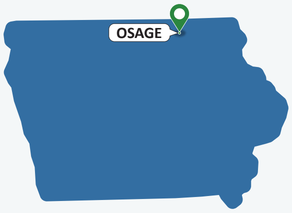
OSAGE COMPUTER SCIENCE

ENSURING IOWA KIDS ARE FUTURE READY



Region 9 Promising Practices is a series of brief publications highlighting successful programs and innovations across Illinois and Iowa, featuring districts working to creatively solve perplexing problems. Through this series, Region 9 seeks to spur ideas and connections among educators and leaders in the region who are looking for real-world examples they can learn from and emulate. **This edition of Promising Practices features Osage, Iowa, Community School Distric**t and the elementary computer science education program the district implemented to answer the following question: **How can we ensure our students have the skills they need to succeed in the workplace of the future?**

Overview

Launched in 2016, the Future Ready Iowa program set out to improve the talent pipeline across the state through education programs aimed at digital age knowledge and skills. Around that same time, educators in Osage, Iowa, sought to offer the students in this rural district new opportunities to take advantage of technology investments in the district and across the state. A small group of educators, supported by Superintendent Barb Schwamman, knew that students would need STEM (Science, Technology, Engineering, and Math) and computer science skills to be prepared for future success and to take advantage of all the opportunities ahead of them. This goal served as the foundation for developing Osage's Computer Science Continuum—a curricular program that integrates computer science with other coursework from math and science and reading and social studies. Students from prekindergarten through Grade 12 in Osage have access to opportunities to develop and use coding skills with new tools and platforms at each grade level, and the district offers stand-alone computer science courses to middle school and high school students.

DISTRICT PROFILE

Osage Community School District is located in northern Iowa and serves about 1,000 students. The student body is predominantly White, with a small percentage (approximately 1%) of English language learners, and 25% of students are eligible for free or reduced-price lunch.

- Osage Community School District
- Osage, Iowa
- 1,000 students
- Rural district in northern Iowa

District Story

Before the district developed its Computer Science Continuum—Osage's prekindergarten through Grade 12 computer science curriculum and professional learning program—Osage had some stand-alone computer science course offerings for high school students but did not have an established pathway. Osage's superintendent saw a need for computer science to become a priority in the district in light of society and the workforce becoming increasingly technology integrated. In 2016, Kelley Molitor, the K–12 librarian and technology integrationist; Thomas Meier, the Osage Technology director; and Chris Kyhl, the lead teacher for high school math and computer science, decided to take this idea and run with it.

SUCCESS AT A GLANCE

The success of Osage's computer science program is built on several factors:

- Supportive district and school leadership
- Teacher buy-in supported by rich professional development opportunities
- Public–private partnerships with local businesses and nonprofit organizations
- Diverse funding streams, including state grants
- A vision for success: Addressing social-emotional learning needs, improving Iowa Statewide Assessment of Student Progress (ISASP) test scores, expanding technology integration, supporting postsecondary and career readiness

Launching the Program With a Small Group of Champions

Determined that there was no time to waste, Molitor, Meier, and Kyhl began applying for funding from the The Iowa Governor's STEM Advisory Council, winning several STEM Scale-Up Awards to help provide tools like robots and platforms. The district has also won two grants from the Iowa Department of Education for computer science professional development. In 2017, the district started working alongside New Bohemian Innovation Collaborative (NewBoCo), a nonprofit organization out of Cedar Rapids, Iowa, that was able to provide more professional development for teachers. Molitor, Meier, and Kyhl were able to get their computer science endorsement for Iowa and started thinking about how computer science could become an integrated pathway at Osage.

Growing the Program Through Professional Development

To ensure that the Computer Science Continuum of Standards was informed by teacher experience, Molitor, Meier, and Kyhl created a computer science workgroup that includes teachers at every grade level who are implementing the integrated model. The workgroup discusses what is happening with integration at each grade level, what teachers in the district need to

PROFESSIONAL DEVELOPMENT JOURNEY

- **2016**
  Osage library staff receive fundamentals training from the Central Rivers Area Education Agency.
- **2017**
  Learning expands for library staff with code.org's CS Discoveries and CS Principles courses.
- **2018**
  Professional development expands to all elementary teachers in the district.
- **2018–19**
  Osage receives an Iowa CS Professional Development (PD) grant and sends staff to several national conferences to learn more.
- **2020–21**
  Osage receives additional Iowa CS PD funding and grows local PD through consultants and the Pathfinder Institute.

be successful, and where the computer science program is headed. Throughout the past six years of developing the computer science program and Continuum of Standards, the workgroup has identified some key components to program success and some roadblocks to moving the program forward. Superintendent Schwamman identifies teacher training as one of the integral pieces to success of the program: "Giving them an environment where they feel safe to try, to take risks, and to make mistakes. I mean, teachers have to be able to say, 'I don't know all the answers; let's figure it out together.'" However, one of the main challenges that computer science at Osage faces is supporting teachers to be successful with this integration model in their subject areas and classrooms. Thomas Meier spoke to the importance of having consultants from NewBoCo and an IT support person like himself accessible to teachers to help them integrate computer science into their existing lesson plans. In Meier's words, Osage's approach has been, "Hey, we're asking you to do this, but we're not asking you to do it alone." The Computer Science Continuum asks teachers to step into a facilitator role that helps students think about how to solve problems that arise. Chris Kyhl explained that computer science classes and projects are very collaborative and student centered, which allows teachers to become facilitators rather than lecturers. Some ways that the computer science workgroup has found success in supporting teachers from all subject areas to clearly understand their roles in the program include showing what students can do through gallery walks, having teachers observe other teachers who are successfully integrating the program, and helping teachers feel supported in implementing the integrated model.

Scaling the Program Through a Continuum of Standards

Although Osage had implemented a mandatory computer science course for freshman students in high school 5 years before the rest of Iowa mandated that computer science be integrated into the curriculum, that course was not situated in a multigrade continuum to connect it to courses and content in earlier grades. Osage sought to address this issue by building from the early grades. As teacher capacity grew in the elementary school, the district built its curriculum from the bottom up, by adding one course at a time at that grade level. The teachers at Osage tailored the topics offered in the computer science programming at each grade level to students' interests. The teachers shaped the computer science curriculum by finding resources that align with what works for the students and what students want to learn. A few examples are new opportunities at the high school level for students to work on video game design, web development, and cyber security; take computer science classes for Advanced Placement credit; and join an eSports team outside of class.

EXAMPLE | Vertical Articulation—Osage Computer Science Continuum of Standards

Level 1A-Early Childhood—Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.

Level 1B-Grades 3–5—Compare and refine multiple algorithms for the same task and determine which is the most appropriate.

Level 2-Grades 6–8—Use flowcharts and/or pseudocode to address complex problems as algorithms.

Level 3A-Grades 9–10—Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.

Level 3B-Grades 11–12—Implement an artificial intelligence algorithm to play a game against a human opponent or solve a problem.

To ensure that the Computer Science Continuum continues to grow, Osage onboards teachers who are new to the district and new to integrating computer science into their classrooms. Onboarding new teachers consists of a 1-day workshop followed by support from NewBoCo throughout the school year to help teachers with lesson planning. The computer science workgroup wants to ensure teachers do not feel alone in the integration process, so the workgroup is taking time, before the school year starts, to let new teachers know about the supports that are available to them.

Evidence Snapshot

Computer Science Education and Computational Thinking

Central to Osage's computer science program development is developing students abilities' in computational thinking—a foundational skill that can be embedded in explicit computer science instruction and cross-curricular teaching and learning. Computational thinking is the process of understanding a problem and offering a solution through which a computer can carry out the solution.[1] This does not necessarily mean that a computer or coding is involved, and it is not about how to use technology. The foundation of computational thinking is problem solving through logical argumentation and logical thinking, which means computational thinking can be embedded in math or computer science and can also be part of language arts. For example, within a language arts class, students can identify the patterns in sentence structures, use logic to get to a conclusion based on facts, and more.[2] As students recognize these connections, they bring their new skills and knowledge to activities that aren't explicitly connected to the computer science curriculum.

Why Should We Teach Computational Thinking to Kids?

In a 2006 seminal think piece by Jeannette Wing, she writes, "[Computational thinking] represents a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use."[3] Since then, other research recognizes computational skills as invaluable within the 21st century.

According to the Association for Computing Machinery's 2014 pathways report, a majority of new jobs within STEM-based careers will be in the computing field and career seekers will need a deeper understanding of computer science.[4] Research done by Pew Research Center in 2018 found a 79% increase in STEM jobs since 1990 and projected that this percentage will grow another 13% by 2027.[5] In addition, employers are recognizing that computational thinking is a valuable for problem solving and analysis for many career paths.[6]

Since 2012, broad movements have occurred globally, including in the United Kingdom, Singapore, Finland, South Korea, and the United States, in integrating and embedding computational thinking into instruction and curriculum.[7] Studies found that teaching computational thinking is associated with higher critical-thinking and problem-solving skills[8, 9, 10] and improved collaborative skills.[11, 12]

To Learn More
For more ideas on how to embed into curriculum, read Screen-Free Computational Thinking and Computational Thinking Is Critical Thinking—and Belongs in Every Subject on Edutopia

Evidence in Action

If you walk into a classroom at Osage to observe the Computer Science Continuum, you will not see students sitting silently with headphones on and creating code and working independently. Rather, students are engaging in collaborative, project-based work using different tools and systems. Students are encouraged to teach others how to fix problems with codes and present their work.

PRACTICE PROFILE

Name—Computer Science Continuum

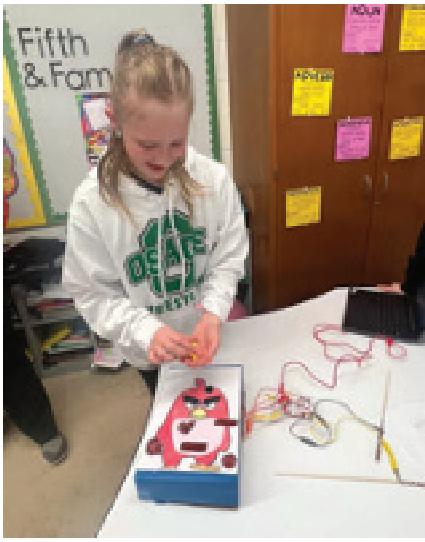
Grade level—Pre-K through 12

Mission Statement—To engage students in computer science processes, such as literacy and interactive thinking and concepts in meaningful ways, so students develop the skills of collaboration, communication, critical thinking, and creativity. If students develop these skills, they will be empowered and successful beyond school.

Some of the computer science skills students are learning at each grade level include coding concepts using Cubetto in first grade and Bee-Bot in kindergarten, basic programming using Marty robots and computer science vocabulary using Finch robots in second grade, shape building using Sphero in third grade, programming using Scratch in fourth grade, project work using Makey in fifth grade, and creating 3D biomes using Merge Cube in sixth grade. In seventh and eighth grades, students use Strawbees, VEX robots, and microbits, as well as units from code.org. High school students build on this by learning Python programming language. These discreet skills are all supported by a sound foundation of computational thinking. That foundation allows students to apply the skills in different contexts.

One example of a computer science integrated project is the operation game that fifth graders created. After a science lesson about the anatomy of the human body, students are tasked with creating their own operation game in small groups. One student uses a cereal box to create the parts of the body for the game, a second student codes in the Makey Makey app to enable the game, and a third student connects the physical cereal box to the game code in the app. This project exemplifies the collaborative and creative nature of these computer science integrated projects that develop problem-solving, communication, and planning skills.

The faculty and staff at Osage who lead the Computer Science Continuum describe many positive impacts of the program on students. Some of the highlights are increased student engagement, seeing students' problem-solving and collaboration skills develop, and engaging the community in the STEAM (Science, Technology, Engineering, Arts, and Math) festival. The STEAM festival is a STEM and arts showcase that includes about 60 stations with students presenting what they have learned and local businesses showcasing STEAM in their business or industry, showing support for students. Parents, as well as the larger community, are able to attend the festival and see what's going on in the district.



Results in Action

Chris Kyhl describes one of the major successes of the program as the growth of the number of teachers and students engaged in computer science throughout the district. Teachers and leaders at Osage have seen their Computer Science Continuum benefit students in numerous ways. They are seeing students engaged in their classes and coming to school consistently because they both enjoy the computer science learning activities and project-based learning activities that apply computer science principles across the curriculum. Students and teachers alike enjoy the way these new computational thinking skills bridge all parts of the school day and reframe teaching and learning. The program has had a positive effect on test scores as well. At the high school level, some students who were hesitant toward computer science or uninterested in the topic have taken the courses and shifted their career aspirations to pursue a career in the technology field. At the elementary level, the program is building resiliency and problem-solving skills in students by letting them know that they can work with one another to debug their code when it does not work as intended. Kelley Molitor shared a story of one student in particular who was able to find a new sense of self-esteem through computer science projects. Schoolwork was often difficult for this student, but computer science came more naturally. The student was even able to help some of their more high-achieving peers with fixing problems in their code. Molitor spoke about observing this student's experience with computer science: "I mean, I don't know if [this student] will ever go into computer science, but, because [the student] had success and because [the student] felt good about [themselves] doing that, I think that's huge."

What's Next?

The Osage teachers and leadership involved in the Computer Science Continuum are focused on continuous improvement of the program, specifically by finalizing each grade level's curriculum, supporting teachers in successful implementation and clear understanding of their roles in the program, and providing innovative and meaningful learning opportunities for students.

- Osage teachers and leadership want to ensure that they are creating a curriculum at each grade level that balances meeting students where they are with their current computer science skills while still challenging students with new learning opportunities and ensuring vertical alignment.
- A key district strategy is to create a supportive environment for teachers to learn new computer science and computational thinking content and build their instructional capacity. Osage program leaders acknowledge that implementing CS in different classes and subjects can be a challenging transition for some teachers. The district continues to work to provide high-quality, comprehensive onboarding for new teachers and continued support through implementation to ensure that computer science integration is happening in classrooms from prekindergarten through Grade 12.
- One of the additional opportunities that Chris Kyhl desires to provide for students is concurrent enrollment courses in partnership with local community colleges. Superintendent Schwamman also mentioned an interest in working with a technology start-up that would ideally be operated in Osage so that students could work in their hometown with the skills they have learned in their school district.

Through its Computer Science Continuum, the district desires to expose all students to computer science and computational thinking to prepare and empower students for success in a modern world where computer science skills are desirable and necessary. In the words of Superintendent Schwamman, “We’re not trying to create a whole system of coders, but you don’t teach English to teach a bunch of authors or to create a bunch of writers.” Osage teachers and leaders view computer science as a way to develop students’ technology skills in addition to soft skills like collaboration, communication, critical thinking, and creativity. Osage’s Computer Science Continuum illustrates how, with the leadership and initiative of district-level faculty and staff, a desire for student success can develop into an established program with tangible impacts.

Learn More

- Osage CS in the Classroom Wiki 2021
  https://osagecommunity.padlet.org/kmolitor3/zhw4ioz2vf0fc0yd
- Osage CS in the Classroom Wiki 2022
  https://osagecommunity.padlet.org/kmolitor3/xw0udc6vm0n7qsxr
- code.org: Why Computer Science?
  https://code.org/promote
- Osage Schools Get sizable Grant to Help Fuel Already Budding Computer Science Program
  https://kchanews.com/2020/12/21/osage-schools-get-sizable-grant-to-help-fuel-already-budding-computer-science-program/
- Osage School District’s Computer Science Program Honored by Reynolds During “Condition of the State”
  https://www.kgloam.com/osage-school-districts-computer-science-program-honored-by-reynolds-during-condition-of-the-state/

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- **Region 9 Comprehensive Center** | https://region9cc.org/

Endnotes

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