

2019

Computer science is elementary: Comprehensive plan for computer science implementation at the elementary level

Erin Chute
University of Northern Iowa

Copyright ©2019 Erin Chute

Follow this and additional works at: <https://scholarworks.uni.edu/grp>



Part of the [Curriculum and Instruction Commons](#), and the [Elementary Education Commons](#)

Let us know how access to this document benefits you

Recommended Citation

Chute, Erin, "Computer science is elementary: Comprehensive plan for computer science implementation at the elementary level" (2019). *Graduate Research Papers*. 937.
<https://scholarworks.uni.edu/grp/937>

This Open Access Graduate Research Paper is brought to you for free and open access by the Student Work at UNI ScholarWorks. It has been accepted for inclusion in Graduate Research Papers by an authorized administrator of UNI ScholarWorks. For more information, please contact scholarworks@uni.edu.

Computer science is elementary: Comprehensive plan for computer science implementation at the elementary level

Abstract

Teaching students computer science in the classroom can have many benefits. Several students in today's education system will go into career fields that do not yet exist and the skills taught through computer science can prepare them for the future. This project outlines the steps for planning a computer science initiative at the elementary level. A literature review examining the effect of teaching computer science on student achievement at the elementary level is used to support an award proposal for funding a high quality computer science curriculum in a rural, underserved district. This project can serve as a model for other schools interested in pursuing a computer science curriculum. Action research could be pursued through this project that could benefit the field of computer science research. Further research is recommended on the effects of a computer science education at the elementary level.

**Computer Science is Elementary: Comprehensive Plan for
Computer Science Implementation at the Elementary Level**

A Graduate Project Report
Submitted to the
Division of Instructional Technology
Department of Curriculum and Instruction
In Partial Fulfillment
Of the Requirements for the Degree
Master of Arts
UNIVERSITY OF NORTHERN IOWA

by
Erin Chute
June 2019

COMPUTER SCIENCE IS ELEMENTARY

This Report by: Erin Chute

Titled: Computer Science is Elementary: Comprehensive Plan for Computer Science
Implementation at the Elementary Level

has been approved as meeting the research requirement for the
Degree of Master of Arts.

Date Approved

Dr. Leigh E. Zeitz

Graduate Faculty Reader

Date Approved

Professor Joseph Marchesani

Graduate Faculty Reader

Date Approved

Dr. Robin Dada

Head, Department of Curriculum and Instruction

COMPUTER SCIENCE IS ELEMENTARY

Abstract

Teaching students computer science in the classroom can have many benefits. Several students in today's education system will go into career fields that do not yet exist and the skills taught through computer science can prepare them for the future. This project outlines the steps for planning a computer science initiative at the elementary level. A literature review examining the effect of teaching computer science on student achievement at the elementary level is used to support an award proposal for funding a high quality computer science curriculum in a rural, underserved district. This project can serve as a model for other schools interested in pursuing a computer science curriculum. Action research could be pursued through this project that could benefit the field of computer science research. Further research is recommended on the effects of a computer science education at the elementary level.

Keywords: computer science, computer programming, elementary, curriculum, assessment, professional development, community partnerships

COMPUTER SCIENCE IS ELEMENTARY

Table of Contents

Introduction	5
Demographics	8
Goals and Measurements	9
District Objectives	9
Program Goals	11
Problem Identification	12
Literature Review	14
Description	19
Plan	19
Curriculum	20
Assessment	23
Professional Learning	24
Community	28
Engagement	28
Partnerships	30
Outcome	32
Conclusions and Recommendations	32
References	34
Appendices	36
Appendix A	36
Appendix B	38
Appendix C	39

COMPUTER SCIENCE IS ELEMENTARY

Introduction

Implementing a kindergarten through 12th-grade computer science curriculum is a long and arduous process, but it's possible benefits to student achievement can make the planning and execution a worthwhile initiative. Designing a high quality curriculum, providing professional development to teachers, and creating partnerships to enrich lessons are all critical aspects of a successful computer science integration. Accessibility to devices and an infrastructure to support them is a vital component for authentic computer science instruction. Kingsley-Pierson, a school that has consistent declining enrollment, struggles to provide the necessities to make a computer science initiative a reality. Seeking outside sources such as grant options and community partnerships are necessary in taking the financial burden off of the school district to be able to provide their students with 21st-century learning experiences.

The purpose of this project is to explore ways in which we can bring a high-quality computer science program to our underserved district. Kingsley-Pierson Community School district is located in rural Northwest Iowa about 30 minutes from Sioux City. Kingsley Elementary aspires to be the computer science model for small, rural districts across the state of Iowa. As a district, we are overlooked for these opportunities because of our size and our free and reduced population. Our district is unique for several reasons. Our elementary students (grades K-4) and our high school students are located in one school building while our 5th through 8th grade students attend a middle school located eight miles away in another county. Kingsley-Pierson serves less than 500 students in their K-12 education system. More than 40% of our students live in the rural area around the communities of Kingsley and Pierson.

COMPUTER SCIENCE IS ELEMENTARY

Kingsley-Pierson Community School District has put time, energy, and resources into starting a sustainable computer science program and Kingsley Elementary will continue this progress to ensure we are successful in creating a strong program that is inclusive to all students.

Our computer science cornerstone started with a high school web design class around 2006 and has expanded to a 6-12th grade computer science program that includes robotics, STEM, information systems and cooperative coding across grade levels. The effort we have put forth has been recognized by Governor Kim Reynolds, as Kingsley-Pierson was acknowledged for our progress in computer science professional development in her 2019 Condition of the State Address. Barriers to our plan of creating a rich curriculum have been the availability of resources, quality relevant professional development, and exposure to the benefits of living in an urban community. Although we have challenges, we continue to find innovative methods to make a K-12 computer science curriculum a reality.

The Kingsley Elementary computer science program is not just a school-wide initiative. We are part of a district, community, northwest Iowa, and statewide effort to bring authentic 21st-century skills into the classroom using programming. We will collaborate with community members, parents, business partners, the region, and the state to showcase our work with students. Demonstrating the importance of teaching computer science and the lasting positive effects it has for the future of our students is beneficial to our initiative.

Loess Hill Computer Programming Specialty School is a part of the Sioux City Community School district. Loess Hills School is the model elementary school for the state of Iowa for computer science implementation. A fully-immersive computer science educational experience is what Loess Hills strives to provide to their students.

COMPUTER SCIENCE IS ELEMENTARY

Kingsley Elementary looks forward to continuing a relationship with Loess Hills Computer Programming Specialty School to collaborate with and demonstrate our methods to other schools. Our goal is to provide two perspectives of how a high quality computer science curriculum can be integrated into the standards of the Iowa Core and existing content. Kingsley-Pierson has a unique opportunity to teach our students that computer science is a global resource and to help them relate computer science to their own surroundings. Students will see and experience the connection between computer science and the growing popularity of programming in rural agriculture.

Kingsley-Pierson school's computer science vision connects to not only our own mission statement but also to the Governor's and the Iowa Department of Education's Future Ready Iowa movement. Within our plan, we will provide students the opportunity to realize their potential and work in the classroom and on job sites in an authentic real-world setting with employers to explore careers. These experiences will allow students to see what careers are available within the state of Iowa and within their own communities.

Kingsley Elementary applied for the *Computer Science is Elementary* award to bring a computer science curriculum to the Kindergarten through 4th-grade classrooms. This \$50,000 award would provide the Kingsley-Pierson elementary students and teachers necessities like Chromebooks, programmable devices, and professional development to make a cross-curricular computer science curriculum a possibility. This award will be able to provide us with the essentials to further develop our program and provide our students with the opportunity to experience an integrated computer science curriculum on a regular basis.

COMPUTER SCIENCE IS ELEMENTARY

Demographics

Kingsley Elementary is the only elementary school for the Kingsley-Pierson Community School District. The elementary serves 160 students - Kindergarten through 4th-grade. Kingsley Elementary is a high poverty school with a 43.14% free and reduced lunch population percentage. Twenty-one students (13%) in the elementary come from an underrepresented population (American Indian, Asian, Black, Pacific Islander, Hispanic).

Code.org recognizes that several populations have been underrepresented in the area of computer science. They have noticed these discrepancies through the individuals that have taken the Advanced Placement (AP) Computer Science Test. Some of these populations that have been identified are African Americans and Hispanics. Gender was also a factor; females accounted for only 22% of the AP examinees (Code.org).

This project can reach the underrepresented female population as well. “The number of women studying CS has been falling pretty steadily since the 80s, despite the increase in demand for these types of skills” (Wired, 2018). The Kingsley Elementary student population is 47% female. Our goal is to ensure that we provide equity to all students in our computer science initiative.

Kingsley-Pierson is an isolated, rural community. A significant amount of students, 44%, live in the country or in the small town of Pierson, Iowa. This prevents several of our students and the school from having access to reliable internet as well as opportunities to connect to and access digital learning tools, educational materials, and real-life opportunities.

COMPUTER SCIENCE IS ELEMENTARY

Goals and Measurements

Kingsley Elementary has set goals that relate to classroom, access, skills, and environment that we can measure. The goals that we have created are for both students and teachers as everyone involved will be growing through this process.

District Objectives

Through this computer science implementation, we want our students to be able to demonstrate their skills and understanding of 21st century skills that go beyond computer science skills acquisition. The following objectives relate to several areas of 21st century skills with a connection to computer science.

1. Demonstrate proficiency in the use of computers and applications as well as an understanding of the concepts underlying hardware, software, and connectivity.
 - **Basic Operations**

In order for our students to be efficient in accomplishing our programming expectations they will need to have a basic understanding of computer/Chromebook operations. This is necessary for a successful computer science implementation.
 - **Multimedia and Presentation Tools**

Within this skill set students will be asked to present their learning through a variety of presentation methods. The computer proficiency goal is necessary for a successful computer science implementation.
2. Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society
 - **Acceptable Use, Copyright, and Plagiarism**

COMPUTER SCIENCE IS ELEMENTARY

Teaching our students responsibility with devices and digital content will be needed as we will ask students to be users and creators of content that will be displayed on the internet. Creating informed and responsible digital citizens is another goal of our project.

3. Demonstrate the ability to use technology for research, critical thinking, decision making, communication, and collaboration, creativity and innovation.
 - Research and Gathering Information
 - Communication and Collaboration

We will take a cross-curricular approach to our computer science initiative. Students will be asked to think critically and solve real-world problems using their computer science skills. Students will be expected to use the four C's while demonstrating their content and computer science knowledge.

Clarity from Bright Bytes is a tool that the district has used in the past to gather data on students' and teachers' digital skills (BrightBytes, 2019). With this survey tool, the district can gather data on learning outcomes from students, teachers, and parents. As a district we take this survey once a year. We will increase the use of this tool during our project to twice a year to gather feedback on our project implementation. Kingsley Elementary staff will review the data in the fall and spring. It is important that we use this information to help us make instructional decisions in the classroom and with professional development moving forward to ensure that our teachers are successful with our CS implementation. Bright Bytes is an assessment tool that we use to gauge our progress in several areas of technology integration.

COMPUTER SCIENCE IS ELEMENTARY

Currently, we are at the *Proficient Level* in using the four C's (as measured by the Bright Bytes assessment). Our goal is to increase teacher online skills and multimedia skills to an advanced level.

We are at the *Emerging Level* for digital citizenship using Bright Bytes Data. We want to increase teacher and student digital citizenship to a proficient level.

Currently, we are at the *Proficient Level* in professional learning of technology. We want to increase our use of learning through technology to the advanced level.

Program Goals

In our cross-curricular approach to computer science implementation our hope is to see increases in student achievement across all areas. Our goals for students address content, technology, and computer science progress.

Students

- 80% of students attending Kingsley Elementary will be proficient in reading on the statewide assessment.
- 80% of students attending Kingsley Elementary will be proficient in math on the statewide assessment
- 75% of students attending Kingsley Elementary will be confident in finding a solution when they have a problem with technology (troubleshooting)
- 75% of students attending Kingsley Elementary will be confident in their ability to solve and present a real-world problem with the use of technology
- 80% of students attending Kingsley Elementary will be able to identify 5 careers that use computer science

COMPUTER SCIENCE IS ELEMENTARY

- 80% of students attending Kingsley Elementary will create and organize parts of code including sequences, events, loops, and conditionals.

Teachers

- 100% of Kingsley Elementary teachers will have instructed at least one lesson with computer science implementation.

Year 1

- 85% of Kingsley Elementary teachers will have instructed one lesson a quarter with computer science implementation.

Year 2

- 100% of Kingsley Elementary teachers will have instructed one lesson a quarter with computer science implementation.
- 70% of Kingsley Elementary students will be exposed to Digital Citizenship lessons each month
- 80% of Kingsley Elementary teachers will ask students to identify and solve authentic problems using technology

Problem Identification

Programming skills acquired through coding in the classroom can translate to success in careers in today's global workforce. The World Economic Forum's Future of Jobs Report states that "the world is at the beginning of the Fourth Industrial Revolution, requiring new skill sets since 65% of children entering school today will work in jobs that currently do not exist" (2016, p. 1). "Competition for talent in in-demand job families such as Computer and Mathematical and Architecture and Engineering and other strategic and specialist roles

COMPUTER SCIENCE IS ELEMENTARY

will be fierce, and finding efficient ways of securing a solid talent pipeline a priority for virtually every industry” (2016, p.3).

At Kingsley-Pierson Community School District, our mission is to champion excellence in education through leadership and service. We are committed to ensuring that all Kingsley-Pierson students have access to a network of services that allows them to realize their potential. Through education, we strive to build a quality of life which sets the standard for Iowa.

According to Senate File 247 signed by Governor Reynolds in 2017, the state of Iowa has set a goal that every student will graduate from high school having had computer science instruction. Kingsley-Pierson CSD would like to expand upon that goal and ensure that all students in the district are exposed to a computer science curriculum at all levels of their education.

Kingsley-Pierson wants to ensure that we are preparing our students for the next step, whether that be in education or in a career. Isolation and lack of resources prevents our district from the opportunity to provide our students with an authentic 21st century computer science curriculum. A computer science education can help students acquire thinking and other skills that can be carried forward into their futures. We will work to make sure that our elementary students are ready to handle the rigors of the next step in their educational and career pathways.

Definitions

Coding - “A list of rules, written in one of the numerous programming languages, that instructs a computer to do what a user wants it to do: perform a sequence of

COMPUTER SCIENCE IS ELEMENTARY

instructions, repeat a sequence of instructions a prescribed number of times, and test whether a sequence was performed correctly” (Horizon, 2017, p.20).

Computational Thinking (CT) - “Solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science” (Wing, 2006, p. 33).

Computer Science (CS) - “The study of computers and algorithmic processes including their principles, their hardware and software design, their applications, and their impact on society” (Tucker, 2006, p.1).

Literature Review

Teaching computer science has evolved into more than typing and running programs. It is now being taught using a problem-based strategy. Research is showing that students are acquiring 21st century skills like critical thinking and problem-solving that have a lasting impact on achievement, reaching far beyond computer science. Seymour Papert was interested in the computer as a support for learning activities, especially for children. He made the claim that “children can learn to program and learning to program can affect the way that they learn everything else” (Papert, 2000).

The computer science initiative has grown stronger over the past 10 years. Research in the computer science field is plentiful, but scattered. There are many areas of computer science and computer programming. Researchers can emphasize programs, skills, or levels of education but there is no consistency in the literature. Students can benefit from exposure to a computer science curriculum at an early age, however, there is limited research available about teaching computer science in the elementary classroom. If more research existed for computer science and programming in the early levels of education,

COMPUTER SCIENCE IS ELEMENTARY

teachers and school districts would have evidence and models to support their computer science programs.

The current job projections for our students show that they are going into a workforce that does not currently exist. Our students will need skills that show that they can be creative, communicate effectively, think outside the box, and work with others. Students need to be exposed to learning opportunities that allow them to acquire these skills and refine them over the years to become productive employees in the years to come. Computer science and programming are areas where these learning opportunities can help our students succeed. Computational thinking is an essential skill that can be developed by engaging in computer science content and programming activities. Encouraging our students to be thinkers who can plan, implement, analyze, and refine can help them achieve in all areas of their education.

Can a computer science curriculum increase student achievement through developing computational skills development at the elementary level? I believe it can. Several studies have shown that approaches may differ but student understanding and computational thinking can be increased through computer programming.

Rose, Habgood, and Jay (2017) and Fessakis and Mavroudi (2013) studied computational thinking in kindergarten-aged students. They researched computer coding software platforms that were effective in implementing computational thinking. Rose, Habgood, and Jay (2017) found that Scratch Jr. and Lightbot were useful to students in learning computer programming. The two platforms used different approaches to block style programming but the differences between the two in regards to helping kindergarteners develop computational thinking were insignificant. Fessakis and Mavroudi (2013) explored

COMPUTER SCIENCE IS ELEMENTARY

research using Seymour Papert's LOGO programming to see the effects of problem-solving to develop mathematical concepts and social skills.

Wangenheim (2017) and his fellow researchers investigated an integrated approach to computer science in a social studies curriculum. Their research involved 105 fifth and seventh grade students in their use of Scratch to create historical events and descriptions of cultures around the world. Within the social studies context students were introduced to computer science concepts and vocabulary. After instruction students were asked to apply their knowledge of historical concepts through the creation of a Scratch game. The students projects were evaluated with a tool called Dr. Scratch. Dr Scratch scores projects based on computational thinking and the use of programming concepts.

All three studies showed that step-based programming platforms allowed students to engage in computational thinking processes and problem-solving skills through a computer science activity within a content area.

Sung, Ahn, and Black (2017) and Sullivan (2008) researched ways to use hands-on approaches with computer science activities to gain computational skills. Sung, Ahn, and Black (2017) used embodiment with kindergarten students as a tool for understanding computer science concepts and computational thinking. Sung, Ahn, and Black's students used physical movement (embodiment) to support their understanding of computational thinking with number lines and they outperformed their peers that used surrogates (computer programs) to display their understanding. Sullivan (2008) researched 11 and 12-year-old exceptional students and their experiences with using robotics for computational thinking. Her research conveyed that students' systems understanding and computational thinking within science processes increased with the use of robotics challenges. These two

COMPUTER SCIENCE IS ELEMENTARY

studies made positive correlations between achievement in mathematics and science concepts and increases in computational thinking through the use of computer science and hands-on activities.

Coradinni concluded that the Code.org platform was appropriate tool to bring informatics education to students. They found that the curriculum was helpful in meeting their goals of bringing awareness to informatics concepts. The researchers were unable to show student progress as Code.org has no assessment tools. Teachers reported their positive feedback for the platform with the following quotes. “Students have been able to better understand what computers can do: there is more in information technology beyond game consoles. I have observed improvement in observation and reflection skills: students have been able to find alternative solutions” (Coradinni, 2017, p. 229)

Appropriate and meaningful professional development can make an impact on a successful project implementation. Hu and Garimella (2014) conducted a study of the effects of professional development on the adoption of iPads for STEM education. Through their use of the ASSURE (Analyze Learners, State Standards and Objectives, Select and Utilize Media, Require Learner Participation, Evaluation and Revision) model they noticed improved perceived proficiency among their educator participants. This hands-on approach to professional development was considered effective in teachers’ perceptions of using technology for STEM instruction.

Through this review, we can see that different computer programming platforms and approaches can be used to teach computer science. Learning computer programming is a way for students to develop computational skills that can benefit them in other areas of education. For the computer science initiative to continue to make advancements, further

COMPUTER SCIENCE IS ELEMENTARY

research is needed. There is a deep need for research to be conducted in computer science education in the K-12 system. It is recommended that research take place to make connections to computer science and all of the interdisciplinary content areas. Research also needs to examine a possible connection between students engaging in computer science and student achievement.

COMPUTER SCIENCE IS ELEMENTARY

Description

Plan

Kingsley Elementary's plan is an extension to an already existing preliminary computer science program. As a district, Kingsley-Pierson CSD has a strong 6-12th grade computer science curriculum that includes Computer Literacy, Technology/Careers, Word Processing, Web Design, Intro to Programming, and a Student Tech Team. Our missing piece in our district's computer science curriculum is the elementary grade levels. This project will be geared towards the Kindergarten through 4th-grade students at Kingsley Elementary and will strengthen our existing 6-12th grade program. We plan to involve all teachers at all grade levels in the elementary including art, PE, music, and guidance. Our goal is to be a K-12 computer science school that provides all of our students the opportunity to experience a high quality, computer science education.

Kingsley-Pierson Community School District is located in isolated, rural, Northwest Iowa and we want to connect our computer science curriculum to our agricultural roots. It is important for us to make the connection between computer science and agricultural life for our students. Farming and agriculture have evolved so much over the past decade and has become a technology-rich profession. The use of automation, drones, and GPS software have changed the way in which these jobs are performed. One way we can continue this career exploration is with our connection to Ag in the Classroom which our 2nd and 4th-grade students participate in. Many of our students come from a farming background and many will return to the farm for their career. We want to help make sure that we are encouraging and preparing our students to be successful in whatever career they chose.

COMPUTER SCIENCE IS ELEMENTARY

Employers will expect our students to have soft skills that will allow them to be independent and productive in the workplace. It is essential that we start working on skills such as communication, critical thinking, and collaboration, and computer science lends itself to these skills. The universal constructs of flexibility, adaptability, productivity, and accountability fit right around these 21st-century skills. A computer science education is not the only end goal. We want our students to gain valuable life and career skills along the way.

Curriculum

Our first objective for this project will be curriculum development. A team approach will be used to create a high-quality computer science curriculum for Kingsley Elementary. Teachers, coaches, the curriculum coordinator, and administrators will make up the team. This team will help to ensure that we create a curriculum that is rigorous at all grade levels. The preliminary planning for this curriculum will start during the summer of 2019.

Our goal at Kingsley Elementary will be to integrate computer science within our already existing curriculum and course content. Implementing computer science principles and programming activities within each core classroom as well as other disciplines including specials (art, music, PE), reading intervention classes, and special education. This is the model that Loess Hills Computer Specialty School has put in place. (See Appendix) We will mimic their plan while also adding our own individual touches that relate to our rural community. We believe our learning outcomes will produce better results if we can immerse our students in computer science in all areas. The learning objective is for students to experience the benefits of programming like creativity, communication, collaboration, and critical thinking within all areas of our school.

COMPUTER SCIENCE IS ELEMENTARY

The curriculum team will use several resources as they create a scope and sequence and kindergarten through 4th-grade curriculum. Since Iowa has adopted the Computer Science Teachers Association (CSTA) computer science standards, this will be the base of our curriculum while we connect these standards to the Iowa Core. One section covered in the CSTA standards is Networks and the Internet. Teaching our students to be responsible with the content, devices, and the internet is important for us to address. We will support these benchmarks by using the Common Sense Media Digital Citizenship Curriculum in conjunction with our guidance lessons. The International Society for Technology Education (ISTE) will also be a valuable resource when planning and implementing our curriculum. ISTE provides standards for students, educators, coaches, and more. Our plan involves all of these stakeholders so using these standards as a guide we can establish high expectations for all groups involved in the plan. The ISTE standards present us with a wide range of skills that incorporate many of the 21st Century skills that we are looking to add to our curriculum.

Our computer science curriculum will use a variety of programs and lessons to support the content. Based off of the research from Coradinni, we can see that the Code.org platform can be a viable tool to use for computer science education. Code.org has the ability to be used in a wide array of classrooms and it serves as a good tool to use when building a foundation for computer programming. The Scratch Jr. programming platform that will be used with our mid-grade level students (2nd and 3rd grade). They are similar tools but also provide a unique set of opportunities for our students to explore programming. Scratch Jr.'s block based computer programming language can assist students with sequencing and to think critically while designing a computer program (Rose, Habgood, and

COMPUTER SCIENCE IS ELEMENTARY

Jay, 2017). Scratch will be a platform that is used with our older students (3rd and 4th grade) because it provides the opportunity for flexibility and creativity. Programming Scratch games can be a way for students to showcase their understanding of content and computer science principles as was researched by Wangenheim (2017) and his colleagues.

Through the research of Sung, Ahn, and Black (2017) and Sullivan (2008) that described the hands-on approach to computer science, we have decided to add a robotics component to our curriculum. Bee Bots are an introductory programmable device that can be used across curricular areas and grade levels. After visiting Loess Hills Computer Programming Specialty School and seeing a teacher use Bee Bots with her students, several of our teachers envisioned how they would use Bee Bots within their curriculum. An elevated programmable device that will be used with our older students will be the Dash robot. Incorporating these devices into the curriculum provides more authenticity and additional ways to work on troubleshooting and tenacity. We envision these programming platforms and devices to be used as an output for students to demonstrate their understanding.

Kingsley Elementary will take a slow, progressive roll-out of the computer science curriculum. We do not want to force the implementation and see it fail. We will utilize our Instructional Coach/Digital Literacy Coach and our STEM Coach to initially assist with co-teaching lessons and eventually transition into the classroom teacher providing the instruction independently. Teachers will have the freedom to implement computer science standards where they feel it is necessary. We will expect all of our teachers to integrate the CSTA computer science standards alongside their Iowa Core standards. We will encourage grade level teachers to collaborate together to create consistency for our students. Ensuring

COMPUTER SCIENCE IS ELEMENTARY

our students are progressing with a similar skill set will assist with following our computer science progression. By year two of this plan, we will expect teachers to be integrating computer science frequently across all content areas.

When we integrate computer science into the other content areas, we are able to make connections for our students and at the same time showcase careers related to technology and computer science. Throughout the kindergarten through 4th-grade scope and sequence, we want our students to learn the connection between computer science and the 16 career pathways. We hope to do this with the help from community and business partnerships that will bring authentic computer science to the classroom through guest speakers and worksite tours.

Once the curriculum maps include the early grade levels, adjustments will need to be made through the whole continuum. If we are able to provide our students with the foundational knowledge base at an early grade, we will need to find ways to challenge our students moving forward. As we implement computer science in the K-12 environment, the district will create a new scope and sequence of applied knowledge and skills to ensure we are providing an appropriate, challenging, rich curriculum to all KP students.

Assessment

We plan to use several different assessment tools to gauge our progress in our implementation. Using district-wide assessments like the Formative Assessment System for Teachers (FAST) and Iowa Statewide Assessment of Student Progress (ISASP) that are already in place will help us measure whether we are making gains within our content areas. We hope to be able to make some correlations between past assessment data and future results and its relationship to applying a computer science curriculum. Through this process,

COMPUTER SCIENCE IS ELEMENTARY

we have learned from the model school at Loess Hills Computer Programming Specialty School that it is very hard to determine if progress in student achievement is related to the computer science curriculum or not. Classroom formative and summative assessments will also be used to monitor student achievement. During curriculum planning we will create some district wide assessments at each level that will address our goals for implementation. We will ask our teachers to review the assessment data and reflect on the school and classroom goals at the end of each quarter and collectively at the end of the year. Making instructional adjustments along the way will help to ensure that we are being effective in our plan and meeting our goals.

Kingsley Elementary will use surveys (Google Forms) as a formative assessment to gather feedback from teachers on their experience with implementing computer science into their classroom. Their input is essential to having a successful program. We will also want to gather input from our business and community members that are supporting our computer science initiative. Following our shared vision is important, without their support we will not be able to provide the strong career focused plan we have created.

Continual reflection and review of assessment data will happen throughout the plan. Instructional decisions will be made based upon these measures. Without this self-evaluation, our program will be able to improve throughout our on-going journey.

Professional Learning

Professional development is a crucial element in this plan. We need teachers to teach the content and integrate the computer science into the lessons. When teachers are comfortable and confident with educational content and materials, that is when they are most effective in the classroom. None of our elementary teachers have a background in

COMPUTER SCIENCE IS ELEMENTARY

computer science but we see that as a welcomed challenge. Twenty-one educators including classroom teachers, interventionists, specials teachers (art, PE, music), and administrators will benefit from our professional development plans.

Hu and Garimella (2014) found a hands-on approach to professional development was beneficial for teachers. Kingsley Elementary will adopt the ASSURE model for our teacher professional development. Teachers' perceptions and their willingness to adopt the computer science curriculum is crucial for a successful implementation.

Professional development will begin in the Fall of 2019. Several teachers visited Loess Hills Computer Programming Specialty School last spring. Teachers who were unable to attend the spring visitation will visit the model school over several visits during the 2019-2020 school year. The visits to Loess Hills will allow all of our teachers to see what computer science immersed into the curriculum and course content looks like. This will spark our teachers' creativity in how they can implement the computer science standards into their core content. Ongoing collaboration between Kingsley Elementary and Loess Hills Computer Programming Specialty School will be beneficial for both schools. Gathering ideas from others and networking with other schools and teachers that teach computer science will help us to be successful with our program.

Attending conferences will allow teachers to select specific areas of need for their professional growth in the areas of technology and computer science. All of our teachers will have the opportunity to attend to professional learning conferences like the Iowa Technology and Education Connection (ITEC), Nebraska Educational Technology Association (NETA), and the Iowa 1:1 conference that focuses on technology and provide workshops for

COMPUTER SCIENCE IS ELEMENTARY

computer science. We want our teachers to grow right alongside of our students and by sending our teachers to conferences we hope to accomplish this task.

Kingsley-Pierson Community School District has an educator on staff who has a computer science endorsement and serves as the district's Curriculum Coordinator/ Instructional Coach. She will be used to provide in-house professional development to staff as she is familiar with all of the platforms that will be incorporated in the classroom content. Teachers that have taken advantage of the Computer Science Professional Development Incentive Fund, such as the high school business teacher and the K-12 STEM coach, will be an ongoing support to teachers that are being introduced to computer science. The technology consultants from the AEA are another resource that we will tap into for guidance, resources, and professional development.

Outside software representatives will be consulted and used to present professional development to the district. Kingsley Elementary will host their Code.org CS Fundamentals PD within the district to provide teachers with the opportunity to learn more about the platform and gather curriculum resources that include unplugged activities. Webinars and the use of web-based video conferencing can connect us to experts in the field all around the world. With all of these avenues for professional development, we feel confident that we can provide our teachers with the tools to be successful.

The emphasis in professional development will be on teaching teachers computer science skills so they can transfer these skills to their students while using their own strategies and teaching styles. We will also emphasize how computer programming is relevant to instruction in our other content areas. PD will also stress the importance of instructional pedagogy. Content that follows the Iowa Core and high-quality instructional

COMPUTER SCIENCE IS ELEMENTARY

practices are the most important element of this plan. We want to focus on students' ability to comprehend and apply the content in a meaningful way that uses technology and computer science.

During scheduled professional development time there will be dedicated time for computer science learning. Each quarter we will focus on a certain content area to help teachers see how computer science practices can be integrated into lessons. This will include completing crosswalks of the standards for the content, computer science, and ISTE. Seeing commonalities in the standards can help ease the implementation of computer science into the curriculum.

1st Quarter - Literacy/ELA

2nd Quarter - Social Studies

3rd Quarter - Science

4th Quarter - Math

In Year Two of our plan we will expand on year one. By year two we hope to be fully implemented into our plan and curriculum. Ongoing professional development will allow us to extend our efforts from the previous year. Computer science and technology are always changing so the teacher will need to continue to seek out new opportunities to grow and new learning experience to be used in the classroom. It will continue to be an expectation that our teachers attend a technology conference and that they seek out opportunities to network with other teachers. Teachers will be able to gather resources and share their accomplishments during these technology conferences. As mentioned before, Kingsley Elementary wants to be the computer science model school for small, rural districts. With that expectation comes the responsibility to share our successes and challenges so that

COMPUTER SCIENCE IS ELEMENTARY

other schools can learn from what we have done. Teachers will be expected to share what is going on in their classrooms in regard to them implementing computer science into their content. Opening their classroom doors to their colleagues and to teachers across the state will help fulfill the goals of our plan and the plan for the State of Iowa.

Community

Kingsley Elementary shares a vision for our students with our community. As a collective group, we want to see our students succeed academically, socially, and be prepared for the demands of their future education and/or career goals. Adding a computer science facet to our already existing Iowa Core curriculum will allow students to gain important 21st century and technology skills by engaging in a high-quality computer science curriculum and career exploration. Any new initiative that the school undertakes is more successful when community members are a part of the decision making and when they are updated with the progress.

Engagement

Kingsley Elementary will use several forms of communication to keep the community engaged with our plan for implementing computer science in our elementary. Teachers will use classroom newsletters to update families on the progress with the class and the school newsletter will share news of the elementary's achievement. Submitting stories to our local papers and news stations will enable us to share information within our region of the state.

Kingsley-Pierson Community School District connects with a wide range of individuals through our social media accounts. The district distributes content through Facebook, Twitter, and Instagram. Positive social interactions from community members, families, and past graduates have helped us use social media as a platform to reach others.

COMPUTER SCIENCE IS ELEMENTARY

There will be multiple tools such as Google Form surveys and email communication that will be used to gather feedback from parents and community members. Kingsley Elementary will also collect information and feedback from students in a variety of ways. Reflections from students will take the form of journaling and video reflections with Flipgrid. Observation will be used to collect an in the moment snapshot of students abilities and attitudes towards using computer science in the classroom setting.

Kingsley Elementary will hold a special event during Open House in the fall. We will invite parents and community members to come to the school to tell them about our plans for computer science in the 2019-2020 school year. At that point, we can share our ideas for curriculum, explain what skills and programs will be used in the classrooms, and let them try out some of the devices.

To provide families with additional computer science resources, we will add a page to our school website that is dedicated to computer science in the elementary. This website, maintained by the high school Student Tech Team, will contain information about what is happening in our classrooms. Updates of our project progress and resources for families to use at home will be available through this webpage.

Parent/teacher conferences are the perfect time for teachers to share with parents the skills and successes that each individual student has achieved in the computer science curriculum. Parents will have the opportunity to have their questions answered about the computer science curriculum. During this time we will give students and parents an opportunity to work together with computer science. A lab will be set up with activities for families to work together. Parents can see what computer science looks like for their student and students can showcase their skills to their parents. By creating this time for

COMPUTER SCIENCE IS ELEMENTARY

families to work together we can build a strong connection to computer science, family, and school. We will maintain our communication with families through our school website. We will provide links to programs and other resources used in the classroom so that parents, students, and families can continue to work on computer science outside of the school.

The most effective way for our stakeholders to assist us with the planning and implementation of our plan is to create a Kingsley-Pierson Computer Science Advisory Committee. This format will be similar to the advisory teams that are used in the Career and Technical Education (CTE) classes. Kingsley Elementary will reach out to a wide variety of individuals to serve on this committee. We envision the committee to be composed of administrators, teachers, school board members, parents, our community and business partners, professionals and advisors in computer science, community colleges, and other regional advisors like Mary Trent from the Northwest Iowa STEM region. All of these voices will provide us with input that will assist us in staying current with our curriculum, instruction, and our vision for a strong computer science program at Kingsley-Pierson.

Partnerships

The district has sought out several community and business partners to assist us with our project. Meeting with our community and business partners will also take place during the early planning stages. We will set a plan to bring in guest speakers throughout the year. Our goal will be to bring in a community member once a quarter. to speak to our students about how they use computer science and technology in their job. Throughout our students' kindergarten through fourth-grade year, we plan to hit all 16 career pathways to show students how computer science is all around them. Another way we want students to experience computer science in the real world is by visiting job sites. Allowing students to

COMPUTER SCIENCE IS ELEMENTARY

see computer science and programming in real-time through a field trip once a year will be a very valuable asset to our program. The world of computer science and technology are constantly changing and for our program to stay relevant we will need to update and seek new and additional opportunities for our students.

The following businesses have committed to partner with Kingsley Elementary School in our computer science efforts. These partnerships include guest speaker appearances to our classrooms, field experience opportunities to workplaces/job sites for our students to experience the real world applications of computer science or financial support.

Financial Partners

- Agri Business - Financial Sponsor and Guest Speaker
- Dirt Road Designs - Financial Sponsor, Guest Speaker, and Field Experience
- Lammers Automotive - Financial Sponsor, Guest Speaker, and Field Experience
- Panther Ball - Financial Sponsor
- Seglem Farms - Financial Sponsor and Field Experience
- WiaTel - Financial Sponsor and Guest Speaker

Field Experience Partners

- CW Suter - Guest Speak and Field Experience
- Titan Machinery - Guest Speaker and Field Experience

Guest Speaker Partners

- First Cooperative Association - Guest Speaker
- Gelita USA - Guest Speaker
- H&H Builders - Guest Speaker

COMPUTER SCIENCE IS ELEMENTARY

- Jim Harvey Agency - Guest Speaker
- Riverside Technologies, Inc. - Guest Speaker

Outcome

As the project comes to fruition we will start to see the results of this computer science implementation. Continual feedback from our stakeholders will be collected, reviewed, and acted upon at each step in the planning and implementation process. Data collection from surveys, observations, Clarity from BrightBytes surveys, and assessments will be analyzed to seek out connections between student achievement within the content areas and our computer science plan. Throughout this entire project implementation we will connect with our community and business partners and additional stakeholders to inform them of our progress.

Conclusions and Recommendations

The current job projections for our students show that they are going into a workforce that does not currently exist. Our students will need skills that show that they can be creative, communicate effectively, think outside the box, and work with others. Students need to be exposed to learning opportunities that allow them to acquire these skills and refine them over the years to become productive employees in the years to come. Computer science and programming are areas where these learning opportunities can help our students succeed. Encouraging our students to be thinkers who can plan, implement, analyze, and refine will help them achieve in all areas of their education.

For the computer science initiative to continue to make advancements, further research is needed. There is a deep need for research to be conducted in computer science education in the K-12 system. It is recommended that research take place to make

COMPUTER SCIENCE IS ELEMENTARY

connections to computer science and all of the interdisciplinary content areas. Research also needs to examine a possible connection between students engaging in computer science and student achievement.

Schools can bridge the gap between the classroom and the needs for our ever-changing job market. “Teachers more than ever have a vital role to play in helping students realize their futures by providing them with instruction that gives direction and allows them to hone their new cognitive and technological skills” (Daggert, 2010, p. 3)

COMPUTER SCIENCE IS ELEMENTARY

References

- BrightBytes. (2019). Clarity. Retrieved from <https://www.brightbytes.net/clarity>
- Code.org. (2019). Code.org and diversity in computer science. Retrieved from <https://code.org/diversity>
- Coding as a literacy. (2017). *NMC/CoSN Horizon Report, 2017 K–12 Edition*, 20.
- Corradini, I., Lodi, M., & Nardelli, E. (2017, June). Computational Thinking in Italian Schools: Quantitative Data and Teachers' Sentiment Analysis after Two Years of Programma il Futuro. In *Proceedings of the 2017 ACM Conference on Innovation and Technology in Computer Science Education* (pp. 224-229). ACM.
- Daggett, W. R. (2010). Preparing students for their technological future. *International Center for Leadership in Education*, 1-14.
- Employment, skills and workforce strategy for the fourth industrial revolution. (2016). *The Future of Jobs*, January 2016, 1.
- Fessakis, G., Gouli, E., Mavourdi, E. (2013). Problem solving by 5-6 years old kindergarten children in a computer programming environment: A case study. *Computers & Education*, 63, 87-97.
- Hu, H., & Garimella, U. (2014). iPads for STEM teachers: A case study on perceived usefulness, perceived proficiency, intention to adopt, and integration in K-12 instruction. *Journal of Educational Technology Development and Exchange (JETDE)*, 7(1), 4.
- Meyers, B. (2018, March 27). *Women and minorities in tech, by the numbers*. Retrieved from <https://www.wired.com/story/computer-science-graduates-diversity/>
- Papert, S. (2000). What's the big idea? Toward a pedagogy of idea power. *IBM systems journal*, 39(3.4), 720-729.
- Rose, S., Habgood, J., & Jay, T. (2017). An exploration of the role of visual programming tools in the development of young children's computational thinking. *Electronic journal of e-learning*, 15(4), 297-309.
- Sullivan, F. R. (2008). Robotics and science literacy: Thinking skills, science process skills and systems understanding. *Journal of Research in Science Teaching*, 45(3), 373-394. doi:10.1002/tea.20238
- Sung, W., Ahn, J., & Black, J. B. (2017). Introducing computational thinking to young learners: practicing computational perspectives through embodiment in mathematics education. *Technology, Knowledge and Learning*, 22(3), 443-463.

COMPUTER SCIENCE IS ELEMENTARY

Tucker, A. (2006). A Model Curriculum for K--12 Computer Science: Final Report of the ACM K--12 Task Force Curriculum Committee.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, 49(3), 33-35.

COMPUTER SCIENCE IS ELEMENTARY

Appendices

Appendix A

Loess Hills Computer Programming Specialty School Info Flyer



LOESS HILLS
</>
COMPUTER PROGRAMMING
 ELEMENTARY SCHOOL

<An Algorithm for Success/>

<About Loess Hills/>

- Opened in 2014-15
- TK-5 Elementary with 650 students
- 40% White, 39% Hispanic, 6% Native American, 6% Black/A American, 7% Other Ethnicities
- 100% Free and Reduced Lunch
- 1:1 Learning Environment
- Believe 100% of Students can be Successful

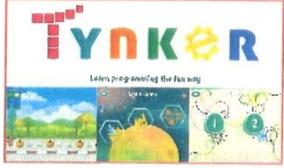


<Computer Programming Goals/>

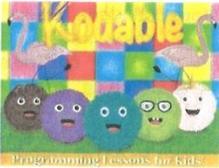
1. Integrate programming (techniques/methods/ tools) into daily instruction across all subjects
2. Offer digital options for standard district projects, ex: 4th grade history
3. Implement capstone programming events at all grade levels
4. Implement 1 hour of coding each week

<Computer Programming Student Outcomes/>

1. Student achievement in math, reading, and writing will improve.
2. Students will demonstrate high levels of engagement
3. All students will gain experience in computational thinking



TYNKER
Learn programming the fun way



Kodable
Programming Lessons for Kids

COMPUTER SCIENCE IS ELEMENTARY

<Programming a Specialty School/>**<Coding Leadership Team/>**

- Year 1 Cohort - A teacher from each grade level volunteered to implement computer programming into their individual classrooms.
 - o Teachers received summer PD to plan and learn
 - o Collaborated with Technology Consulting Teacher and Teacher Librarian to develop classroom lessons and integrated activities
 - o ISTE International Conference
- Coding Leadership Team - One teacher from each grade level meets monthly to advise on school wide coding implementation

<Professional Development/>

- Job embedded PD with Technology Consulting Teacher and Teacher Librarian
- Workshops with Tynker® and Kodable® co-founders
- Summer PD for curriculum development

<Community Engagement/>

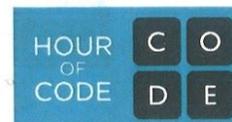
- Coding Advisory Team - Coding Leadership Team and Community Partners meet quarterly to collaborate on coding projects and capstone events
- Each grade level will be partnered with a local business
- Partners include WITCC, Briar Cliff University, Morningside College, Electric Innovations, CrossPointe Church

<Finances/>

- Site License for Tynker® and Kodable® - \$1600
- Professional Development
 - o Full Staff for 2 Days - \$10,140
 - o 4 Days Leadership Team - \$2,600
 - o Trainer from Tynker - \$3000

<Student and Parent Engagement/>

- Hour of Code Week
 - o Cookies and Coding open house to showcase students work and allow for parents to experience coding in the curriculum
 - o Coding Relay Competition grades 3-5
 - o K-5 in class coding activities
 - o H.O.C. field trips to other schools
 - o Middle school collaboration on coding projects



COMPUTER SCIENCE IS ELEMENTARY

Appendix B

[Loess Hills Computer Programming Specialty School Blueprint for the State](#)



Blueprint for the State
Loess Hills Computer Programming Specialty School

COMPUTER SCIENCE IS ELEMENTARY

Appendix C

Computer Science is Elementary Award Announcement

On April 30, 2019 at the Governor's Future Ready Summit the *Computer Science is Elementary* awardees were announced. Kingsley Elementary received notice on May 29th, during a second round of awards, that they would receive the \$50,000 award. This means that Kingsley Elementary School will be able to implement this project. The Kingsley-Pierson Community School District will start this computer science endeavour during the 2019-2020 school year.

Press Release:

<https://governor.iowa.gov/2019/06/gov-reynolds-announces-six-more-computer-science-is-elementary-schools>