Computer Science, K-12

> As technology continues to evolve at an accelerated pace, transforming the way we live and work in the process, we find ourselves navigating the challenges of an always-changing digital landscape. Understanding the principles of computing is quickly becoming an essential skill. It provides people with a keen understanding of how technology impacts their lives, empowers them to become full participants in society, and unlocks a wide range of career opportunities. This is especially true for today's students, who will rely on computing skills throughout their lives, making it necessary for them to have opportunities to learn Computer Science. (Microsoft Education Team, 2023)

Nevada recognizes that it is critical to provide equitable access to computer science instruction for all K-12 students. Since expanding computer science education to students in 2017 through groundbreaking legislation (Nevada Revised Statutes 391A.125, 2019), Nevada has continued to make strides to ensure students have access to learning about computer science through statewide initiatives. Nevada's continued commitment to ensuring access to learning about computer science is evident in the Nevada Department of Education's Addendum to the State Plan for the Improvement of Pupils (2021) goal to increase access to STEM learning and the earmarking of Elementary and Secondary School Emergency Relief (ESSER) funds to support STEM learning. The Nevada Department of Education's (2020) vision for Nevadans is that all are ready for success in a global 21st century. Realizing this vision will require educators with the knowledge and skills to teach computer science concepts. The Northeastern Nevada Regional Professional Development Program (NNRPDP) is leading the charge, equipping Nevada's educators with the knowledge and pedagogical skills to teach the Nevada Academic Content Standards for Computer Science (NVACS-CS) by providing ongoing local, regional, and statewide professional learning opportunities.

Initial Data and Planning

Fifty U.S. states and territories, including Nevada, reported teacher and school personnel shortages. Teacher preparation programs in Nevada did not graduate a single new teacher prepared to teach computer science in 2018 (Hays et al., 2018.). A large majority of elementary school teachers do not possess the computer science content or pedagogical understandings, resulting in an urgent need to provide educators with professional learning opportunities necessary to effectively address the Nevada Academic Content Standards-Computer Science (NVACS-CS). Data collected in the 2019 - 2020 school year indicated 76% of the K-5 rural educators surveyed in six counties in Nevada were not even moderately aware of the NVACS-CS and 86% were not very confident in teaching the NVACS-CS (C. Thomson, personal communication, 2020).

The NNRPDP has one professional learning leader on staff who possesses the capacity to support educators throughout the region with their learning and teaching of computer science concepts. The NNRPDP Computer Science Specialist (CSS) has a Master of Science in Mathematics Education and is a National Board-Certified Teacher in Adolescent Mathematics.

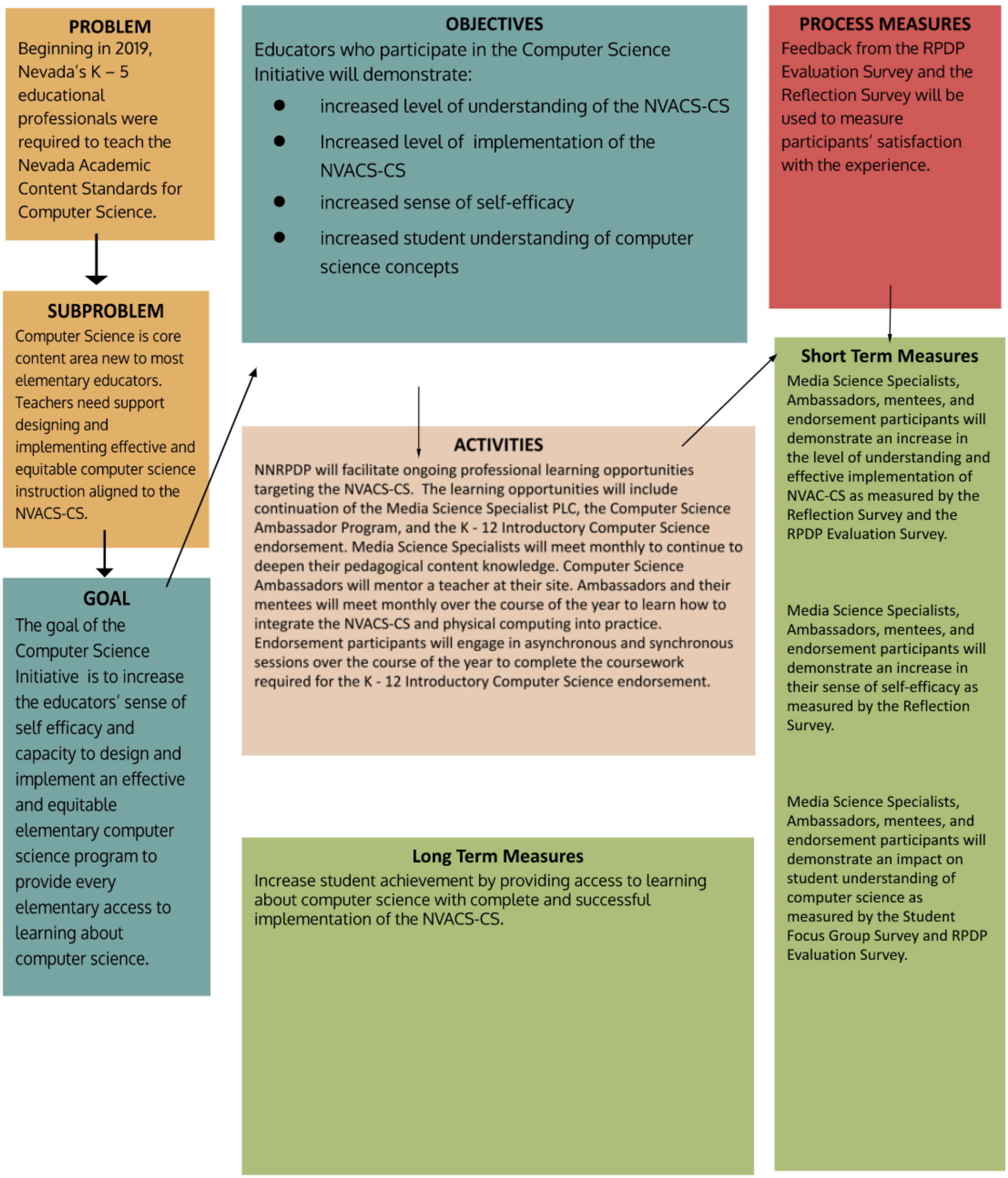
The CSS also obtained Nevada's K-12 Introductory Computer Science licensure endorsement and serves as a facilitator for Code.org as part of the Regional Professional Development Program's (RPDP) partnership with Code.org. The CSS has participated in work with the NVACS-CS at the local and state level, and served on the Nevada Department of Education's Computer Science Curriculum Review Committee. In addition to leading four years of the Computer Science Ambassador Program, the CSS offered an endorsement program for K-12 Introductory Computer Science in partnership with the Northwestern Regional Professional Development Program and the Southern Nevada Regional Professional Development Program. The CSS also developed and facilitated professional learning to support a rural district's Media Science Specialist Professional Learning Community in 2021-2022 and 2022-2023.

To ensure all K-12 students have access to learning about NVACS-CS, the objectives for the Computer Science Initiative (CSI) are outlined in the following Logic Model (Figure 1):

Figure 1.

Computer Science Initiative Logic Model

Computer Science Initiative - Logic Model



Method

Learning Design

The NNRPDP is called upon by members in the region and the state as an intervention measure to impact desired outcomes. The effectiveness of the NNRPDP is evidenced in annual reports to stakeholders and outlined in research-based professional learning plans. The learning design of the CSI was informed by Nevada's Standards for Professional Development (2018), Guskey's Five Levels of Professional Development (2002), the Seven Elements of Effective Professional Development (Darling-Hammond et al., 2017), the U.S. Department of Education's guidance document Non-Regulatory 2 Guidance: Using Evidence to Strengthen Education Investments (2016), the research of John Murray (2014), as well as other effective teacher professional development research. The content and foci of the CSI was informed by the NVACS-CS, K–12 Computer Science Framework, Computer Science Teachers Association (CSTA), International Society for Technology in Education (ISTE), Code.org, Association for Computing Machinery (ACM) and ACM's leading researchers in computing education research. To ensure students have access to effective computer science instruction and to support educators implementing the NVACS-CS, the objectives for the CSI were also informed by the Computer Science Teachers Association Standards for Computer Science Teachers. The CSTA established the standards to provide clear guidance around effective and equitable computer science instruction in support of rigorous computer science education for all K-12 students (2020).

The CSS constructed a Professional Learning Plan (Appendix A) that provides an overview of the design of the CSI. The Professional Learning Plan also delineates how the CSI's learning design aligns with Nevada's Standards for Professional Development (2018) and Learning Forward's Standards for Professional Learning (2011).

In addition to these professional learning standards, the learning design of the CSI also incorporated the seven elements of effective professional development identified in a meta-analysis of 35 studies (Darling-Hammond et al., 2017).

Table 1.

Incorporation of the Seven Elements of Effective Professional Development in the NNRPDP Computer Science Initiative

Professional Development Element	Computer Science Initiative: Element Alignment Evidence
Content Focus	The Computer Science Initiative's intentional focus on discipline-specific curriculum development and pedagogies is reflected through: • Alignment with the NVACS-CS • Implementation of NVAC-CS • Integration of NVACS-CS into other core content instruction

Professional Development Element	Computer Science Initiative: Element Alignment Evidence
Active Learning	The opportunity for participants' engagement in active learning in the Computer Science Initiative is reflected through: • Lessons modeled by NNRPDP Computer Science Specialist • Lessons modeled by participants • Learning Walks • Implementation of physical computing resources • Metacognitive routines
Collaboration	The creation of space for sharing ideas and collaboration in the Computer Science Initiative is reflected through: • Content learning • Lesson analysis • Learning Walks • Curriculum analysis • Resource review and analysis
Models of Effective Practice	The modeling of effective practice in the Computer Science Initiative is reflected through: • Lesson review and analysis • Learning Walks • Curriculum analysis • Resource review and analysis • Application-to-Practice reflection
Coaching and Expert Support	The sharing of expertise and best practices targeting individual needs in the Computer Science Initiative is reflected through: • Individual supports offered outside of the monthly sessions via classroom visits, emails, and/or one-to-one meetings
Feedback and Reflection	The facilitation of reflection and elicitation of feedback in the Computer Science Initiative is reflected in: • Model lesson analysis • Content focus debrief • Curriculum analysis • Resource analysis • Learning Walks • Metacognitive routines
Sustained Duration	Adequate time to learn, practice, implement, and reflect is evidenced in the Computer Science Initiative is reflected through the ongoing and sustained nature of the professional learning:

Professional Development Element	Computer Science Initiative: Element Alignment Evidence
	● Media Science Specialist PLC: Ongoing over the 2021-2022 school year and continuation in the 2022-2023 school year ● Computer Science Ambassador Program: Ongoing over 2019 - 2020; 2020-2021; 2021-2022; and 2022-2023 school years ● K-12 Introductory Computer Science endorsement: Ongoing sessions for each course required over the course of the 2021-2022 school year and the 2022-2023 school year

As noted by John Murray (2014), "effective teacher professional learning [includes] an emphasis on pedagogical content knowledge, a focus on student learning, implementation over time, alignment with school goals, a connection to teacher needs, and ongoing teacher collaboration" (p. 13). The CSI design addresses these key components of effective professional learning:

- The learning design is focused on increasing participants' understanding of the NVACS-CS. Thus, the focus is on content knowledge.
- The learning design includes an element for classroom application, which highlights the focus on student learning.
- The duration of CSI is ongoing as indicated in Table 2.
- The CSI is aligned with the NRS (NRS 389.520, 2017 and NRS 391A.370S, 2019), and, thereby, school goals.
- The CSI is based on regional, state, and national data that demonstrates educators' need to increase their understandings about computer science.
- The structure of the CSI provides opportunities for teacher collaboration when synthesizing understandings, planning implementation, analyzing and sharing resources, and debriefing implementation successes and challenges.

Participants and Procedure

To achieve the overarching goal of impacting student achievement, each component of the CSI (i.e., Media Science Specialist PLC, Computer Science Ambassador Program, and the K-12 Introductory Computer Science endorsement) was designed to continue to deepen understanding and support implementation of the NVACS-CS.

Twelve out of the 13 Media Science Specialists from ECSD participated in Year 2 of the Media Science Specialist Professional Learning Community (PLC). The Media Science Specialist PLC met each month with the exception of December 2022 and April 2023. The structure of the monthly, full-day, onsite sessions included whole group instruction on computer science concepts, continued analyses of the piloted curriculum's alignment to the NVACS-CS, curating supplemental resources, constructing common assessments, and exploration of physical computing devices, and notions (e.g., discussing logistical and management challenges and solutions, determining structural consistency). Learning walks were also incorporated into the monthly sessions. The learning walks consisted of an informal visit to the hosting Media Science Specialist's classroom where fellow Media Science Specialists observed the host and offered detailed feedback on the area of focus determined by the host.

Thirty-five educators from across the region participated in Year 4 of the Computer Science Ambassador Program. There were 22 participants from the Elko County School District, two participants from Lander County School District, four participants from Eureka County School District, five participants from Humboldt County School District, and three participants from charter schools. To extend the impact of the program, Year 4 of the Computer Science Ambassador Program included participants from previous years along with participants new to the program. Returning ambassadors selected a colleague from their respective school sites to participate in Year 4 and offered mentorship to the new participants. The Computer Science Ambassador program included monthly virtual sessions and monthly asynchronous sessions from October 2022 through March 2023. During the synchronous sessions, participants explored physical computing devices, planned instruction, shared analyses of resources, and debriefed successes and challenges related to implementation. The CSS partnered with a non-profit (Desert Research Institute) who provided participants with the physical computing devices and training on how to use the devices during the virtual sessions. During asynchronous sessions, participants explored resources provided by the CSS to strengthen concept understanding and to support integration of CS into other core content areas.

Thirty-three educators participated in the K-12 Introductory Computer Science endorsement. There were 24 participants from Clark County School District, four participants from Elko County School District, two participants from Washoe County School District, and one participant from Carson City. The K-12 Introductory Computer Science endorsement participants completed three, 3-credit, graduate level courses over the course of the 2022-2023 school year: *Concepts in Computer Science*, *Methods for Teaching Computer Science*, and *Methods for Teaching Computer Applications*. Each of the three courses included virtual synchronous and asynchronous sessions conducted over the course of a seven-week time frame. The content of the courses was approved as meeting the requirements for licensure by the Nevada Department of Education.

Measurement and Methodology

The purpose of the CSI to increase student achievement by providing access to learning about computer science with complete and successful implementation of the NVACS-CS as outlined in legislation. The long-term outcome and overall measure of the CSI is to increase student learning and growth as measured by aggregate assessment scores from participating educators and those same scores analyzed against a comparison group. Due to system structure barriers, this has not been completed to date, and will continue as a future goal for the CSI.

The goal of the CSI to increase educators' sense of efficacy in teaching computer science by building the capacity of educators to design and implement an effective and equitable CS program that provides access to learning about computer science as outlined in legislation. The short-term outcomes and measures of this goal within the CSI are as follows:

1. Participants will demonstrate an increase in the level of understanding of NVACS-CS and instructional design as measured by the Exit Survey (Appendix ?) and NNRPDP Evaluation (Appendix ?).
2. Participants will demonstrate an increase in the level of effective implementation of the NVACS-CS, as measured by the Exit Survey and NNRPDP Evaluation.
3. Participants will demonstrate an increase in their sense of self-efficacy as measured by the Exit Survey.
4. Participants will demonstrate an impact on student understanding of computer science concepts as measured by the Student Impact Survey (Appendix ?) and NNRPDP Evaluation.

Qualitative and quantitative measurements were used to assess the following variables:

- Level of understanding
- Level of instructional proficiency
- Level of self-efficacy
- Student learning

The variables informed the evaluation plan based on Guskey's Five Levels of Professional Development (2002):

Table 3.

NNRPDP Computer Science Initiative Evaluation Plan

Evaluation Level	What Questions Are Addressed?	How Will Information Be Gathered?	What Is Measured or Assessed?	How Will Information Be Used?
1. Participants' Reactions	Training expectations, presenter skills, increased knowledge, motivation to improve	*NNRPDP Evaluation* *Exit Survey*	Initial satisfaction with the experience	To improve program design and delivery
2. Participants' Learning	Did participants acquire the intended knowledge and skills?	*NNRPDP Evaluation* *Exit Survey*	*Participants' increased understanding of NVACS-CS*	To improve program content, format, and organization

Evaluation Level	What Questions Are Addressed?	How Will Information Be Gathered?	What Is Measured or Assessed?	How Will Information Be Used?
3. Organization Support & Change	Was implementation advocated, facilitated, and supported? Was the support public and overt? Were problems addressed quickly and efficiently? Were sufficient resources made available? Were successes recognized and shared? What was the impact on the organization? Did it affect the organization's climate and procedures?	*Exit Survey*	The organization's advocacy, support, accommodation, facilitation, and recognition	To document and improve organization support To inform future change efforts
4. Participants' Use of New Knowledge and Skills	Did participants effectively apply the new knowledge and skills?	*NNRPDP Evaluation* *Exit Survey*	*Participants' ability to implement NVACS-CS*	To document and improve the implementation of program content
5. Student Learning Outcomes	What was the impact on students? Did it affect student performance or achievement?	*NNRPDP Evaluation* *Student Impact Survey*	Student growth and achievement	To document impact and subsequent student growth and achievement

Note: Italicized text is specific to this intervention.

Results

Process Measures

Implementation

Ninety-eight percent of the participants consistently attended their respective sessions and completed asynchronous assignments when included in the component's structure (n = 103).

Perspectives

The NNRPDP Evaluation item -- *The training matched my needs* -- received a mean rating of 4.7 on a scale of 1-5, where a rating of one indicated not at all and rating of a five indicated to a great extent (n = 103). The NNRPDP Evaluation item -- *The presenter's experience and expertise enhanced the quality of the training* -- received a mean rating of 4.7 on a scale of 1-5, where a rating of one indicated not at all and rating of a five indicated to a great extent (n = 103). The following participant reflections from the NNRPDP Evaluation further indicate the positive nature of the professional learning:

> *This PLC learning experience time has been invaluable! It gives me hope for our profession and all the possibilities for our students.*
>
> *This course built [sic] year after year. I have enjoyed the growth and well-rounded education and practice we have been able to learn and do has given me so many skills and tools that I can continue to use year after year!*
>
> *This was one of the BEST trainings and opportunities I've participated in! It transformed how I am as a teacher because no matter what content area I will teach moving forward, I will be including technology and computer science with student-based inquiry. Last year (2021-22) was basically traumatic on all fronts, but for the first time in about 5 years, I LOVE my job. Everything that I feel confident or excel at has been in some way influenced by taking this coursework with RPDP.*

Level of Understanding

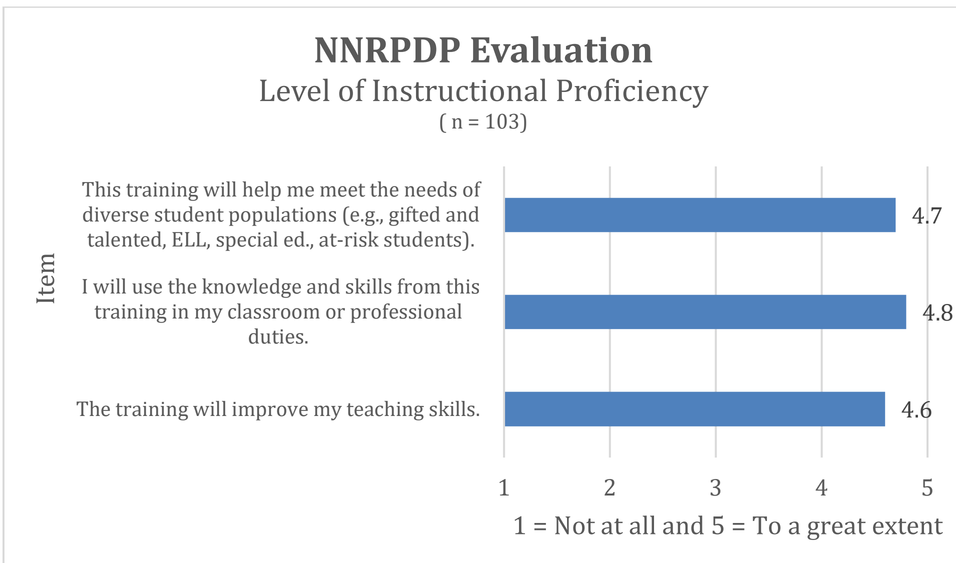
The measures used to assess levels of understanding were included the NNRPDP Evaluation and the Exit Survey. The NNRPDPD Evaluation item -- *This training added to my knowledge of standards and/or my skills in teaching subject matter content* -- received a mean rating of 4.7 on a scale of 1-5, where a rating of one indicated not at all and rating of a five indicated to a great extent (n = 103). Participants completed the Exit Survey after the CSI component in which they participated had concluded. When comparing their level of understanding and knowledge of skills prior to engaging the CSI component to their level of understanding and knowledge of skills at the conclusion of the component, the increase in their understanding of the NVACS-CS received a mean rating of 5.0 on a scale of 1 - 6, where a one rating indicated the level of understanding was similar to the start and a rating of a six indicated the level of understanding had grown significantly (n = 49).

Level of Instructional Proficiency

The measures used to assess levels of understanding included the NNRPDP Evaluation and the Exit Survey.

Figure 1.

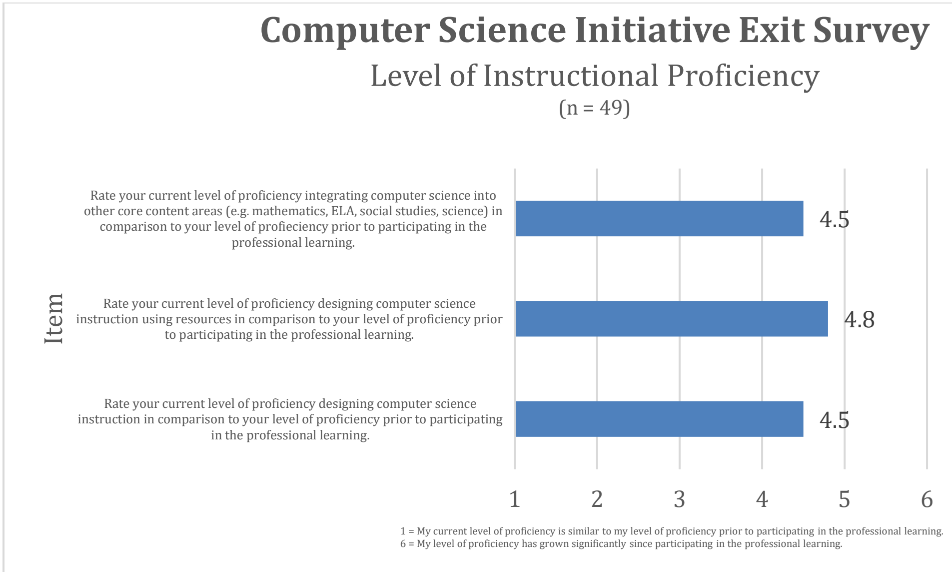
NNRPDP Evaluation (Level of Instructional Proficiency)



The mean ratings of the items related to instructional proficiency on the NNRPDP Evaluation indicate the participants' instructional proficiency was impacted to a great extent as a result of participating in the CSI.

Figure 2.

Exit Survey (Level of Instructional Proficiency)



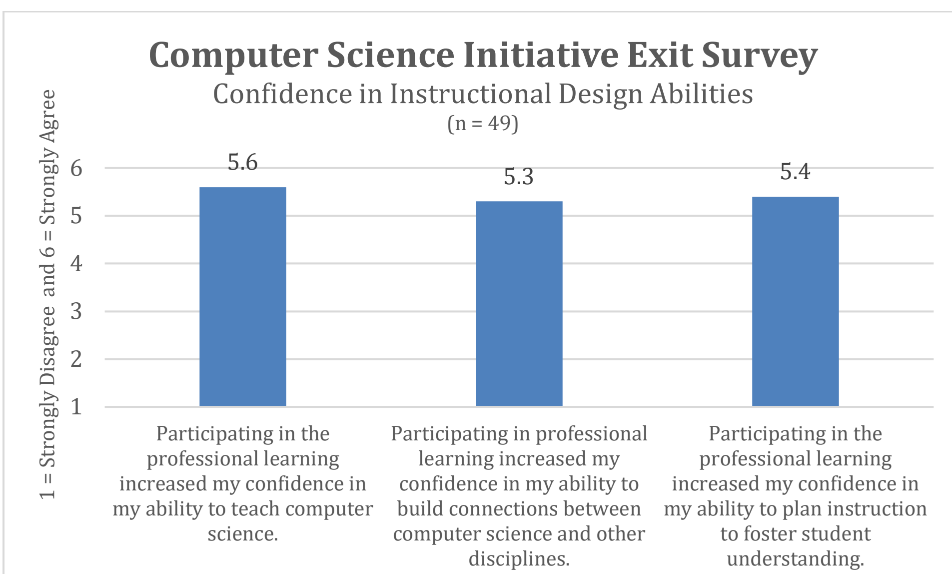
Responses on the Exit Survey indicate participants' level of proficiency teaching the NVACS-CS grew moderately as a result of participating in the CSI.

Level of Self-efficacy

Self-assessments of participants' confidence in their ability to design instruction and perception of organizational support were measured in the Exit Survey to assess participants' sense of self-efficacy.

Figure 3.

Exit Survey (Confidence in Instructional Design Abilities)



Ratings on the Exit Survey indicate a strong impact on participants' confidence in their ability to design computer science instruction. A textual analysis of participants' comments on the Exit Survey reflected increases in confidence in their level of ability.

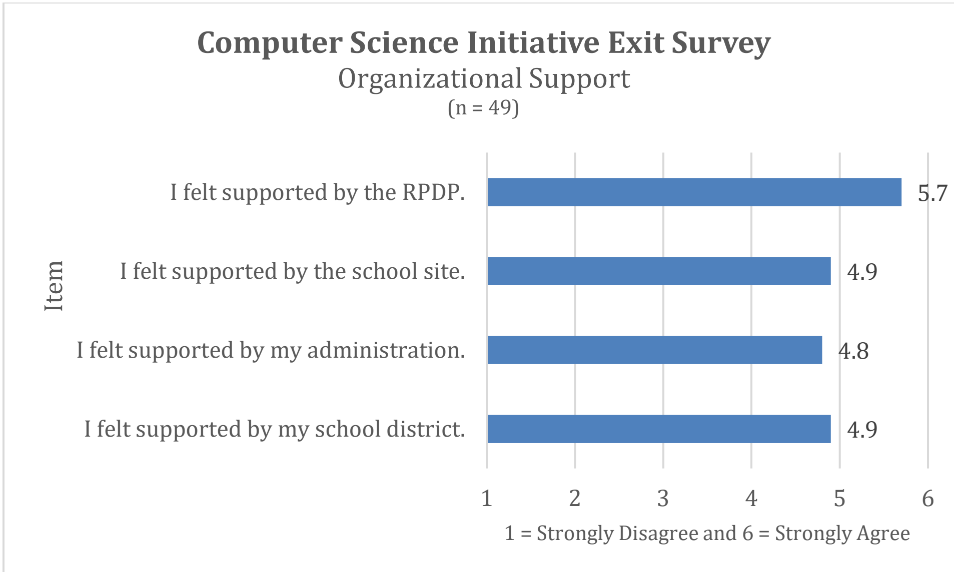
Table 4.

Representative Excerpts from Exit Survey

Component	Computer Science Initiative: Participants' Increased Self-Efficacy
Media Science Specialist	*This year I have developed even stronger bonds with my PLC and learn something new every time we are together. My colleagues and leader pushed me outside of my comfort zone to try new things, reconsider why and how I engage my students in CS learning, and challenge me to learn more about the field, best practices, and how best to engage my students in deepest level learning.*
Computer Science Ambassador	*I've learned so much and grown to see the importance of implementing CS into everyday [sic]. With that knowledge, my confidence has grown to be able to just let the kids try. They learn by making mistakes and with computer science, that is what matters. They need to "debug" something to make it work correctly. It also helps build my confidence in implementing activities into every subject. I feel so much more ready to do that.*
K-12 Introductory Computer Science endorsements	*Participating in the Computer Science endorsement courses has significantly boosted my confidence to teach computer science, build interdisciplinary connections, and plan effective instruction. These courses have provided me with a strong foundation of fundamental concepts and principles of computer science, taught me how to integrate computer science with other subjects, and equipped me with techniques to engage students in hands-on activities, promote critical thinking, and problem-solving skills. Overall, the endorsement courses have been a valuable experience that has helped me grow both professionally and personally.*

Figure 4.

Exit Survey (Organizational Support)



In general, participants felt supported by organizational entities. A review of participants' comments on the Exit Survey identified continuing opportunities for professional learning, increasing awareness of the importance of teaching the NVACS-CS, creating opportunities for collaboration, and prioritizing the NVAC-CS as the types of organizational support that would be helpful to participants as they continue on with their journey as computer science educators.

Table 5.

Representative Excerpts from Exit Surveys

Organization	Type of Support	Computer Science Initiative Participant Comments
RPDP	Continuing opportunities for professional learning	*Please have another session next year. I am just beginning, and I am so excited to continue this journey.*
School Site	Understanding the importance of teaching the NVACS-CS	*I feel that more teachers need awareness and understanding ….and how important these standards are to teaching!*
Administration	Creating opportunities for collaboration	*I would like to be able to visit other schools and teachers that are having success (or not!) and have time to see what they are doing and discuss with them steps that are needed to get their level of success (or avoid their same mistakes!).*

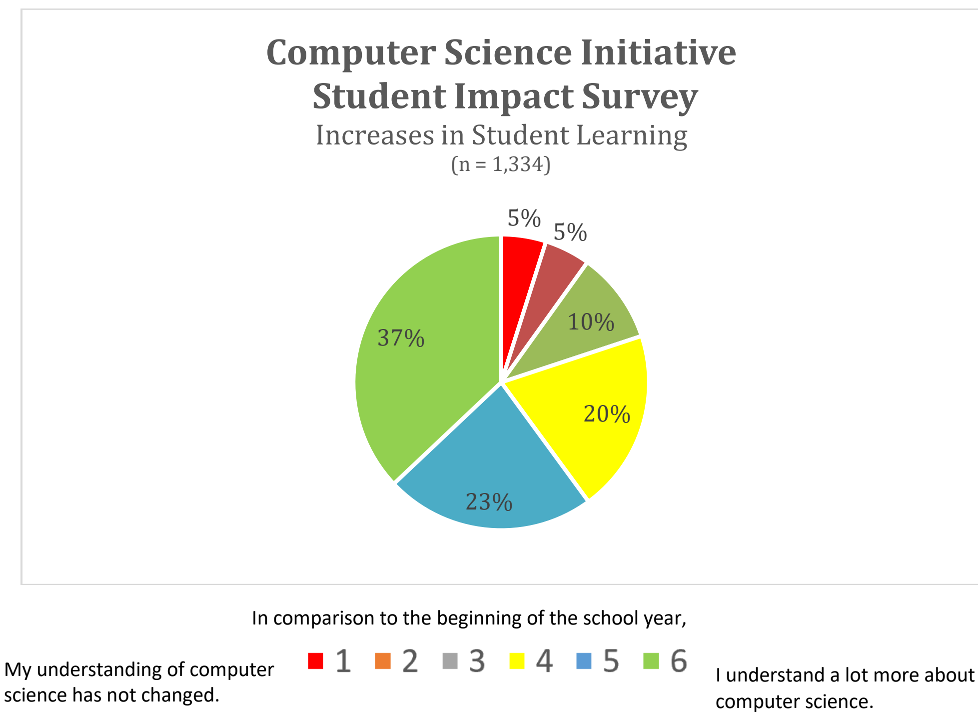
Organization	Type of Support	Computer Science Initiative Participant Comments
District	Prioritizing NVACS-CS	*More validation from the District to the site administrators on the importance of teaching this core subject.*

Student Learning

Two measures were used to assess student learning: (a) the NNRPDP Evaluation and (b) the Student Impact Survey. On the NNRPDP Evaluation, the participants' mean rating of the item -- *My learning today will affect students' learning* -- was 4.6 on a scale where one indicates not at all and a five indicates to a great extent (n = 39).

Figure 6.

Student Impact Survey (Increases in Student Learning)



Participants administered the Student Impact Survey to their students. Out of the 1,334 students surveyed, 1,070 students indicated, on a linear scale of 1-6, that their level of understanding about computer science had increased to a degree of four or higher. Seven percent of students' comments to the item -- *Describe something that you now know about computer science that you did not know at the beginning of school year* -- were nonsensical, such as random letters, or unrelated to computer science, such as *I love my teacher* and *I learned how to make Google slides* (n = 1,334). Ninety-three percent of the comments described something that students had learned about computer science with varying levels of detail about their learning. The majority of the comments made reference to learning about algorithms and programming concepts. The Student Impact Survey also included the question -- *What else would you like to learn about computer science?* Again, the majority of the responses referenced learning about concepts related to algorithms and programming. Table 6 captures concepts students identified that they would like to learn outside of the typical response of *coding.*

Table 6.

Representative Excerpts from the Student Impact Survey

Describe something that you now know about computer science that you did not know at the beginning of the school year.	***What would you like to learn about computer science?***
We learned about nested loops and a Function how to stay safe on the internet Private VS Personal. We also learned about the history of who inveted [sic] *computers Charles Babbage.*	*I want to learn about viruses on computers and how to handle it.*
Using a reapeat [sic] *block inside a reapeat* [sic] *block.*	*I want to learn to do hacking for good not for bad*
I did not know about Ida love lace and the history of computers.	*how to be safe on the computers*
Nested loops debugging functions V.R headsets	*I would like to know if AI can do your chores?*
I know know [sic] *that coding comes with plenty of challenges that you overcome with practice there will always be difficulties when coding and its okay to ask for help, its* [sic] *okay to allow others to help find your bugs…*	*What's inside a computer*

Discussion

Evaluating the effectiveness of the CSI based on the variables of Guskey's (2002) five critical levels suggests the CSI provided effective professional development that resulted in an increase in levels of understanding, instructional proficiency, self-efficacy, and student learning.

Meeting on an ongoing basis provided the participants with time to learn, practice, implement, and reflect, which are key elements of effective professional learning (Hammond, et.al, 2017).

Level of Understanding

Results on the questions aligned to the levels of understanding on the NNRPDP Evaluation and Exit Survey indicate the CSI contributed to the participants' increased levels of understanding. The structure of the CSI provided opportunities for the participants to deepen their pedagogical content knowledge. Given the overall increase in understandings, the CSI was successful in achieving the attainment of its specific learning goal to impact participants' learning, which is Guskey's (2002) second level of evaluation of professional development effectiveness.

Level of Instructional Proficiency

The design of the CSI was structured to provide participants with opportunities to apply the acquired knowledge and skills. Each component of the CSI included elements of job-embedded professional development. The Media Science Specialists translated their learning to practice through instructional design for the program, the curation and analysis of supplemental resources, development of assessments, and learning walks. The Computer Science Ambassador Program participants translated their learning to practice through the analysis of supplemental resources, integration of computer science into other core content, and the incorporation of physical computing into their practice. The K-12 Introductory Computer Science endorsement participants elevated their understandings and capacity to teach computer science through developing and analyzing their practice using the lens of the Standard for CS Teachers. The Council of the Great City Schools (2021) notes that "discipline-specific, content focused professional development supports teaching and learning within the classroom context … as opposed to generic professional development delivered externally or divorced from teachers' school or district contexts" (p. 8). Thus, the CSI addressed Guskey's (2002) fourth level of evaluation of professional development effectiveness: participants' use of new knowledge and skills.

Level of Self-efficacy

"Teachers' self-efficacy … plays a key role in influencing important academic outcomes, e.g., students' achievement and motivation" (Barni et al., 2019, np). Results from the Exit Survey indicate participants' sense of self-efficacy increased as a result of participating in the CSI. The CSI increased participants' confidence in their ability to teach computer science, to build connections between computer science and other disciplines, and to plan effective computer science instruction. Another factor that contributes to a greater sense of self-efficacy is organizational support (Skaalvik, E.M., & Skaalvik, S., 2018). The results also indicate participants generally felt supported by the district, the school, and the administration. Due to the ongoing nature of each component of the CS, which included frequent interaction with the

CSS, participants indicated the strongest sense of support was provided by the NNRPDP. Thus, the CSI also addressed the third level of Guskey's (2002) evaluation: organizational support.

Student Learning

Results from the Student Impact Survey indicate the student understanding of computer science increased from the beginning of the year. Eighty percent of the students identified growth in understanding within the 4-6 range on the Likert scale of 1 (low growth) to 6 (a lot of growth). The majority of the students' responses described learning related to coding. While the data indicate impact, it is not substantive enough to draw the conclusion that the CSI met the fifth level of Guskey's (2002) evaluation: student learning outcomes.

Many typical forms of assessments, such as classroom assessments, present validity challenges, and the "best way to counter these threats to the validity of results is to include a comparison group — another similar group of educators or schools not involved in the current activity or perhaps engaged in a different activity" (Guskey, 2016, p. 36). Identifying a comparison group was not an option given there were too many other variables impacting outcomes, such as the inconsistency in the amount of instructional time devoted to teaching NVACS-CS. Further explorations will be necessary to identify measurement tools that will provide reliable and valid data regarding increases in student learning specific to the NVACS-CS five core concepts and seven practices.

Conclusion

Computer science is a core content area at the K-5 level, yet, many educators do not feel equipped to teach the standards. In order to ensure all of Nevada's students have access to learning about computer science as outlined in legislation, educators need to be provided with ongoing professional development. Ongoing professional learning promotes sustained changes making it more effective than other structures of professional learning, such as conferences or one day workshops (Wang, M., & Odell, S.J., 2019). Indeed, the key element inherent to all three components comprising the CSI is the ongoing structure. Participants' sense of self-efficacy increased as they made great strides in building their levels of understanding and instructional proficiency with the NVACS-CS over the course of the Computer Science Initiative, i.e., the last two years of the Media Science Specialist PLC and the K-12 Introductory Computer Science endorsement and over the last four years of the Ambassador program, and the year of the Ambassador program with Mentees.

While great strides have been made, there is more to be done. Computer science encompasses more than coding. Algorithms and programming are certainly central to computer science, but computing systems, networks and the internet, data and analysis, and the impacts of computing are becoming even more critical as we embark on navigating the world of artificial intelligence. Continued investment in the components of the CSI is warranted to ensure educators are equipped to teach all facets of computer science. By continuing to provide high-quality, ongoing, professional learning, the CSI will continue to empower educators to impact students’ understanding of the NVACS-CS and equip students with essential problem-solving, critical thinking and complex analytical skills.

References

Barni, d., Danioni, F., & and Benevene, P. (2019). Teachers 'self-efficacy: The role of personal values and motivations for teaching. *Frontiers in Psychology*, *10*(1645). https://doi.org/10.3389/fpsyg.2019.01645

Carey, B. (2015). *How we learn: The surprising truth about when, where and why it happens*. Random House.

Code.org. (2023). *Support K-12 education in Nevada*. https://code.org/advocacy/state-facts/NV

Council of the Great City Schools. (2021). *Advancing instruction and leadership in the nation's great city schools: A framework for developing, implementing, and sustaining high-quality professional development.* https://www.cgcs.org/cms/lib/DC00001581/Centricity/domain/35/publication%20docs/CGCS_PDFrameworkFINAL.pdf

Computer Science Teachers Association. (2020). *CSTA standards for computer science teachers*. https://csteachers.org/teacherstandards

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.

ESSA Advisory Group. (2019, February 26). *ESSA presentation*. http://www.doe.nv.gov/Boards_Commissions_Councils/ESSA_Adv_Group/ESSA_Advisory_Group/

Fisher, D. & Frey, N. (2014). Using teacher learning walks to improve instruction. http://www.scsk12.org/memo/files/files/learning%20walk2.pdf

Gallop and Google. (2015). *Images of computer science: Perceptions among students, parents and educators in the U.S.* Washington, D.C.: The Gallup Organization.

Guskey, T. R. (2002). Does it make a difference? Evaluating professional development. *Educational Leadership, 89*, 45-51.

Guskey, T.R. (2016). Gauge impact with 5 levels of data. *Learning Forward, 37*, 32 – 37.

Hayes, Mizel. (2010). *Why professional development matters*. Learning Forward.

Hays, D. G., Borek, M., Metcalf, K. K. (2018). *The Nevada teacher workforce report.* The Nevada Consortium on the Teacher Pipeline. https://digitalscholarship.unlv.edu/co_educ_fac_articles/25

Knowles, M.S. (1984). *The modern practice of adult education: From pedagogy to androgyny*. Wilton, CT: Association Press.

Learning Forward. (2011). *Standards for professional learning*. Learning Forward.

Mahler, D., Großschedl, J., & Harms, U. (2017). Opportunities to learn for teachers' self-efficacy and enthusiasm. *Education Research International*, 2017. https://doi.org/10.1155/2017/4698371

Microsoft Education Team. (2023). Why students need Computer Science to succeed. *Microsoft.* https://educationblog.microsoft.com/en-us/2023/03/why-students-need-computer-science-to-succeed

Murray, John. (2014). Designing and implementing effective professional learning. Corwin.

National Center for Women Information Technology. (n.d). *Moving beyond.* NCWIT. https://www.ncwit.org/resources/moving-beyond-computer-literacy-why-schools-should-teach-computer-science-0

Nevada Department of Education. (March 11, 2021). *Addendum to the state plan for the improvement of pupils.* https://doe.nv.gov/uploadedFiles/ndedoenvgov/content/STIP/2021STIPAddendum.pdf

Nevada Department of Education. (n.d.). *K – 12 computer science*. https://doe.nv.gov/Nevada_Academic_Standards/Computer_Science/

Nevada Department of Education. (2019). *Nevada academic content standards for computer science and integrated technology.* https://doe.nv.gov/uploadedFiles/nde.doe.nv.gov/content/Nevada_Academic_Standards/Comp_Tech_Standards/NevadaAcademicContentStandards_forrev.pdf

Nevada Department of Education. (2018, February 1). *Nevada's standards for professional development*. http://www.doe.nv.gov/uploadedFiles/ndedoenvgov/content/Educator_Licensure/NVStandardsforPD.pdf

Nevada Department of Education. (2017, March 21). *The new Nevada plan under the Every Student Succeeds (ESSA) plan.* http://www.doe.nv.gov/uploadedFiles/ndedoenvgov/content/Boards_Commissions_Councils/ESSA_Adv_Group/2017/Thenewnevadaplan.pdfinked

Nevada Revised Statutes. (2017). *NRS 389.520*. https://www.leg.state.nv.us/nrs/NRS-389.html#NRS389Sec520

Nevada Revised Statutes. (2019). *NRS 391A.370*. https://www.leg.state.nv.us/NRS/NRS-391A.html#NRS391ASec370

Rockow, S., Kowalski, C., Chen, K., & Smothers, A. (2016). Self-efficacy and perceived organizational support by workers in a youth development setting. *Journal of Youth Development, 11*(1), 1 - 15. https://doi.org/10.5195/jyd.2016.432

Skaalvik, E. M., & Skaalvik, S. (2018). Job demands and job resources as predictors of teacher motivation and well-being. *Social Psychology of Education*, *21*(6), 1251-1275.

Thomson, Connie. (2020). Computer science ambassadors: Year 2. [Unpublished Manuscript]. Northeastern Nevada Regional Professional Development Program.

U.S. Department of Education. (2016). *Non-regulatory guidance: Using evidence to strengthen education investments.* https://www2.ed.gov/policy/elsec/leg/essa/essassaegrantguid10212016.pdf

Wang, M., & Odell, S. J. (2019). The effects of sustained, job-embedded professional development on teacher efficacy and student achievement. *Journal of Educational Psychology*, *111*(8), 1416-1435.

Wing, J.M. (2017). Computational thinking's influence on research and education for all. *Italian Journal of Educational Technology*, *25*(2), 7-14. doi: 10.17471/2499-4324/922

Appendix ?

Computer Science Initiative Exit Survey

Rate your current level of understanding of the Nevada Academic Content Standards for Computer Science in comparison to your level of understanding of the standards prior to participating in the professional learning. *

	1	2	3	4	5	6	
My current level of understanding of the Nevada Academic Content Standards for Computer Science standards is similar to my level of understanding prior to participating in the professional learning.	○	○	○	○	○	○	My current level of understanding of the Nevada Academic Content Standards for Computer Science has grown significantly since participating in the professional learning.

Rate your current level of proficiency teaching the Nevada Academic Content Standards for Computer Science in comparison to your level of proficiency prior to participating in the professional learning. *

	1	2	3	4	5	6	
My current level of proficiency teaching the Nevada Academic Content Standards for Computer Science standards is similar to my level of proficiency prior to participating in the professional learning.	○	○	○	○	○	○	My current level of proficiency teaching the Nevada Academic Content Standards for Computer Science has grown significantly since participating in the professional learning.

Rate your current level of proficiency designing computer science instruction in comparison to your level of proficiency prior to participating in professional learning. *

My current level of proficiency designing computer science instruction is similar to prior to participating in the professional learning.	1	2	3	4	5	6	My current level of proficiency designing computer science instruction has grown significantly since participating in the professional learning.
	○	○	○	○	○	○	

Rate your current level of proficiency integrating the Nevada Academic Content Standards for Computer Science into other core content areas (e.g. mathematics, ELA, social studies, science) in comparison to your level of proficiency prior to participating in the professional learning. *

My current level of proficiency integrating the Nevada Academic Content Standards for Computer Science into other core content areas is similar to my level of proficiency prior to participating in the professional learning.	1	2	3	4	5	6	My current level of proficiency integrating the Nevada Academic Content Standards for Computer Science into other core content areas has grown significantly since participating in the professional learning.
	○	○	○	○	○	○	

Participating in the professional learning increased my confidence in my ability to teach computer science. *

	1	2	3	4	5	6	
Strongly Disagree	○	○	○	○	○	○	Strongly Agree

Participating in the professional learning increased my confidence in my ability to build connections between computer science and other disciplines. *

	1	2	3	4	5	6	
Strongly Disagree	○	○	○	○	○	○	Strongly Agree

Participating in the professional learning increased my confidence in my ability to plan instruction to foster student understanding of computer science. *

	1	2	3	4	5	6	
Strongly Disagree	○	○	○	○	○	○	Strongly Agree

Elaborate on how participating in the professional learning impacted your confidence to teach computer science, to build connections between computer science and other disciplines, and/or to plan instruction to foster student understanding. *

Appendix ?

Computer Science Initiative Student Impact Survey

In comparison to the beginning of the school year, *

	1	2	3	4	5	6	
I don't know anymore about computer science than I did at the beginning of the year.	○	○	○	○	○	○	I know a lot more about computer science than I did at the beginning of the year.

Describe something that you now know about computer science that you did not know at the beginning of the school year. *

What else would you like to learn about computer science? *