 2023. ICT is a yearlong course, typically offered in grades 9 or 10, that develops students' understanding of mathematical concepts and computational thinking and increases student engagement and interest in mathematics and computer sciences. The course uses a high-level programming language (codeworld-api) that enables students to build their knowledge of mathematical functions using computing commands that resemble mathematical notation. ICT can be offered as a standalone course and is a required core course for all students in grades 9 or 10 who choose to participate in an LSU STEM Pathway.

For this project, ICT was implemented in high schools in East Baton Rouge Parish (EBR), which is considered high need; non-EBR high schools that are considered high need, many in rural areas; and non-EBR high schools that are considered low need, many in suburban areas. Need is defined by the percentage of students in a district who qualify for free or reduced-price lunch.

Implementation fidelity

Education Northwest is conducting both impact and implementation evaluations of ICT. The implementation evaluation assesses whether the key support components of the course are being implemented with adequate fidelity to the design. This second of two implementation reports primarily covers the 2022–23 implementation year, including summer 2022. In summary tables (such as table ES-1, below) we also provide findings from the prior year, 2021–22, as a comparison.

We measure the implementation fidelity of each of ICT's four main support components separately. Each component is defined by multiple indicators, which may be assessed at different levels (e.g., teacher, school, program) and then aggregated to the component level. For each component, we define a program-level threshold that determines whether or not the component was implemented with fidelity across the program in a particular year. At the component level, in the 2022–23 school year, two of the four components were implemented with low fidelity—ICT teacher training and teacher recruitment and student enrollment—and two components were implemented with adequate fidelity, or as planned—ICT curriculum materials and the train-the-trainer session. Table ES-1 summarizes the implementation fidelity findings.

Table ES-1. Summary of program- and component-level implementation fidelity findings over two years

Key components and indicators	Implementation level 2021–22	Implementation level 2022–23
Key component 1. ICT teacher training		
Indicator 1. LSU offers 24-day training course	Adequate	Adequate
Indicator 2. Teacher participates in 24-day training course and becomes certified	Adequate	Low
Indicator 3. LSU certifies teachers after 24-day training course	Adequate	Low
Indicator 4. Teacher expresses satisfaction with 24-day training course	Low	Adequate
Indicator 5. LSU offers community of practice sessions (7–8)	Adequate	Adequate
Indicator 6. Teacher participates in community of practice sessions	Adequate	Low
Indicator 7. LSU develops and offers prescriptive plan and one-on-one coaching to teachers who receive provisional certification	Adequate	Adequate
Indicator 8. Teacher with provisional certification receives a prescriptive plan and participates in its activities	Adequate	Adequate
Indicator 9. LSU provides online community of practice	Adequate	Adequate
Indicator 10. LSU provides timely technical support (via online community of practice)	Adequate	Low
Indicator 11. Teacher engages in online community of practice regularly	Low	Low
Indicator 12. LSU offers annual refresher training	Adequate	Adequate
Indicator 13. Teacher attends annual refresher training	Adequate	Adequate
Component-Level Implementation Fidelity Rating	**Low**	**Low**
Key component 2. ICT curriculum materials		
Indicator 1. LSU provides teacher instructional materials comprising four units and teacher solutions	Adequate	Adequate
Indicator 2. LSU provides student learning materials comprising four units	Adequate	Adequate
Indicator 3. Teacher expresses satisfaction with teacher instructional and student learning materials	Adequate	Adequate
Component-Level Implementation Fidelity Rating	**Adequate**	**Adequate**
Key component 3. Teacher recruitment and student enrollment		
Indicator 1. District/school staff members recruit or replace teachers	Low	Low
Indicator 2. School staff members encourage students to enroll in ICT	Low	Low

Key components and indicators	Implementation level 2021–22	Implementation level 2022–23
Component-Level Implementation Fidelity Rating	**Low**	**Low**
Key component 4. Train-the-trainer session		
Indicator 1. LSU offers train-the-trainer session	NA	Adequate
Indicator 2. Instructor attends train-the-trainer session	NA	Adequate
Component-Level Implementation Fidelity Rating	**NA**	**Adequate**

Source: Authors' analysis of implementation data.

Three key patterns emerged when we disaggregated the analyses above by school locale and level of need (defined by the percentage of students eligible for free or reduced-price lunch):

- Teachers in **high-need schools** (in and outside of East Baton Rouge) scored higher on "teacher participates in 24-day training course and becomes certified"

- Teachers in **high-need schools** (in East Baton Rouge) scored lower on "teacher participates in community of practice sessions"

- Teachers in **low-need schools** scored higher on "district/school staff members recruit or replace teachers"

Across the two years of implementation, the component-level scores were the same for the three key components that were delivered in both years—ICT teacher training (low), ICT curriculum materials (adequate), and teacher recruitment and student enrollment (low). Key component 4, the train-the-trainer session, was not implemented in 2021–22 and was implemented as planned (adequate) in 2022–23.

At the indicator level, implementation fidelity for key component 1 (ICT teacher training) decreased for four indicators and increased for one indicator in the second year. Implementation outcomes related to teacher participation in the training, teacher certification, teacher participation in the community of practice, and LSU provision of technical support decreased while teacher satisfaction in the training increased. Meanwhile implementation fidelity remained the same year-to-year for key components 2 (ICT curriculum materials) and 3 (teacher recruitment and student enrollment).

Facilitators of implementation fidelity

Several factors facilitated teachers' participation in the ICT training. Based on participant responses in focus groups, offering virtual options for both the 24-day training and community of practice and offering multiple opportunities to participate in the community of practice were critical. Other facilitators included instructor support during the 24-day summer training and throughout the school year, including via the online community of practice. Participants also cited the integration of project-based learning and certain aspects of computational thinking as facilitators of student engagement.

Barriers to implementation fidelity

The fact that some teachers attended training sessions but did not become certified suggests that the course may not be a good fit for all educators and schools. In surveys and focus groups, teachers cited few barriers to implementation. Those mentioned most often were related to logistical issues and access, which might have inhibited participation in the community of practice sessions and use of the online community of practice. These issues included limited whole-group interaction during the summer training, the timing of the summer training, and the length and organization of the community of practice sessions. Access to the curriculum and its developers were also barriers to engagement—for students when they did not have access to curriculum materials and for educators when they did not have access to the curriculum, struggled with continuous curriculum updates, and or had to wait for responses in the online community of practice. Teachers also cited excessive assessment as a barrier to student engagement. Finally, about half of the teachers reported not receiving preparation to encourage students to enroll in ICT.

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Chapter 1. Introduction

Louisiana State University (LSU) received an <u>Education Innovation and Research</u> (EIR) grant to implement its Introduction to Computational Thinking (ICT) course from fall 2019 through spring 2023. ICT is a yearlong course that builds skills in problem solving, programming, and mathematics (algebra and geometry) and is intended to improve performance on Louisiana state math assessments. The course's goals are to improve understanding of mathematical concepts and computational thinking and increase engagement and interest in mathematics and computer sciences for students from all backgrounds.

ICT is typically taken in grade 9 or grade 10 and is intended to be taken concurrently with Algebra I. It uses a high-level programming language (codeworld-api) that enables students to build their knowledge of mathematical functions using computing commands that resemble mathematical notation. It also incorporates project-based instruction that integrates learning objectives for math and coding.

The course is based on the principles of the Core-Plus mathematics curriculum:[1]

- Contains interwoven strands of content from algebra, geometry, probability, and discrete mathematics

- Places a strong emphasis on modeling

- Uses technology to promote reasoning with multiple representations (verbal, numerical, graphical, and symbolic)

- Focuses on goals in which problem solving based on mathematical thinking (and in this case, also computational thinking) is central

- Emphasizes active learning, small-group collaboration, and summarization activities that lead to reflection on the main ideas

Furthermore, ICT was designed under the following assumptions:

- Students taking the course will have a wide spectrum of interests

- Most students who take the course will not become programmers

- Most teachers of the course have no computer science background

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[1] What Works Clearinghouse, National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. (2010). WWC intervention report: Core-Plus Mathematics. https://ies.ed.gov/ncee/wwc/Docs/InterventionReports/wwc_coreplus_092110.pdf

- Course content must be rigorous

- Students will demonstrate their learning by creating computer programs

- Creativity and choice within the given constraints is an essential aspect

- ICT can be offered as a standalone course and is a required core course for students in grades 9 or 10 who chose to participate in an LSU STEM Pathway

For this project, the ICT course was implemented in high schools in East Baton Rouge Parish (EBR); non-EBR high schools that are considered high need, many in rural areas; and non-EBR high schools that are considered low need, many in suburban areas. Need is defined by the percentage of students in a district who qualify for free or reduced-price lunch.

EIR grant

LSU contracted with Education Northwest to conduct the impact and implementation fidelity studies required of every EIR grant recipient. Both studies are vetted by Abt Associates technical assistance providers contracted by the Office of Elementary and Secondary Education at the U.S. Department of Education and assigned to support the research team. This report summarizes findings associated with the second year of implementation, which includes summer 2022 and the 2022–23 school year.[2] The implementation fidelity study has three research questions:

1. Were the key components of the intervention implemented as planned?

2. How did implementation fidelity vary by school geographic area (urban, suburban, town, or rural) and level of need?

3. What were facilitators of and barriers to implementation?

Requirements for the implementation fidelity study include a logic model and implementation fidelity measure.

ICT logic model

The ICT intervention logic model contains four key components:

1. Teacher training

2. Online portal and curriculum

3. Teacher recruitment and student enrollment

4. Train-the-trainer session

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[2] The final impact report, which will include a summary of implementation findings, will be completed in 2025.

Each of these key components is described below, including the associated activities, mediators, and short- and long-term outcomes. The logic model is in appendix A.

ICT teacher training

1. Teachers must participate in a multi-faceted professional development program that spans 12 months and includes four components. Teachers participate in a **24-day training** that prepares them to support students' completion of the ICT online curriculum. The training is offered in late spring/early summer and introduces teachers to fundamental computing principles rather than a specific programming language. Teachers engage with theme-based units that emphasize the transfer of computing principles to mathematics and engage in project-based learning to create specific computing products. Units are divided into lessons and each lesson has several exercises and a longer activity that requires written code to demonstrate mastery of a particular skill. During the training, teacher materials are interwoven with student materials. Teachers only gain access to teacher materials after they complete the work as students. Teachers must pass the student ICT course with a score of 80 percent (i.e., certified) before gaining access to ICT materials in their classroom.

    After the initial training and while they are teaching the course, teachers attend monthly **community of practice sessions (i.e., whole-group coaching).** ICT developers lead seven to eight of these virtual community of practice sessions, each lasting 1.5 to 2 hours. These sessions are open to all ICT teachers, but summer training participants are required to attend and are compensated for their time.[3] Additional one-on-one coaching is provided to teachers as needed and includes a prescriptive plan and scheduled times for checking in.

    This whole-group coaching model allows teachers to receive feedback from the ICT developers on teacher and student course analytics as they incorporate virtual documents, class sessions, and rubrics. The coaching covers content such as best pedagogical practices, feedback on grading, student recruitment, and a review of content areas that data from previous years suggest have been difficult for students to learn and/or teachers to teach. In addition to the planned content, teachers can ask questions, receive targeted support, and share successes. Ultimately, these activities support teachers' understanding of mathematics and computational thinking and their ability to implement the course with fidelity. Understanding and fidelity should increase each year as teachers gain experience.

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[3] Only teachers in urban and rural districts receive this stipend through the EIR grant. In suburban districts, teacher participation in the 24-day training and communities of practice are not funded through the EIR grant.

The **online community of practice** is initiated during the 24-day training. Teachers continue to have access to it for as long as they teach the ICT course and are expected to communicate with their peers or the ICT developers at least monthly. They can use the online community of practice to ask questions and address challenges they encounter while teaching the course. For technical questions, ICT developers respond within 24 hours to ensure teachers have the information and support they need to continue teaching.

Finally, teachers attend an annual **refresher training**. This half-day virtual training, held in July or August, addresses critical components of the course that teachers and/or students struggled with in the previous year as well as any changes the ICT developers made to the course in response to these challenges. All returning teachers providing ICT instruction for the upcoming school year are required to attend the refresher training.

The four main components of the teacher training not only prepare teachers to engage and support students in their ICT coursework (complete units and assignments with fidelity and in appropriate time and sequence), but also help develop the requisite programming, computational thinking, mathematics, and pedagogical skills (e.g., online instruction) to do so. Once teachers have concluded the training, their school can continue to offer the ICT course and they can continue to teach it. As a direct result of the training, more schools can offer ICT and the STEM teacher workforce is increased.

ICT online portal and curriculum

2. All components of the ICT course are delivered online. The course includes portals for teachers and students. The teacher portal provides access to the teaching materials, manual (four units and teacher solutions), and online community of practice. The student portal also has four units and includes student activities.

   Teachers gain access to the teacher portal when they complete the 24-day training or refresher training. Students are provided access to the student portal when they register for the course. Teachers and students engage in course activities throughout the school year. Student engagement with the course materials and exercises increases their understanding of fundamental mathematical concepts and computational thinking, leading to increased interest and engagement in STEM courses and the STEM Pathways. As a result, students' short-term outcomes include increased achievement in algebra and geometry and increased credits earned in upper-level algebra and advanced placement computer science courses. Long-term outcomes include increased high school graduation rates; a larger, more diverse STEM workforce; and sustained or increased enrollment in ICT by a diverse group of students.

ICT teacher recruitment and student enrollment

3. The third component of the intervention is teacher recruitment and student enrollment. For sustainability purposes, it is imperative that each school has at least one trained ICT instructor. Administrators recruit teachers attend the training and teach the course. To increase the diversity of the STEM teacher workforce, ICT is designed so that any teacher—not just computer science teachers—can provide instruction once trained. In addition, LSU expects at least 21 percent of each participating school's grade 9 student population to be enrolled in the course. As ICT is part of the Computer Science for All initiative, LSU further expects the student enrollment in ICT to mirror overall grade 9 student enrollment in terms of gender, race and ethnicity, and program.

   ICT teachers are expected to encourage students to enroll in the course. While not all high school staff members have the opportunity to interact with grade 8 students, teachers learn in the community of practice how to effectively encourage students to enroll in their ICT course. Strategies include having students present their work during parent-teacher association meetings, school open houses, grade 8 high school visits, and engaging their peers. As a result, the logic model posits the diversity of ICT stakeholders is expected to increase: schools in cities, suburbs, towns, and rural locales will offer the course, diverse teachers will teach the course, and students will be equitably represented in ICT (e.g., participation rate mirrors representation in the school population for male and female students; Hispanic/Latinx, American Indian/Alaska Native, Asian, Black/African American, Native Hawaiian/Pacific Islander, and white students and students of two or more races; students who qualify for special education services; students who are English learners; and students who are eligible for free or reduced-price lunch). In the long term, a cadre of diverse teachers will teach the ICT course and enrollment in ICT by diverse groups of students will be sustained or increased—which will in turn increase the size and diversity of the STEM workforce.

Train-the-trainer session

4. The intervention includes a final training for educators interested in teaching the 24-day training, facilitating the school year community of practice sessions, and/or providing coaching during the school year. This train-the-trainer session takes place in spring, prior to the 24-day training. Educators participating in the train-the-trainer session will increase their skill in adult and online pedagogy. As they complete the training, provide instruction, and support new teachers, they contribute to the development of a trained, diverse, and competent STEM workforce in the long term.

Implementation fidelity measure

The implementation fidelity measure delineates the key components of the intervention and includes metrics for assessing low, adequate, or ideal implementation at the individual or school levels. The measure also includes rules for aggregating either low or adequate implementation fidelity to the program and component levels. Adequate means the program or component was implemented as planned.

Implementation study findings will also inform impact study findings. For example, if the impact study finds no impact, and the implementation study finds low implementation, one can argue that low implementation may have contributed to the lack of impact. If adequate implementation is associated with positive but small impacts, one can argue that had the intervention been implemented with increased fidelity there might have been more impact. Furthermore, if the impact study finds some impact, but the fidelity study finds low implementation, that might suggest that the level of support is not a factor in the effectiveness of the intervention.

During the 2019–20 school year, the evaluation team and ICT course developers and instructors collaboratively developed an implementation fidelity measure based on the logic model. At LSU's request, the implementation fidelity measure that identifies indicators for what constitutes full implementation of support for each of the four components is delineated for three groups:

- Grant administrators engaged in their tasks

- Intervention participants (i.e., teachers and instructors) engaged in their requirements

- Schools engaged in their requirements

However, as the grant administrator tasks are essentially the same as aggregating to the program level, we refer to them as program-level indicators. Generally, in aggregating up to the component level, we required all but one of the indicators of grantee responsibilities to be implemented with adequate fidelity and all but one of the participant or school indicators to be implemented with adequate fidelity. Further, for each component, some indicators had to be implemented with adequate fidelity for the component to receive a score of adequate implementation. The implementation fidelity measure is provided in appendix B.

Methodology

Each implementation fidelity measure indicator has a data source. The evaluation team collected and analyzed all data according to the implementation fidelity measure.

The data sources are:

- **Recruitment materials** from summer 2022 24-day training course and summer 2022 refresher training.

- **Attendance records** from spring 2022 train-the-trainer sessions, summer 2022 24-day training course, and 2022–23 school year community of practice sessions; LSU could not provide documentation related to the summer 2022 refresher training.

- **Program records** regarding ICT certification; documentation regarding prescriptive plans and one-on-one coaching were not provided as no teachers received provisional certification.

- **Teacher survey** administered to assess overall quality of the 24-day training course and the ICT teacher and student instructional materials. The research team administered the survey items regarding the 24-day training course in January; a total of 24 teachers participated in the training; 18 were invited to complete the survey and 11 did so. The remainder of the survey was administered to all 38 ICT teachers in April 2023; 34 teachers completed it (89% response rate).

- **Schedule** for community of practice sessions.

- **Website access** for online community of practice (to assess access, technical support, and teacher participation via posts) and teacher and student portals (to assess access and instructional material content).

- **Focus groups** to obtain feedback on barriers to and facilitators of participation, among other topics. The evaluation team conducted two focus groups with ICT teachers during regularly scheduled community of practice sessions in January 2023. A total of 14 ICT teachers participated across both focus groups.

Chapter 2. Implementation Fidelity of Key Component 1: ICT Teacher Training

This chapter addresses the three research questions related to the ICT teacher training component. This component has 13 implementation fidelity indicators (box 1). Seven of the indicators address grantee activities and six address participant activities.

Was the ICT teacher training implemented as planned?

Indicator 1. LSU offers 24-day training course

Indicator 1 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if the training is not offered and an adequate score (1) if the training is offered.

LSU provided the research team with a recruitment flyer advertising the training dates as June 6 through July 8, 2022.

Program-level implementation fidelity is **adequate (1)** because the training was offered.

Indicator 2. Teacher participates in 24-day training course and becomes certified

Indicator 2 is a teacher-level expectation and is scored dichotomously. A teacher receives a score of low (0) if they do not complete the training or complete the training but do not become certified and a score of adequate (1) if they complete the training and become certified. When aggregating to the program

> **Box 1. Fidelity of implementation indicators for the ICT teacher training component**
>
> **Indicator 1.** LSU offers 24-day training course*†
>
> **Indicator 2.** Teacher participates in 24-day training course and becomes certified†
>
> **Indicator 3.** LSU certifies teachers after 24-day training course*
>
> **Indicator 4.** Teacher expresses satisfaction with 24-day training course
>
> **Indicator 5.** LSU offers community of practice sessions (7–8)*†
>
> **Indicator 6.** Teacher participates in community of practice sessions
>
> **Indicator 7.** LSU develops and offers prescriptive plan and one-on-one coaching to teachers who receive provisional certification*
>
> **Indicator 8.** Teacher with provisional certification receives a prescriptive plan and participates in its activities
>
> **Indicator 9.** LSU provides online community of practice*
>
> **Indicator 10.** LSU provides timely technical support (via online community of practice)*
>
> **Indicator 11.** Teacher engages in online community of practice regularly
>
> **Indicator 12.** LSU offers annual refresher training*
>
> **Indicator 13.** Teacher attends annual refresher training
>
> *Grantee expectation.
> †Cannot be "0" for component to have adequate fidelity.

level, implementation fidelity is also scored dichotomously. The program receives a low score on fidelity (0) if less than 90 percent of teachers who participate in at least three days of training are certified and an adequate score (1) if at least 90 percent of teachers who participate in at least three days of training are certified.

LSU provided an Excel file that indicated the total number of days each participating teacher attended the 24-day training offered in 2022.[4] A total of 21 teachers attended at least three days of training.[5] A third of teachers attended all 24 days (33%); the remaining attended 23 days (14%), 22 days (24%), 21 days (10%), 20 days (5%), or six days or less (14%). The three teachers who attended six days or less did not receive certification, nor did with a fourth teacher who was participating to assess if the course was a good match for their program (19%). Seventeen teachers attended at least three days of training and received their certification to teach ICT during the 2022–23 school year (81%); no teachers received provisional certification.

Program-level implementation fidelity is **low (0)** because less than 90 percent of teachers who participated in at least three days of training were certified.

Indicator 3. LSU certifies teachers after 24-day training course

Indicator 3 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if less than 90 percent of recruited high schools have a certified teacher and an adequate score (1) if at least 90 percent of recruited high schools have a certified teacher.

LSU provided Excel files that detailed recruited teachers by school and certification status. LSU recruited a total of 23 teachers from 22 high schools/programs and certified at least one teacher in 17 schools (77%).

Program-level implementation fidelity is **low (0)** because LSU certified teachers in fewer than 90 percent of recruited high schools.

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[4] LSU invited teachers in the EIR impact study to attend a 24-day training. They invited non-EIR impact study teachers to attend a 16-day pilot training. Teachers were scored adequate if they attended for at least 16 days of this pilot training (some teachers attended more than 16 days). For teachers who attended fewer than 16 days we calculated an equivalent number of days based on the 24-day standard. For example, we converted a teacher who attended 15 days of the 16-day training to attending 22.5 days of the 24-day training.

[5] Two attendees of the 16-day training were LSU graduate students; they are excluded from this analysis.

Indicator 4. Teacher expresses satisfaction with 24-day training course

Indicator 4 is a teacher-level expectation and is scored categorically. We asked teachers to respond to the question "Overall, I was satisfied with the 24-day summer training course" using a 10-point scale where "1" was low and "10" was high. This indicator was scored as low fidelity (0) if a teacher's response was less than "6," adequate (1) if their response was "6" or "7," and ideal (2) if their response was at least "8." When aggregating to the program level, implementation fidelity is scored dichotomously. The program receives a low fidelity score (0) if less than 75 percent of teachers responded with at least "6" and an adequate score (1) if at least 75 percent of teachers responded with at least "6."

Survey data indicate that 14 percent of teachers responded with an overall rating less than "6" (low), 29 percent with an overall rating of "6" or "7" (adequate), and 57 percent with an overall rating of "8" or above (ideal). In total, 84 percent of teachers responded to this survey item on overall satisfaction with at least "6."

Program-level implementation fidelity is **adequate (1)** because at least 75 percent of teachers selected at least "6" on a 10-point scale when responding to "Overall, I was satisfied with the 24-day summer training course."

Indicator 5. LSU offers community of practice sessions (7–8)

Indicator 5 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if it offers fewer than seven community of practice sessions during the school year and an adequate score (1) if it offers at least seven such sessions.

A member of the ICT team shared the dates for three series of community of practice sessions: one for teachers providing yearlong ICT instruction; one for teachers providing ICT instruction in fall 2022 using a 4x4 schedule, and one taking place on Saturdays. Each series included eight sessions. The first session of each series was advertised in a post to the online community of practice on August 17 for the upcoming dates of August 23, August 27, and August 30. LSU invited teachers providing instruction in spring using a 4x4 schedule to participate in the remaining sessions offered to yearlong ICT teachers.

Program-level implementation fidelity is **adequate (1)** because LSU offered at least seven community of practice sessions during the school year.

Indicator 6. Teacher participates in community of practice sessions

Indicator 6 is a teacher-level expectation and is scored categorically. A teacher receives a low fidelity score (0) if they participate in four or fewer community of practice sessions, an adequate score (1) if they participate in five or six sessions, and an ideal score (2) if they participate in at least seven sessions. When aggregating to the program level, implementation fidelity is scored dichotomously. The program receives a low fidelity score (0) if less than 75 percent of teachers participate in at least five sessions and an adequate score (1) if at least 75 percent of teachers participate in at least five sessions.

LSU shared the number of community of practice sessions each certified, or provisionally certified, ICT teacher participated in during the 2022–23 school year. Of the 17 certified teachers, 35 percent attended four or fewer sessions (low), 35 percent attended five to six sessions (adequate), and 29 percent attended at least seven sessions (ideal). In total, 65 percent of teachers participated in at least five sessions.

Program-level implementation fidelity is **low (0)** because fewer than 75 percent of teachers participated in at least five sessions.

Indicator 7. LSU develops and offers prescriptive plans and one-on-one coaching to teachers who receive provisional certification

Indicator 7 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if it develops and offers prescriptive plans and one-on-one coaching to less than 90 percent of teachers who receive provisional certification. The program receives an adequate score (1) if it develops and offers prescriptive plans and one-on-one coaching to at least 90 percent of teachers who receive provisional certification or if all teachers are certified after completing the 24-day training.

Program-level implementation fidelity is **adequate (1)** because LSU certified all teachers after completing the 24-day training.

Indicator 8. Teacher with provisional certification receives a prescriptive plan and participates in its activities

This indicator is a teacher-level expectation and is scored dichotomously. The teacher receives a low fidelity score (0) if they do not participate in prescriptive plan activities and an adequate score (1) if they do. When aggregating to the program level, implementation fidelity is scored dichotomously. The program receives a low fidelity score (0) if less than 100 percent of teachers with provisional certification receive a prescriptive plan, participate in its activities, and are certified, and an

adequate score (1) if 100 percent of teachers with provisional certification receive a prescriptive plan, participate in its activities, and are certified, or if all teachers were certified after completing the 24-day training.

Program-level implementation fidelity is **adequate (1)** because LSU certified all teachers after completing the 24-day training.

Indicator 9. LSU provides on online community of practice

This indicator is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if they do not make an online community of practice available and an adequate score (1) if they do. The online community of practice is hosted on the Mattermost platform, which provides an interface for ICT teachers to communicate with each other and with the LSU team. In addition, it provides links to a Google Drive and the teacher portal.

Program-level implementation fidelity is **adequate (1)** because LSU made the online community of practice available.

Indicator 10. LSU provides timely technical support (via online community of practice)

Indicator 10 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if technical support is not available or does not respond to teachers' technical issues within 24 hours at least 90 percent of the time and an adequate score (1) if such support is available and meets that standard.

LSU provided Education Northwest with access to the ICT online community of practice. We recorded the information on the online community of practice on a spreadsheet (cohort, date of the post, poster's name, a summary of the post content, time of the post, time of the response, and responder's name).

For the posts coded as "technical error," we subtracted the time of the original post from the time of the first response. Then we scored as adequate any post with a result less than 1,440 minutes (24 hours) and as low any post with a result greater than 1,440 minutes or without a response. Out of a total of 59 technical error posts, 49 (83%) were responded to within 24 hours.

Program-level implementation fidelity is **low (0)** because LSU responded to teacher posts that addressed technical issues within 24 hours less than 90 percent of the time.

Indicator 11. Teacher engages in online community of practice regularly

Indicator 11 is a teacher-level expectation and is scored categorically. The teacher receives a low fidelity score (0) if they post in the online community of practice fewer than six times during the school year, an adequate score (1) if they post six to seven times, and an ideal score (2) if they post at least eight times. When aggregating to the program level, implementation fidelity is scored dichotomously. It is scored low (0) if less than 75 percent of teachers post at least six times during the school year and adequate (1) if at least 75 percent of teachers post at least six times during the school year.

Using the spreadsheet described above, we counted the number of posts by teacher. Ten teachers who were certified in 2022 (59%) and 27 of the 41 teachers who taught during the 2022–23 school year (66%) posted to the online community of practice. Two of the newly certified teachers posted at least eight times (12%) and five of the teachers certified prior to the 2022–23 school year posted at least eight times (21%). In total, 17 percent of teachers posted at least six times during the school year.

Program-level implementation fidelity is **low (0)** because less than 75 percent of teachers posted at least six times during the school year.

Indicator 12. LSU offers annual refresher training

Indicator 12 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if it does not offer a refresher training for the upcoming school year and an adequate score (1) if it does.

In late June, LSU invited returning ICT teachers to participate in a four-hour refresher training on July 25 to receive updates on the ICT curriculum to be used during the 2022–23 school year. Teachers who could not attend the training were provided with one-on-one updates.

Program-level implementation fidelity is **adequate (1)** because LSU offered a refresher training for the upcoming school year.

Indicator 13. Teacher attends annual refresher training

Indicator 13 is a teacher-level expectation and is scored dichotomously. Teachers receive a low fidelity score (0) if they do not attend the annual training and an adequate score (1) if they do. When aggregating to the program level, implementation fidelity is scored dichotomously. The program receives a low fidelity score (0) if less than 50 percent of returning teachers attend the annual training and an adequate score (1) if at least 50 percent of returning teachers attend.

LSU was unable to provide Education Northwest with a file of teachers who attended the 2022 summer refresher training.[6] However, the only way for teachers to gain access to the ICT curriculum, and provide instruction during the school year, is to attend the group or a one-on-one training (for those unable to attend the group training). LSU did share a file of ICT student enrollments by school for the 2022–23 school year. The student enrollment file shows that 40 teachers were certified or exempt from certification and two teachers were not certified to provide ICT instruction during the 2022–23 school year.[7] Of these 42 teachers, 16 had just completed the 24-day training and did not need to attend the refresher. Of the remaining 26 teachers, 16 received an invitation to the refresher training (62%). However, all 42 teachers were provided access to the course materials, which indicates they were not required to attend the refresher, they attended the refresher, or they participated in a one-on-one refresher training after July 25.

Program-level implementation fidelity is **adequate (1)** because at least 50 percent of returning teachers attended the refresher training.

Implementation at the component level

Guidelines for rolling up the 13 indicators into a component-level score are delineated in the fidelity implementation measure (appendix B). To score adequate on implementation for key component 1, the sum of the 13 program-level scores must equal 11. Six points must come from the program indicators (1, 3, 5, 7, 9, 10, and 12; meaning six of seven components had to be implemented at an adequate level) and five points must come from teacher indicators (2, 4, 6, 8, 11, and 13; meaning five of six components had to be implemented at an adequate level). In addition, indicators 1, 2, and 5 cannot have scores of low (0).

Program indicators earned five points since five indicators were implemented at an adequate level (1, 5, 7, 9, and 12). Teacher indicators earned three points since three indicators were implemented at an adequate level (4, 8, and 13). Of the required indicators (1, 2, and 5), only two received scores of adequate (1).

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[6] LSU no longer had Zoom records for the when they attempted to share them with the evaluation team.

[7] The file also indicated that two teachers had students enrolled in ICT but were not certified. These teachers replaced other teachers who either did not complete the summer training or left the profession after receiving certification. In addition, the uncertified teachers with 2022–23 student enrollments were hired after the summer training and were invited to participate in one-on-one training. Both these teachers left the profession before they did so (RT and TK). Two other teachers replaced certified teachers who left their school during the school year. These teachers received one-on-one training and were certified to provide ICT instruction.

Component-level implementation fidelity is **low (0)** because the program scored low on indicator 2 and teachers scored adequate on three indicators instead of five.

Table 1. ICT teacher training fidelity findings

Key components and indicators	Implementation level
Key component 1. ICT teacher training	
Indicator 1. LSU offers 24-day training course	Adequate
Indicator 2. Teacher participates in 24-day training course and becomes certified*	Low
Indicator 3. LSU certifies teachers after 24-day training course	Low
Indicator 4. Teacher expresses satisfaction with 24-day training course*	Adequate
Indicator 5. LSU offers community of practice sessions (7–8)	Adequate
Indicator 6. Teacher participates in community of practice sessions (7–8)[†]	Low
Indicator 7. LSU develops and offers a prescriptive plan and one-on-one coaching to teachers who receive provisional certification	Adequate
Indicator 8. Teacher with provisional certification receives a prescriptive plan and participates in its activities*	Adequate
Indicator 9. LSU provides online community of practice	Adequate
Indicator 10. LSU provides timely technical support (via online community of practice)	Low
Indicator 11. Teacher engages in online community of practice regularly[†]	Low
Indicator 12. LSU offers annual refresher training	Adequate
Indicator 13. Teacher attends annual refresher training[†]	Adequate
Component-Level Implementation Fidelity Rating	**Low**

*Only includes teachers who participated in the 2022 24-day training

†While all ICT teachers are invited to participate in the community of practice sessions, it is only required for teachers who participated in the 2022 24-day training and only they were included in the analysis. The online community of practice is optional; we only assessed usage by the teachers who participated in the 2022 24-day training. Any teacher previously trained and planning on providing ICT instruction in the upcoming school year is required to attend the refresher training.

Source: Authors' analysis of implementation data.

How did implementation fidelity for ICT teacher training vary by school locale and level of need?

Table 2 summarizes program-level findings for the six teacher-level indicators, disaggregated by school locale and level of need.[8] Fidelity was lower for teachers in schools in cities and suburbs than it was overall. For this component overall, teachers in rural schools and high need schools outside of EBR scored highest, followed by teachers in schools in towns, in EBR high-need schools, and in low need schools.

Table 2. Program-level ICT teacher training findings, by school locale and level of need

Indicator	Overall	City	Suburb	Town	Rural	EBR high need	Non-EBR high need	Low need
2. Teacher participates in 24-day training course and becomes certified	Low	Low	Low	Adequate	Adequate	Adequate	Adequate	Low
4. Teacher expresses satisfaction with 24-day training course	Adequate	NA*	NA*	NA*	NA*	NA*	NA*	NA*
6. Teacher participates in community of practice sessions	Adequate	Low	Low	Low	Adequate	Low	Adequate	Adequate
8. Teacher with provisional certification receives a prescriptive plan and participates in its activities	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
11. Teacher engages in online community of practice regularly	Low	Low	Low	Low	Low	Low	Low	Low
13. Teacher attends annual refresher training	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
Total Score	3^	2	2	3	4	3	4	3

*We administered the survey that collected this data anonymously and cannot tie responses back to individual teachers and their school.

^Indicator 4 is excluded from the total because we could not disaggregate implementation by locale or level of need.

Source: Authors' analysis of implementation data.

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[8] Some data sharing agreements do not allow us to report the names of schools included in the study. Therefore, we cannot identify schools by locale and level of need.

What were the facilitators of and barriers to implementation of ICT teacher training?

Facilitators

Participants cited virtual training and multiple options for community of practice attendance as strategies that made it easier to participate in the ICT teacher training program. They also appreciated the summer training instructors and the program's responsiveness and ongoing support during the school year, including the immediate access to developers and colleagues available through the online community of practice.

> *I think me, personally, even though I trained last summer, having everything online, honestly I'm not trying to go to Baton Rouge every weekend or a weekend a month. Not that it wouldn't be fun, but I'm sure LSU doesn't want to pay for my gas money to go there either or somewhere to stay. Last year, compared to this year, I will say having the option, I can see the difference, because I've done the two years. Having the option to either Saturday morning or do the weekdays. Having choices, that choice really did make it a lot easier to plan our lives around. Doing this every fourth weekend, I think that that was really considerate.*
>
> — **ICT teacher**

> *I went through the summer and I like the set-up that's going on right now and we had some really great instructors this summer. They're very supportive. You can call them anytime and you can get help. We have some great assets helping you, training you, and also the content that's there, the kids can learn.*
>
> — **ICT teacher**

> *The brief Community of Practice meetings are great. It is a really good way to connect with other teachers. It is also good to meet with our program leaders at LSU. Contact with LSU is vital, especially if we are experiencing technical difficulties.*
>
> — **ICT teacher**

Barriers

Teachers cited no real barriers to participation. However, it appears the course was not a good fit—as a teacher or for their school—for three of the four teachers who started the training and did not earn certification. At least one participant in focus groups provided the feedback, regarding the 24-day training session, that they missed the whole-group interaction that was present during the in-person trainings. The same person suggested that the training happen at the end of the summer and felt that the course was geared too specifically toward math or computer science teachers. Feedback on the community of practice sessions might explain why participation was low. At least one teacher questioned if the community of practice sessions could be shorter, at least one thought they were unorganized, and at least one wished they could be organized in a way that allowed teachers at similar places in the curriculum to participate in breakout rooms together. One teacher requested that facilitators of the online community of practice respond to questions in a timely manner.

> *For the most part, I didn't feel connected perhaps because my situation is very different. I wonder if there was a way to spend more of the time in breakout rooms with people teaching in similar environments so that we can compare our experiences with particular lessons and then share out to the larger groups.*
>
> **– ICT teacher**

Chapter 3. Implementation Fidelity of Key Component 2: ICT Curriculum Materials

This chapter addresses the three research questions related to the ICT curriculum materials component. This component has three fidelity implementation indicators (box 2). Two of the indicators address grantee activities and the other addresses participant activities.

Were the ICT curriculum materials implemented as planned?

Indicator 1. LSU provides teacher instructional materials comprising four units and teacher solutions

Indicator 1 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if it does not provide a complete set of instructional materials to all teachers and receives an adequate score (1) if it does.

> ***Box 2. Fidelity of implementation indicators for the ICT curriculum materials component***
>
> **Indicator 1.** LSU provides teacher instructional materials comprising four units and teacher solutions*†
>
> **Indicator 2.** LSU provides student learning materials comprising four units*†
>
> **Indicator 3.** Teacher expresses satisfaction with teacher instructional and student learning materials†
>
> *Grantee expectation.
> †Cannot be "0" for component to have adequate fidelity.

LSU provided the research team with access to the teacher portal, which contains a preface, four core units, and two additional units (Interfaces and Automation). Each unit has lessons with teacher and student text; objectives; bellringer activities; vocabulary review; notes;[9] and a variety of examples, activities, and exercises. Each unit includes at least one project and core units include a post-test.

- The preface, Pre-BRBytes, includes a link to unplugged activities that address critical thinking, team building, Pathways connections, perseverance, and building computational thinking skills. These activities are designed to be used during the first weeks of school, when class rosters are in flux, to engage students in relevant activities until the entire class is finalized and can begin Unit 1 together. The second part of the preface, What is Computational Thinking?, is more like the lessons in the remaining units and includes teacher and student text, objectives, and exercises.

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[9] Not all lessons have notes.

- Unit 1, Intro to Programming, has nine lessons (The CodeWorld System, Ethics of Coding, Your First Program, Lists, Using Functions, Lettering and Lettering Block, Painting Pictures, and Variables (parts 1 and 2), as well as a project (Slideshow Party) and a post-test.

- Unit 2, Points and Pictures, has six lessons (Naming Points, Placing Dots, Quadrants, Predicting Coordinates, Combined, and Labeling), a project (Pointillism), and a post-test.

- Unit 3, Shapes and Design, has seven lessons (Lines, Introduction to Polygons, Polygons Practices, Generalizing Polygon Models, Color the Bird, Custom Colors, and Illusions), three projects (One Line Drawing, Polygonal Animals, and Logos), and a post-test.

- Unit 4, Effects and Efficiency, has eight lessons (Simplifying Repetitive Tasks, Unevaluated Expressions, Defining Functions, Translations, Composite Transformations, Changing Direction, Manipulating Data, and Tools for Advanced Modeling), three projects (Stop Motion, Sunny Scene, and Quilt Design), and a post-test.

- Additional unit 5, Interfaces, has five lessons (Introduction to Interfaces, Organizing Code, Modeling with Polygons, Making Copies Fit, and Taming Dilations) and two projects (Avatar and Interactive diagrams).

- Additional unit 6, Automation, has four lessons (Automation, Stretching and Mirroring, Transforming Coordinates, and Patterns and Regularity) and three projects (Clock, Teddy Bear Movie, and A Neighborhood).

The teacher portal includes text in green boxes that is not visible in the student portal. This text includes suggested time allocations, student groupings (e.g., whole class, partners), and ideas for formative assessment and transitions; key concepts to address and highlight; answers to prompts; and examples of responses to questions in the lessons. The teacher portal also provides access to several areas including the course index, student feedback, the student portal, the BRBytes Chat (the online community of practice), CodeWorld, and additional resources available in a Google Drive. The latter resources include standards aligned to the ICT curriculum (intercurricular, grades 6–8, geometry, algebra 1, computer science, and mathematical practice), an implementation guide, printables, pacing guides, a scoring rubric, and a supply list.

Program-level implementation fidelity is **adequate (1)** because LSU provided a complete set of instructional materials.

Indicator 2. LSU provides student learning materials comprising four units

Indicator 2 is a program-level expectation and is scored dichotomously. The program receives a low fidelity score (0) if it does not provide a complete set of student instructional materials and receives an adequate score (1) if it does.

LSU provided the research team with access to the student portal. The student portal looks identical to the teacher portal except the lessons do not provide the teacher solutions (e.g., green boxes), and the portal does not include access to the BRBytes Chat and the Google Drive resources.

Program-level implementation fidelity is **adequate (1)** because LSU provided a complete set of student instructional materials.

Indicator 3. Teacher expresses satisfaction with teacher instructional and student learning materials

Indicator 3 is a teacher-level expectation and is scored categorically. Teachers receive a low fidelity score (0) if they disagree or strongly disagree with two of four survey items (curriculum is: easy to follow, easy to deliver, relevant, and educational); an adequate score (1) if they agree or strongly agree with three of four survey items; and an ideal score (2) if they agree or strongly agree with all four survey items. When aggregating to the program level, implementation fidelity is scored dichotomously. A program receives a low fidelity score (0) if less than 50 percent of teachers agree or strongly agree with three or four survey items and an adequate score (1) if at least 50 percent of teachers do so.

In April 2023, the research team administered a survey to teachers who registered for the summer 2022 24-day training. The survey asked teachers the extent to which they agreed that the curriculum was easy to follow, easy to deliver, relevant, and educational. Of the 32 teachers who completed the survey, five disagreed with at least two of the items (16%; low), four agreed with three of the items (13%; adequate), and 23 agreed with all four of the items (72%; ideal).

Program-level implementation fidelity is **adequate (1)** because at least 50 percent of teachers agreed or strongly agreed with three or four survey items.

Implementation at the component level

Guidelines for rolling up the three indicators into a component-level score are delineated in the fidelity implementation measure (appendix B). To score adequate implementation for key component 2, the sum of the three indicators must equal 3 (that is, all of the indicators have to be implemented at the adequate level).

Component-level implementation fidelity is **adequate (1)** because all three indicators scored adequate.

Table 3. Key component 2 fidelity findings

Key components and indicators	Implementation level
Key component 2. ICT curriculum materials	
Indicator 1. LSU provides teacher instructional materials comprised of four units and teacher solutions	Adequate
Indicator 2. LSU provides student learning materials comprised of four units	Adequate
Indicator 3. Teacher expresses satisfaction with teacher instructional and student learning materials*	Adequate
Component-Level Implementation Fidelity Rating	**Adequate**

*Questions regarding the curriculum were asked in the survey administered to teachers who completed the 2022 24-day training.

Source: Authors' analysis of implementation data.

How did implementation fidelity for ICT curriculum materials vary by school locale and level of need?

Regardless of school locale or level of need, teachers implemented curriculum materials with adequate fidelity (table 4).

Table 4. ICT curriculum materials program-level findings, by school locale and level of need

Indicator	Overall	City	Suburb	Town	Rural	EBR high need	Non-EBR high need	Low need
4. Teacher expresses satisfaction with teacher instructional and student learning materials	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
Total score	1	1	1	1	1	1	1	1

Source: Authors' analysis of implementation data.

What were the facilitators of and barriers to implementation of ICT curriculum materials?

Facilitators

Teachers did not address factors that facilitate their own, or their students', use of the curriculum materials. However, they did have positive comments regarding the integration of computational thinking and project-based learning components into the curriculum. These included how course components supported understanding computational thinking with functions, layering, and order of operations and how the course's reliance on project-based learning differentiates it from other typical high school courses.

Barriers

Throughout the focus groups and in surveys, participants described instructional barriers they face while teaching ICT. Barriers included the sheer amount of content to be delivered to students, taking into consideration variation from school to school in scheduling (first versus fourth period), time blocks (50 minutes versus 120 minutes), and access to computers (e.g., during state testing). Several teachers cited the constantly changing curriculum as a barrier to implementation, including instances of misalignment of lesson names, instructions, and the introduction of code. Teachers also wanted access to the full curriculum at the beginning of the year and wanted to better understand how to use units three and four. Several teachers cited the need to be made aware in advance when curricular materials would not be available. There was a cited need for more explicit connections to high school math standards. Finally, teachers had mixed feedback on assessment, with some thinking the course needed more skills assessment while others wanted to ensure that course did not become too assessment heavy and move away from project-based learning.

> *Well, on one hand I like the idea of having some sort of assessments. Maybe something like there's code, can you find the error in the code or something like that, or how would you fix this error in the code, or something like that. But I don't know. On the other hand, I guess one of the things that makes it more special for the kids is that it's not a class that has all these tests and stuff like that, it's all project based and stuff like that. And that does kind of set it apart from other courses. So I think if we bogged them down with a lot of assessments too, it might lose some of that interest to the kids versus having them work on projects. So I feel there's probably a balance there somewhere.*
>
> *— ICT teacher*

The new organization of the course does not flow very well. The lessons need to be adjusted to fit the changes that were made. The names of the lessons changed, but the instructions still have the old names of the lessons. There are lessons that require students to use a previous code that they have not done due to the reorganization.

– ICT teacher

I understand that reorganizing the course as student feedback is received is good, but at some point, we need to decide on exactly what content will be covered and in what order and leave it alone for 2–3 years so that teachers can become familiar with the flow of the course … I am continually planning from scratch. Each year, the course has been changed during the school year. That needs to stop.

– ICT teacher

Chapter 4. Implementation Fidelity of Key Component 3: Teacher Recruitment and Student Enrollment

This chapter addresses the three research questions related to the ICT Teacher Recruitment and Student Enrollment component. This component has two fidelity implementation indicators (box 3). Both indicators address school activities.

Were teacher recruitment and student enrollment implemented as planned?

Indicator 1. District/school staff members recruit or replace teachers

> **Box 3. Fidelity of implementation indicators for the ICT teacher recruitment and student enrollment component**
>
> **Indicator 1.** District/school staff members recruit or replace teachers[†]
>
> **Indicator 2.** School staff members encourage students to enroll in ICT[†]
>
> †Cannot be "0" for component to have adequate fidelity.

Indicator 1 is a school-level expectation and is scored dichotomously. The school receives a low fidelity score (0) if it does not recruit or replace an appropriate number of teachers and receives an adequate score (1) if it does—or if no teachers need to be recruited or replaced. When aggregating to the program level, implementation fidelity is scored dichotomously. A program receives a low fidelity score (0) if less than 90 percent of schools recruit or replace an appropriate number of teachers and an adequate score (1) if at least 90 percent of schools recruit or replace an appropriate number of teachers or no teachers need to be recruited/replaced.

Using training and instructional rosters LSU provided to the research team, we assessed whether the teachers who taught ICT during the 2022–23 school year returned to provide ICT instruction in fall 2023, and if not, whether a new teacher from the same school was enrolled in the summer 2023 training course.[10] Of the 41 teachers (across 40 schools) who taught during the 2022–23 school year, 19 teachers (across 19 schools) returned to teach during the 2023–24 school year; teachers from an additional five schools participated in the 2023 training (60%).

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[10] The 2023 summer training was 12 days.

Program-level implementation fidelity is **low (0)** because less than 90 percent of schools recruited or retained an appropriate number of teachers.

Indicator 2. School staff members encourage students to enroll in ICT

Indicator 2 is a school-level expectation and is scored dichotomously. The school receives a low fidelity score (0) if it does not enroll at least 21 percent of its grade 9 students and receives and an adequate score (1) if it does enroll at least 21 percent of such students. When aggregating to the program level, implementation fidelity is scored dichotomously. A program receives a low fidelity score (0) if less than 90 percent of schools enroll at least 21 percent of their grade 9 students and an adequate score (1) if at least 90 percent of schools enroll at least 21 percent of their grade 9 students.

LSU provided the research team with total counts of students enrolled in ICT by school in 2022–23. The research team downloaded school enrollment files from the <u>Louisiana Department of Education</u> and averaged grade 9 enrollments from October 2022 and February 2023. We then determined the percentage of grade 9 enrollments engaged in ICT.

Program-level implementation fidelity is **low (0)** because less than 90 percent of schools enrolled at least 21 percent of their grade 9 student population.

Implementation at the component level

Guidelines for rolling up the two indicators into a component-level score are delineated in the fidelity implementation measure (appendix B). To score adequate implementation for key component 3, the sum of the two indicators must equal 2 (that is, both indicators must be implemented at the adequate level).

Component-level implementation fidelity is **low** because neither of the indicators met its fidelity threshold.

Table 5. Key component 3 fidelity findings

Key components and indicators	Implementation level
Key component 3. ICT teacher recruitment and student enrollment	
Indicator 1. District/school staff members recruit or replace teachers*	Low
Indicator 2. School staff members encourage students to enroll in ICT*	Low
Component-Level Implementation Fidelity Rating	**Low**

*Includes all schools with ICT student enrollment in the 2021–22 school year.

Source: Authors' analysis of implementation data.

How did implementation fidelity for teacher recruitment and student enrollment vary by school locale and level of need?

Overall, schools implemented ICT teacher recruitment and student enrollment at a low level. This was similar for ICT student enrollment, after disaggregating by school locale and level of need (table 6). However, low-need schools were able to implement ICT teacher recruitment at an adequate level.

Table 6. ICT teacher recruitment and student enrollment program-level findings, by school locale and level of need

Indicator	Overall	City	Suburb	Town	Rural	EBR high need	Non-EBR high need	Low need
1. School staff members recruit or replace teachers	Low	Low	Low	Low	Low	Low	Low	Adequate
2. School staff members encourage students to enroll in ICT	Low	Low	Low	Low	Low	Low	Low	Low
Total score	0	0	0	0	0	0	0	1

Source: Authors' analysis of implementation data.

What were the facilitators of and barriers to implementation of teacher recruitment and student enrollment?

Educators did not specify facilitators or barriers to encouraging students to enroll in ICT. However, in surveys, slightly less than half of teachers reported receiving no (19%) or "a little" (28%) preparation from LSU to encourage enrollment; the remaining teachers indicated receiving "some" (34%) or "a lot" of (19%) preparation to do so. Regardless of preparation from LSU, most teachers reported engaging in promotional activities to encourage students to enroll in ICT (72%).

When asked what kind of promotional activities they engaged in, most ICT teachers mentioned engaging with students. These included sharing or displaying ICT work (e.g. output and code) for non-ICT students to experience, having general conversations about the course, or encouraging specific students or groups of students to enroll in the course. Other promotions involved school venues such as fairs for incoming freshman, overviews of the STEM pathways options, robotics exhibitions, or through forecasting (high school teacher attend middle school events, middle school students tour the high school, printed materials, or social media sites). Less common engagement activities involved ICT students sharing their work or their experiences with non-ICT students, such as during forecasting or exhibition events. Some examples of ICT teacher responses follow:

> *We also have open house as an evening where kids who are trying to decide what high school to attend, and their parents, can come. Absolutely, I create a slideshow rather than printing out the polygonal animals; that's running in the background. Then I invite some of my students who are engaged in the class to come and engage these kids. I think that works a whole lot better than anything I can say, is to have students tell them how much they like it.*
>
> **– ICT teacher**

> *I mentioned it to students in my math classes, as well as attending the scheduling fair for 8th graders (rising 9th graders) and upperclassmen.*
>
> **– ICT teacher**

> *By having the students that are already enrolled present several projects that we work on during the course to show other students what the scholars created while enrolled in the course.*
>
> **– ICT teacher**

Chapter 5. Implementation Fidelity of Key Component 4: Train-the-Trainer Session

This chapter addresses the single research question related to the ICT train-the-trainer session component. We do not disaggregate the overall results by need or geography because LSU does not expect representation of all schools in this aspect of the project. This component has two implementation fidelity indicators (box 4). One indicator addresses grantee activities and the other participant activities.

Was the ICT train-the-trainer session implemented as planned?

Indicator 1. LSU offers train-the-trainer session

> **Box 4. Fidelity of implementation indicators for the ICT train-the-trainer session**
>
> **Indicator 1.** LSU offers train-the-trainer session*†
>
> **Indicator 2.** Instructor attends train-the-trainer session†
>
> *Grantee expectation.
> †Cannot be "0" for component to have adequate fidelity.

Indicator 1 is assessed at the program level and is dichotomous. The program receives a low score (0) if it does not provide the train-the-trainer session and receives a score of adequate (1) if it does provide the session or if no teachers want to be instructors.

LSU provided the research team with the materials used during the training sessions, which were offered on May 31 and June 3, 2022. The sessions addressed changes from the 2021 to the 2022 versions of the 24-day summer training, roles and expectations for instructors and learning coaches, and specifics regarding implementing and supporting learning during the summer training. Instructors received training to support content and pedagogy and learning coaches received training to support participants working in small groups and breakout rooms.

Program-level implementation fidelity is **adequate (1)** because LSU provided the train-the-trainer session.

Indicator 2. Instructor attends train-the-trainer session

Indicator 2 is assessed at the instructor level and is dichotomous. The instructor receives a low score (0) if they do not attend the train-the-trainer session and receives a score of adequate (1) if they do. The program receives a low score (0) if less than 90 percent of instructors who begin the training complete it and a score of adequate (1) if at least 90 percent of instructors who begin the training complete it or if no teachers want to be instructors.

LSU provided the research team with a list of nine instructors and learning coaches who started, and completed, the train-the-trainer session. All instructors who started the training sessions completed them and supported the 2022–23 cohort during the summer 2022 24-day training.

Program-level implementation fidelity is **adequate (1)** because at least 90 percent of instructors began and completed the training sessions.

Implementation at the component level

Guidelines for rolling up the two indicators into a component-level score are delineated in the fidelity implementation measure (appendix B). To score adequate implementation for key component 4, the sum of the two indicators must equal 2 (that is, both indicators must be implemented at the adequate level).

Component-level implementation fidelity is **adequate (1)** because the program scored adequate on both indicators.

Table 7. Key component 4 fidelity findings

Key components and indicators	Implementation level
Key component 4. Train-the-trainer session	
Indicator 1. LSU offers train-the-trainer session	Adequate
Indicator 2. Instructor attends train-the-trainer session	Adequate
Component-Level Implementation Fidelity Rating	**Adequate**

Source: Authors' analysis of implementation data.

The research team did not survey or ask for feedback from the participants of the train-the-trainer session, and therefore we do not have data on facilitators of or barriers to participation.

Chapter 6. Conclusion and Recommendations

LSU successfully trained and supported implementation of the ICT course in 42 high schools during the 2022–23 school year. Teachers appreciated many aspects of the training program, including the 24-day training and the community of practice sessions.

> **Recommendations:** LSU already piloted a shortened summer training (16 days) and changed the summer training to 12 days in summer 2023. In addition, LSU should continue to offer highly engaging and interactive training that provides a good balance of whole- and small-group instruction with plenty of differentiated support available during the summer and school year (virtual and online communities of practice). LSU might consider developing a video or other resource to allow interested schools and educators to review the course to assess its fit before enrolling and engaging teachers in the summer training. Engaging teachers in the online community of practice frequently during the summer training might increase their use of the tool during the school year. Finally, throughout the various training opportunities LSU should continue to share ways in which teachers can engage non-ICT students in the content to support enrollment.

LSU provided teachers and students with curricular materials that were easy to use and follow and supported their implementation with timely, but not ideal, technical assistance during the school year.

> **Recommendations:** LSU should complete updates to the curriculum prior to the summer training and provide teachers full access to the curriculum following the 24-day training or refresher training. Developers should ensure they respond to all inquiries in the online community of practice in a timely manner.

Schools struggled to recruit and retain teachers to instruct and enroll students in ICT.

> **Recommendations:** To increase sustainability of the course in the high schools, ensure processes are in place prior to beginning recruitment for the summer training to determine which ICT teachers will be returning to teach ICT in the upcoming school year. LSU could support student enrollment by producing ICT promotional materials.

Appendix A. ICT Logic Model

Figure A1. Introduction to Computational Thinking (ICT) logic model

Key support components	Direct components	Mediators	Short-term outcomes	Long-term outcomes
1. ICT teacher training that comprises: • 24-day training course with certification[a] • Community of practice group coaching sessions • Prescriptive plan and one-on-one coaching sessions (as needed) • Online community of practice portal available during the 24-day training and school year to access live help from developers or experienced teachers • Refresher training (half-day) **2. ICT online portal where teachers and students have access to online materials that include:** • Teacher instructional materials (4 units and teacher solutions)[b] • Student learning materials (4 units) **3. Teacher recruitment and student enrollment** • Teachers recruited to instruct ICT • Students encouraged to enroll in ICT **4. ICT train-the-trainer session** • One-day spring train-the-trainer session for instructors to lead the 24-day ICT training course and facilitate a community of practice (school year whole-group and one-on-one coaching)	• Teachers instruct the ICT course with skill and fidelity (complete units and assignments in appropriate time and sequence) (KC2) • Students engage in ICT learning activities (KC2)	• Teachers demonstrate increased understanding of programming, computational thinking, and mathematics (KC1) • Teachers increase skills in online (KC1) and adult (KC4) pedagogy • Students exhibit increased understanding of fundamental mathematical concepts and computational thinking (KC2) • Students exhibit increased engagement and interest in STEM courses and pathways (KC2)	Districts/schools experience: • Increased number of schools (in diverse locales) offer ICT (KC3) • Increased number of diverse teachers instruct ICT (KC1/KC4) • Equitable representation in ICT course as in school enrollment (KC3) • Increased student achievement in algebra and geometry (KC2) • Students more likely to earn credits in upper-level algebra and advanced placement computer science courses (KC2)	• Trained cadre of experienced ICT teachers (KC1/KC4) • Larger, more diverse STEM teacher workforce (KC1/KC3/KC4) • Increased high school graduation rates (KC2) • Larger, more diverse STEM workforce (KC2) • Sustained or increased enrollment in ICT by diverse groups of students (KC3)

[a] Beginning in summer 2023, this was changed to a 12-day training course. [b] Beginning in fall 2022, an automated grading feature was added. KC = Key component.

Appendix B. ICT Implementation Fidelity Measure

Table B1. Introduction to Computational Thinking (ICT) implementation fidelity measure

Indicator	Unit of measurement	Indicator scoring at unit level	Indicator scoring at program level
Key component 1. *ICT teacher training*			
1. LSU offers 24-day training course *Data source: Recruitment materials*	Program		0 = Does not offer 24-day training course 1 = Offers 24-day training course
2. Teacher participates in 24-day training course and becomes certified (current year's cohort) *Data source: Attendance records*	Teacher	0 = Does not become certified 1 = Becomes certified	0 = LSU certifies less than 90% of teachers who participate in at least 3 days of training 1 = LSU certifies at least 90% of teachers who participate in at least 3 days of training
3. LSU certifies teachers after 24-day training course *Data source: Program records*	Program		0 = Less than 90% of recruited high schools have a certified teacher 1 = At least 90% of recruited high schools have a certified teacher
4. Teacher expresses satisfaction with 24-day training course (current year's cohort) *Data source: Teacher survey*	Teacher	0 = Teacher responds with less than 6 on the overall satisfaction item on the professional development survey 1 = Teacher responds with 6–7 on the overall satisfaction item on the professional development survey 2 = Teacher responds with at least 8 on the overall satisfaction item on the professional development survey	0 = Less than 75% of teachers respond at least 6 on the overall satisfaction item on the professional development survey 1 = At least 75% of teachers respond at least 6 on the overall satisfaction item on the professional development survey

Indicator	Unit of measurement	Indicator scoring at unit level	Indicator scoring at program level
5. LSU offers community of practice sessions (7–8) *Data source: Community of practice schedule*	Program		0 = Does not offer or offers fewer than 7 community of practice sessions during the school year 1 = Offers at least 7 community of practice sessions during the school year
6. Teacher participates in community of practice sessions (current year's cohort) *Data source: Attendance records*	Teacher	0 = Participates in 4 or fewer community of practice sessions 1 = Participates in 5–6 community of practice sessions 2 = Participates in at least 7 community of practice sessions	0 = Less than 75 percent of teachers participate in at least 5 community of practice sessions 1 = At least 75 percent of teachers participate in at least five community of practice sessions
7. LSU develops and offers prescriptive plan and one-on-one coaching to teachers who receive provisional certification (current year's cohort) *Data source: Program records*	Program		0 = Less than 90% of provisionally certified teachers are offered a prescriptive plan and one-on-one coaching, or prescriptive plan and one-on-one coaching is not offered 1 = At least 90% of provisionally certified teachers are offered a prescriptive plan and one-on-one coaching or all teachers were certified after completing the 24-day training
8. Teacher with provisional certification receives a prescriptive plan and participates in its activities (current year's cohort) *Data source: Program records*	Teacher	0 = Teacher does not participate in prescriptive plan activities 2 = Teacher participates in prescriptive plan activities and is certified	0 = Less than 100 percent of teachers with a prescriptive plan participate in its activities and are certified 1 = 100 percent of teachers with a prescriptive plan participate in its activities and are certified or all teachers were certified after completing the 24-day training
9. LSU provides online community of practice (program) *Data source: Website access*	Program		0 = Online community of support not available 1 = Online community of support is available

Indicator	Unit of measurement	Indicator scoring at unit level	Indicator scoring at program level
10. LSU provides timely technical support* (via online community of practice) *Data source: online community of practice posts*	Program		0 = Technical support not available or does not meet the adequate definition 1 = Support responds to teachers' technical issues within 24 hours at least 90% of the time
11. Teacher engages in online community of practice regularly (current year's cohort) *Data source: Online community of practice posts*	Teacher	0 = Teacher posts fewer than 6 times during the school year 1 = Teacher posts in 6–7 times during the school year 2 = Teacher posts at least 8 times during the school year	0 = Less than 75% of teachers post at least 6 times during the school year 1 = At least 75% of teachers post at least 6 times during the school year
12. LSU offers annual refresher training *Data source: Recruitment materials*	Program		0 = Does not offer refresher training for the upcoming school year 1 = Offers refresher training to all ICT teachers in the upcoming school year
13. Teacher attends annual refresher training *Data source: Attendance records*	Teacher	0 = Does not attend 1 = Attends	0 = Less than 50% of returning teachers attend the refresher training 1 = At least 50% of returning teachers attend the refresher training
Key component 1 total score			Sum of sample-level indicator scores (Range = 0–13) Adequate = 11 with 6 points from program indicators (1, 3, 5, 7, 9, 10, and 12) and 5 points from teacher indicators (2, 4, 6, 8, 11, and 13) and indicators 1, 2, and 5 cannot be 0

Indicator	Unit of measurement	Indicator scoring at unit level	Indicator scoring at program level
Key component 2. **ICT online portal and curriculum**			
1. LSU provides teacher instructional materials comprised of 4 units and teacher solutions *Data source: ICT teacher and student websites*	Program		0 = Does not provides complete set of teacher instructional materials 1 = Provides complete set of teacher instructional materials
2. LSU provides student learning materials comprised of 4 units *Data source: ICT teacher and student websites*	Program		0 = Does not provide complete set of student instructional materials 1 = Provides complete set of student instructional materials
3. Teacher expresses satisfaction with teacher instructional and student learning materials (current year's cohort) *Data source: Teacher survey*	Teacher	0 = Teacher strongly disagrees or disagrees with 2 of 4 survey items (curriculum is: easy to follow, easy to deliver, relevant, and educational) 1 = Teacher agrees or strongly agrees with 3 of 4 survey items (curriculum is: easy to follow, easy to deliver, relevant, and educational) 2 = Teacher agrees or strongly agrees with 4 of 4 survey items (curriculum is: easy to follow, easy to deliver, relevant, and educational)	0 = Less than 50% of teachers agree or strongly agree with 3 of 4 survey items (curriculum is: easy to follow, easy to deliver, relevant, and educational) 1 = At least 50% of teachers agree or strongly agree with 3 of 4 survey items (curriculum is: easy to follow, easy to deliver, relevant, and educational)
Key component 2 total score			Sum of sample-level indicator scores (Range = 0–3) Adequate = 3; indicators 1, 2, and 3 cannot be 0

Indicator	Unit of measurement	Indicator scoring at unit level	Indicator scoring at program level
Key component 3. Teacher recruitment and student engagement			
1. District/school staff members recruit or replace teachers *Data source: Program records*	School	0 = Does not recruits or replace appropriate number of teachers 1 = Recruits or replaces appropriate number of teachers or no teachers need to be recruited/ replaced	0 = Less than 90% of schools recruit appropriate number of teachers or no teachers need to be recruited/ replaced 1 = At least 90% of schools recruit appropriate number of teachers or no teachers need to be recruited/ replaced
2. School staff members encourage students to enroll in ICT (current school year) *Data source: Program and state records*	School	0 = School does not enroll at least 21% of grade 9 enrollment 1 = School enrolls at least 21% of grade 9 enrollment	0 = Less than 90% of schools enroll at least 21% of grade 9 enrollment 1 = At least 90% of schools enroll at least 21% of grade 9 enrollment
Key component 3 total score			Sum of sample-level indicator scores (Range = 0–2) Adequate = 2
Key component 4. ICT train-the-trainer training			
1. LSU offers train-the-trainer training *Data source: recruitment materials*	Program		0 = Does not offer training 1 = Offers training, or no teachers want to be instructors
2. Instructor attends train-the-trainer training *Data source: Attendance records*	Instructor	0 = Does not attend 1 = Attends	0 = Less than 90% of instructors who begin the training complete the training 1 = At least 90% of instructors who begin the training complete the training or no teachers want to be instructors
Key component 4 total score			Sum of sample-level indicator scores (Range = 0–2) Adequate = 2

*Technical support addresses login issues and not being able to access online materials.

Table B2. Introduction to Computational Thinking (ICT) summary of implementation fidelity scores (2022–23 results)

Key component	Total number of measurable indicators	Unit of implementation	Sample-level threshold for fidelity of implementation	Number of units in which component was implemented	Number of units in which fidelity component was measured	Achieved fidelity score and whether program met sample level threshold
ICT teacher training	13	7 program level indicators 6 teacher-level indicators	Sample-level component score of at least 11 out of 13	1 program 40 schools 42 teachers	1 program 40 schools 42 teachers	Score is 8 Program fidelity = low
ICT curriculum materials	3	2 program level indicators 1 teacher-level indicator	Sample-level component score of at least 3 out of 3	1 program 40 schools 42 teachers	1 program 18 schools 20 teachers	Score is 3 Program fidelity = adequate
Teacher recruitment and student enrollment	2	2 school-level indicators	Sample-level component score of at least 2 out of 2	1 program 40 schools 42 teachers	1 program 40 schools 42 teachers	Score is 0 Program fidelity = low
Train-the trainer training	2	1 program level indicator 1 teacher level indicator	Sample-level component score of at least 2 out of 2	1 program 40 schools 42 teachers	1 program 40 schools 42 teachers	Score is 2 Program fidelity = adequate