Expanding Computer Science and Game Development Education in K-12

Christopher Allen

School of Education, Southern Oregon University

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Dr. Amy Belcastro

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Contents

Executive Summary

Purpose

The purpose of this draft executive summary is to increase the capabilities and amount of qualified real-time 3d educators in the high school settings via community outreach, training programs, certifications, and professional development events, and to expand the scope of computer science programs in my school and others. Teacher competency directly impacts the outcome of students in cutting edge fields such as game design, visual effects, animation, 3d simulation, programming, and other, and is a key focus of addressing the lack of real-time 3d educational programs in high schools as well as expanding upon existing computer science programs. Improving the abilities of educators, and compensating them for their time, pays off for each and every student that educator interacts with is paramount.

Problem Statement

Game design and computer science educational programs are very limited at k-12 schools due to lack of trained educators, adequate hardware, and leadership support.

Importance

The importance of a high quality computer science, and real-time 3d design programs at the high school level can not be understated. Interactive, real-time 3d design is growing at an astonishing rate, and the demand for trained professionals is constantly increasing. According to Unreal Engine (2021) “As the use of 3D graphics and real-time 3D technology becomes more and more ubiquitous, we are seeing these skills considered essential across architecture and construction, civil engineering, mechanical and electrical engineering, graphic design, interior

design, and game development." The article goes on to state that "the demand for real-time 3d skills is increasing at 50% faster than the average information technology job." I also teach a variety of programming courses unrelated to real-time 3d design. Traditional computer science is in high demand as the world relies more and more on code and technology to do everything. According to the U.S. Bureau of Labor Statistics (2022) "Employment in computer and information technology occupations is projected to grow 13 percent from 2020 to 2030, faster than the average for all occupations." and that "The median annual wage for computer and information technology occupations was $97,430 in May 2021, which was higher than the median annual wage for all occupations of $45,760." The demand is even more prevalent in certain fields such as cybersecurity and information technology, with a relatively low bar of entry being certifications, as opposed to a bachelor's degree plus multiple years of experience.

Intended Outcome

The goal is to increase the amount of real-time 3d programs being taught in high schools across the United States, and to bolster traditional existing computer science programs. Ideally, both real-time 3d design and traditional computer science students could work together on new and exciting projects of their own designs. Students studying other subjects such as science, math, or art could be part of larger scale projects that facilitate teamwork and critical thinking. The initial phase is to ensure that enough high quality educators are trained in the basics of the subject matter and are then supplied with adequate technology and resources to be able to bring the concepts and subject matter to a larger student body. Using programming, art, game design, and technology as a medium to teach students a variety of topics while allowing them freedom to pursue their interests is a form of education that this proposal is striving for.

Literature Review

Introduction

Computer science is a highly valuable education field that benefits all study in many different ways. Understanding and implementing the core concepts of computer science allows students to grow academically, personally, and professionally. Many skills developed in computer science translate over to other fields of study. Computer science helps students outperform in school, college, and workplace (Code.org, 2021). One of the most valuable 21st-century skills that students can develop is the ability to problem solve, which is a core concept needed to learn any type of computer science. Developing problem solving and critical thinking skills can promote student success in all aspects of education. “The role of computers in daily life and the economy grows yearly, and that trend is only expected to continue for the foreseeable future. Those who learn and master computer science (CS) skills are widely expected to enjoy increased employment opportunities and more flexibility in their futures, though the U.S. currently produces too few specialists to meet future employment demands. Thus, providing exposure to CS during compulsory schooling years is believed to be key to maintaining economic growth, increasing employment outcomes for individuals, and reducing historical gaps in participation in technology fields by gender and race.” (Hansen & Zerbino, 2022). How can equitable access to computer science programs benefit students and their futures, and how can we increase the quality, quantity, and equitability of these programs?

The Importance of Computer Science Programs

“Computer science develops problem solvers and innovators: Fundamentally, computer science teaches computational thinking, logical data analysis and organization, the ability to

create concise problem statements, to identify and implement algorithm-based solutions, and to generalize and extrapolate solutions that can be applied to other problems. Helping students develop these skills will be a benefit to them in every subject, in the classroom and beyond." (Derbenwick Miller, 2017). Some skills used in computer science include, but are not limited to, critical thinking problem solving, logic and analysis, collaboration independent research and improved understanding of science and math (Papadimitriou, 2003). These skills are used in almost every industry and thus an argument can be made for the requirement of computer science courses in high school. Benefits of making computer science a high school requirement include developing analytical thinking skills, increased earning potential, increased job opportunities, diverse options, a chance to change the world and closing the diversity gap. (Lynch, 2019). In addition to developing soft skills that transfer to any area of study, computer science is one of the most in demand and lucrative industries in the world right now, and it is only going to continue to grow. Computer science skills are in high demand, offering high wages, and are needed in almost every industry. (Derbenwick Miller, 2017).

Computer Science in k-12 Education

In order to serve the demands of students, colleges, companies, and all stakeholders, improvements should be made to the quality and proliferation of computer science programs in k-12 education. Computer science is at the forefront of many industries and our world is increasingly dependent on computers. "Computer science (CS) and information technologies have transformed all sectors of society, businesses, and government. Today, the transformation continues and much is driven by artificial intelligence, robotics, the Internet of Things, information security, and data science. A wide range of jobs in virtually all sectors demand

computing skills to an unprecedented extent. And every academic discipline finds itself incorporating computing into its research and educational mission." (National Academies of Sciences, Engineer, and Medicine, 2018). Currently, only 15 U.S. states require high school students to take computer science. Many parents, industry professionals, and educators are advocating for computer science to be taugh as a requirement, just like math, English, science, etc. (Lynch, 2019). Computer science can also be integrated with core classes in order to teach complex math problems and do scientific research of any kind. "Despite the growing use of computers and software in every facet of our economy, not until recently has computer science education begun to gain traction in American school systems. The current focus on improving science, technology, engineering, and mathematics (STEM) education in the U.S. school system has disregarded differences within STEM fields. Indeed, the most important STEM field for a modern economy is not only one that is not represented by its own initial in "STEM" but also the field with the fewest number of high school students taking its classes and by far has the most room for improvement—computer science." (Nager & Atkinson, 2016). Computer science is a science, and arguably one of the most commonly used and world-changing science fields. That is why it is important to have computer science represented as part of STEM education.

The goal of this research outline is to understand ways to increase the capabilities and amount of qualified real-time 3d, and computer science educators in the high school settings via community outreach, training programs, certifications, and professional development events, and to expand the scope of computer science programs in my school and others by demonstrating the importance of the computer science field in education and almost all industries.

Benefits of Computer Science Programs in k-12 Education

There are many benefits to computer science programs in k-12 education. Computer science programs teach soft skills that can be transferred to any field of study. These skills include but are not limited to critical thinking, problem solving, logic and analysis, collaboration independent research, and proficiency in science and math. (Papadimitriou, 2003). Computer science helps students outperform in school, college, and workplace (Code.org, 2021). Implementing a strong computer science program helps students become "problem solvers and innovators: Fundamentally, computer science teaches computational thinking, logical data analysis and organization, the ability to create concise problem statements, to identify and implement algorithm-based solutions, and to generalize and extrapolate solutions that can be applied to other problems. Helping students develop these skills will be a benefit to them in every subject, in the classroom and beyond." (Derbenwick Miller, 2017).

The Importance of High Quality Computer Science Education

The importance of a high quality computer science, and real-time 3d design programs, at the high school level can not be understated. Interactive, real-time 3d design is growing at an astonishing rate, and the demand for trained professionals is constantly increasing. According to Unreal Engine (2021), "As the use of 3D graphics and real-time 3D technology becomes more and more ubiquitous, we are seeing these skills considered essential across architecture and construction, civil engineering, mechanical and electrical engineering, graphic design, interior design, and game development." The article goes on to state that "the demand for real-time 3d skills is increasing at 50% faster than the average information technology job." I also teach a variety of programming courses unrelated to real-time 3d design. Traditional computer science is

in high demand as the world relies more and more on code and technology to do everything. According to the U.S. Bureau of Labor Statistics (2022) “Employment in computer and information technology occupations is projected to grow 13 percent from 2020 to 2030, faster than the average for all occupations.” and that “The median annual wage for computer and information technology occupations was $97,430 in May 2021, which was higher than the median annual wage for all occupations of $45,760.” The demand is even more prevalent in certain fields such as cybersecurity and information technology, with a relatively low bar of entry being certifications, as opposed to a bachelor’s plus multiple years of experience.

Historical Roles of Computer Science in Education.

Computer science was introduced to the field of education in 1928 when IBM got involved working with universities to calculate difficult problems that were done by hand at the time. (IBM, 2022). “IBM worked with Howard Aiken, a professor at Harvard University, to design and build the first running programmable computer, the Harvard Mark I, which was installed at the university in 1944.” (IBM, 2022). Aiken then set up a computer lab at Harvard and started a computer science degree program there. “At the time, few scientists of any discipline understood how to use computers. So in 1947, IBM created the “Watson Laboratory Three-Week Course on Computing” and, over time, thousands of academics and high school science and math teachers took the course.” (IBM, 2022). Computer science programs have expanded rapidly since the early days of computer science education. In the last 10 years, public policies, public interest, and financial opportunities have led to the proliferation of computer science education programs. Unfortunately, most of these programs are aimed primarily at college students. Expanding computer science programs to k-12 is crucial in order to give our

young students the skills they need to succeed in an increasingly high tech world. During the recent expansion of computer science programs there have been “sharp, coinciding increases in both state adoption of CS education policies and overall participation in AP CS exams. AP CS participation rates for all student subgroups have also increased, with representation gaps between student groups narrowing. Narrowing participation gaps for females and especially Black and Latino students have been primarily driven by the introduction of a new AP CS exam (CS Principles), with gaps changing little since then and passing rates on AP CS exams have modestly increased for underrepresented student groups during this period, resulting in slightly narrower passing gaps.” (Hansen & Zerbino, 2022). Although computer science classes have been offered in k-12 education they are not generally required. This contributes to an inequitable gap in access among different student populations. Many economically disadvantaged students do not have access to the same high quality computers and curriculum, and may not be encouraged to join extracurricular activities such as after school computer science clubs and competitions. Making computer science a requirement would bring equal access to all diverse populations and increase the overall competitiveness of the United States in computer science fields. Computer science education benefits students in many ways, regardless of whether they become employed in the field or not. “Individuals who develop expertise in computer and technology fields enjoy higher wages and employment. Even those who do not pursue technical occupations still reap these benefits, as computing and data analysis skills have been broadly integrated into many industries and occupations. Finally, CS education also benefits students who do not use computers in their future careers. Prior studies have documented cognitive and interpersonal skills that CS education uniquely provides to students, which transfer outside of computing domains.” (Hansen & Zerbino, 2022).

Possible Cons and Risks of Requiring Computer Science Education in k-12

Learning computer science is not without a few possible drawbacks. If students are not interested or proficient in math, computer science may be very difficult. Working in the computer science field is not for everyone, but by using scaffolding, students will be able to gain useful knowledge that can be transferred to other professions. One of the cons that many people don't necessarily think about before deciding to focus on computer science is the health impact of sitting at a desk all day. This can be mediated by using a standing desk or ergonomic chairs to some extent but sitting at a desk, staring at a screen for 40 hours a week may take a toll on one's health if not properly managed. Another con is the time commitment needed to become proficient in specific areas of computer science. The industry is always changing and advancing, so students will need to constantly be learning in order to stay on the cutting edge. Another drawback is the amount and cost of education needed. "Due to the various roles you may choose as a computer scientist, there are different requirements for education. Some employers may hire based on experience or require specific programs and degree levels for specialized positions." (Indeed Editorial Team, 2022). There are a lot of entry level positions available, and depending on proficiency, one may not need further education if they learn the skills needed on the job. Computer scientists may also feel isolated and lack interaction with others, depending on the specific job. "With independent computer scientist work, you may have minimal communication with other professionals. Limited interaction can reduce engagement or interest in your work. You can establish workplace relationships through participating in team events or programs, whether online or in person, to increase your interaction." (Indeed Editorial Team, 2022). This may be viewed as a benefit of computer science, since there are many opportunities to work

remotely and have more work/life balance. Not everyone will want to work in the computer science field, but not everyone wants to be a mathematician or an English major either. Exposing students to computer science concepts has myriad benefits along with some cons, and should be considered by administrators as a possible requirement for high school students.

Solutions to Expanding High Quality Computer Science Programs

Computer Science is utilized in countless technologies and jobs in today's world. Computer Science programs help to prepare students for high paying jobs that, according to The U.S. Bureau of Labor Statistics (2021), is poised to add 667,600 new jobs, with a median salary of $97,430, as of May 2021, compared to the median annual wage for all occupations of $45,760. "Demand for these workers will stem from greater emphasis on cloud computing, the collection and storage of big data, and information security." (U.S. Bureau of Labor Statistics, 2021). And yet, computer science courses are offered in only about 45% of our nation's high schools. (Bentley, 2021). In California, considered a tech innovation center in the world, only 1/3 of schools have computer science courses. Data shows that students of color, low-income, and rural students have fewer opportunities to engage in these courses and prepare for CS careers. There are several problems that need to be overcome to improve access to these programs including the lack of funding, development of curriculum, and the shortage of qualified teachers.

The lack of qualified teachers in CS is a challenging problem that affects the ability to expand access to quality CS programs at our High Schools. "This shortage is the No.1 reason more computer science courses are not offered." (Harris & Hegeman-Davis, 2021) With the high demand in the job market, many qualified individuals choose high paying tech sector careers over teaching. As a result, schools often turn to teachers who are not skilled or qualified to teach

the highly technical content. According to Code.org, California only graduated 3 new computer science teachers in 2018. (Code.org, 2022)

There isn't one simple solution to the shortage of qualified CS teachers, rather a combination of ideas to address the shortage is needed. It is a complex issue that is truly important to address to prepare our students for the highly technical careers of the future. One possible solution is to partner with companies in the computer science industry to commit to share their talent. This could be accomplished in a variety of ways and would help meet the need to provide knowledgeable, expert teachers in CS. Course content could be created by companies and be used as certification that proves a student is proficient in the desired coding languages and concepts. Ultimately, the commitment would benefit both the student and the industry professional, by helping to educate students for future careers. Companies may also develop direct training and certification programs that may be implemented in high schools in order to satiate the demand for computer science professionals. Companies like Oracle, and Cisco have been offering certification programs in high school settings for years, and it is a great opportunity for students that are interested in the field to get high quality training that leads directly to a high paying job after high school.

Funding is one of the main issues driving inequity in STEM based on socioeconomic backgrounds and other factors. Most funding must come from school districts in order to create and support STEM education programs. Unfortunately, not all schools are funded equally.

The funding of schools in America is highly inequitable and almost entirely based on the income of the area students live in. Currently the federal government only provides 7.9% of the funding for public k-12 schools. (Hanson, 2022). The rest is made up by state and local taxes. This means the poorer the area a student lives in, the less funding their school receives.

Compounding the problem, high quality teachers will seek out higher paying school districts. In order to alleviate this funding disparity at least two things need to happen. First, states will need to allocate funds progressively to low-income students. Second, the federal government can either contribute more funding to k-12 education, or be more responsible for making sure that each student receives an equal amount of funding for their education regardless of socioeconomic background or location. Programs such as the Every Student Succeeds Act (ESSA) are making strides towards providing equal funding to lower income students. One of the main goals of this act, signed into law in 2015 by president Obama, is to "provide all children significant opportunity to receive a fair, equitable, and high-quality education, and to close educational achievement gaps" and to "To increase capacity of states and districts to 1) provide students with access to a well-rounded education, 2) improve school conditions for student learning, and 3) improve the use of technology to increase digital literacy of all students." (Next Generation Science Standards, 2019). Much of this funding has been used to bring equity to educational funding for all socioeconomic groups and has been used to boost STEM programs. More government funded programs like this would increase the competitiveness of America in an ever increasingly competitive, technology dominated world.

Collaboration is a great way to bring a diverse group of students together for a common goal. These collaborations can be in the form of clubs, competitions, group projects, mentorships, and more. Some competitions can lead to direct scholarship or employment opportunities, such as Cyber Patriots, a hacking competition my students competed in this year run by the U.S. Air Force and is sponsored by Northrop Grumman, Boeing, Cisco, and other large STEM corporations. There are many other types of competitions specific to each STEM

discipline. These are great opportunities to join other like minded people, learn real world skills, and develop an impressive resume at a young age.

Corporations are one key to improving the socioeconomic equality of STEM education, as they will be the beneficiaries of such improvement. Corporations have been increasingly involved in providing funding opportunities to help fund STEM education programs. In fact I was the recipient of such funding in the form of MegaGrant from Epic Games. I received this funding in order to create the curriculum needed to support my students, as well as the technology to work in real-time 3d. (Sharon, 2021). There are many corporations that are now offering grant support for STEM education programs. “Although top STEM funders that prioritize higher education have, in recent years, given hundreds of millions of dollars in annual funding, they represent a fraction of the total foundations that award such grants.” (Inside Philanthropy, 2024). Internships and externships are another great tool for allowing passionate students to dive into the STEM field of their choice and be provided with real-world, hands-on experiences that are invaluable in starting a career in STEM. Many STEM companies are reaching out to schools and creating a direct employment pipeline. My students have personally worked with Epic Games, IBM, and Cisco, in an effort to train the next generation of qualified STEM professionals.

Conclusion

Using a combination of improved school funding, more even distribution of funding for STEM programs across the country, corporate backing, improved teacher training programs, and improved STEM education programs in school, we have the ability to combat and overcome the

socioeconomic disparity currently plaguing STEM education and the STEM industry as a whole, while improving the lives of students and society.

Action Plan and Steps

Action Plan

Strategy: Improve and expand the existing computer science and game design programs, with the goal of offering k-12 computer science courses.

Change to Be Sought: Expand the current computer science and game design course to reach elementary and middle school students.

Collaborators and Stakeholders: Classroom teachers, counselors, CTE department, individual campus leadership, district leadership, parents, local companies, and board members.

Action Steps

Action Steps	**By Whom**	**By When**	**Resources and Support** Available/Needed		**Potential Barriers or Resistance**	**Communication Plan for Implementation**
What needs to be done?	Who will take actions?	By what date will the action be done?	Resources Available	Resources Needed (financial, human, political, and other)	What individuals and organizations might resist? How?	What individuals and organizations should be informed about/involved with these actions?
Step 1: Survey student and parent interest.	Admin	9/1/22	Online survey tools like Google Forms can be added to our current email blasts that go out to all parents and students.	Collaboration with administration and site leadership to send out survey links to all interested parents and students.	Counselors and parents might resist if their student is already struggling to pass their core classes.	Students, parents, and leadership.

Step 2: Develop a curriculum outline for each grade that is cohesive and additive.	CTE leadership and STEM teachers.	5/1/23	Codehs.com subscription, Scratch.mit.edu (free), Unreal Engine (free), gaming PCs with remote desktop software Parsec, Chromebooks, wi-fi hotspots.	Stipend for course development and implementation. Time dedicated to creating and implementing course curriculum. Additional administrative support	Creating and implementing curriculum for grades k-8 will take time. Codehs.com has a pre-made curriculum but should be supplemented by teacher made units specific to each grade level.	Admin, CTE teachers, K-8 teachers.
Step 3: Implement course curriculum and create courses in our LMS (learning management system), Canvas	CTE leadership and STEM teachers.	7/1/23	Canvas, CodeHS, Chromebooks, only one computer science teacher (myself).	Administrative assistance in creating the various courses. Counselor support to add students.	Setting up each course can take a long time and assistance from CTE leadership may be required to expedite the process.	Admin, CTE teachers, K-8 teachers, site facilitators, board members.
Step 4: Hire additional computer science teachers	Admin, CTE leadership	7/14/23	Teacher salary and CTE funding available.	Support from leadership that computer science is worth funding.	Lack of funding on behalf of the school. Lack of available qualified computer science teachers.	Human resources.
Step 5: Enroll students in pilot computer	Administration, site facilitators, principals,	8/1/23	Canvas, student surveys, counselors, administrati	Help from counselors getting students interested and enrolled.	Possible lack of interest by students to fully fill out the courses.	Human resources, counselors, teachers, parents, students.

science programs k-12.	counselors.		on, registrar, and parent support.			
Step 6: Evaluate first year course success rates. Make changes to improve the courses as needed.	CTE leadership, STEM teachers, board members, district leadership	5/1/24	Analyze the data regarding grades, success rate, motivation, engagement, and results. Change programs as needed to improve success rates.	Meetings with CTE and district leadership to discuss efficacy and success of the pilot program and determine what changes, if any, could be made to improve.	High failure rates may lead to program shut down. Balancing the difficulty of each course and the grade level may be challenging the first year.	CTE teachers, K-8 teachers, admin, board members, leadership.

Adapted from Community Tool Box (University of Kansas)

Evaluation Plan

Formative Evaluation	
Type of Evaluation	**Purpose**
1. Needs Assessment	There are many strengths, weaknesses, opportunities and threats when it comes to implementing a k-12 computer science and game development program throughout the school district. Computer science helps students develop problem-solving, critical thinking and complex analytical skills while encouraging creativity, collaboration and other 21st century skills that are crucial in the success of our students. This plan attempts to address the 21st century skills needs of students by implementing a school wide, k-12 computer science program and integrating STEM teaching techniques in all courses. Strengths ● Increase the capabilities and amount of qualified computer science, and real-time 3d educators in k-12 settings by community outreach, training programs, certifications, and professional development events. ● Teacher competency directly impacts the outcome of students in cutting edge fields such as game design, visual effects, animation, 3d simulation, programming, and more.

	● Improving the abilities of educators, and compensating them for their time, pays off for each and every student that educator interacts with. ● California State Standards, and Next Generation Science Standards provide curriculum guidance. ● CodeHS has premade coding course for grades k-12 ● 21st century skills for all students. ● Increased focus on science and math competency. ● Interdisciplinary skills. ● Technological literacy. ● Career opportunities. Weaknesses ● Possible lack of interest and understanding of the need for computer science by leadership. ● Ability to articulate and communicate the value of real-time 3d education. ● Oversight. Our school is huge and my small program does not get as much attention as needed currently to expand. ● Possible lack of interest by students to fully fill out the courses. ● Balancing the difficulty of each course and the grade level may be challenging the first year. ● Extra training for teachers should be encouraged and/or

	mandatory in order to keep our school at the cutting edge. Opportunities ● High paying, in demand careers. ● Skills help students succeed personally, educationally, and professionally. ● Increased interest in enrollment due to program notoriety and/or availability. ● Industry partnership ○ Unreal Engine and their Megagrant program, which I have been a recipient of, is a great resource that is highly passionate about bringing educational resources about real-time 3d design to high schools across the world. ○ Recently we have also been working with IBM and SpaceX to simulate satellite launches and collect data. This provides a direct path for high quality careers, and empowers students with the knowledge required to obtain them as well. ● Perkins funding as well as other technology related funding sources for education are growing, as is the demand for skilled workers. ● The field is only growing and so is the demand. Having educators that can keep up with these trends is crucial in supporting our next

	generation students. Threats ● Lack of qualified, or interested, staff. ● Financial compensation for extra training programs may be required. ● Lack of technology. Real-time 3d education requires high-end computers. Luckily we have used grant money for ours. Other districts can do the same. ● Counselors and parents might resist if their student is already struggling to pass their core classes.
2. Process or Implementation Evaluation	The first stage of implementation of this project is a 6 step plan that will take roughly 1 year to implement. Success rate and possible modification options should be revisited annually. ● Step 1: Survey student and parent interest. ● Step 2: Develop a curriculum outline for each grade that is cohesive and additive. ● Step 3: Implement course curriculum and create courses in our LMS (learning management system), Canvas ● Step 4: Hire additional computer science teachers ● Step 5: Enroll students in pilot computer science programs 8-12.

	• Step 6: Evaluate first year course success rates. Make changes to improve the courses as needed. The strategy of implementation is to improve and expand the existing computer science and game design programs, with the goal of offering k-12 computer science courses. The changes that are sought consist of expanding the current computer science and game design course to reach elementary and middle school students by hiring additional computer science teachers, and training existing teachers in STEM education techniques to boost STEM integration. Collaborators and stakeholders include classroom teachers, counselors, CTE department, individual campus leadership, district leadership, parents, local companies, and board members.

Summative Evaluation	
Type of Evaluation	**Purpose**
1. Goal Evaluation	After curriculum, staffing, implementation, and enrollment has been completed, the program can begin expanding to k-8.The goal of this plan is to implement a school-wide k-12 computer science program in three years. The first year will consist of planning curriculum, hiring teachers, and setting up necessary hardware and software. The second year will consist of implementing a middle school computer science program. Year three, the computer science program will expand to elementary school, with an additional goal of integrating computer science standards into core elementary school subjects taught by the assigned teachers. Success will be determined by student enrollment rates, student engagement, student success/fail rates, retainment rates, and feedback from all stakeholders involved. Exact rates will be determined by the school board. Topics, standards and techniques should be evaluated each year and altered accordingly to benefit our students, teachers, and stakeholders.
2. Impact Evaluation	Students will be able to demonstrate 21st century skills such as problem-solving, creativity, collaboration, critical thinking and more.

	Math and science scores should improve as STEM integration becomes more widespread. Student engagement in optional STEM in CTE classes should improve and success should be rewarded and advertised. Students will have opportunities to learn the skills needed for high-paying jobs. College and career readiness should improve and career placement and internships need to be encouraged and promoted. Students will have the ability to learn about in demand topics and acquire the skills to be successful in school, life, and work.

Conclusion of Project Design

The Importance of Computer Science in K-12 Education

Computer science is an extremely important discipline for students to understand. Not only are computer science jobs in high demand, and high paying, but learning computer science also has been shown to improve 21st century skills like problem solving, critical thinking, teamwork, and more.

Expanding and Implementing a K-12 Computer Science Program

The expansion of our existing computer science program will be a huge endeavor. Currently, I am the only computer science teacher in our district. I teach computer science and game design to high school students from multiple campuses via online learning. In order to successfully expand and implement a high quality computer science program throughout our school district, and for all ages, it will take a lot of support from leadership, administration, students, parents, board members, and existing teachers. Starting with an expansion into 8th grade will be the initial goal, with the expectation of hiring at least one new CTE computer science teacher to fill this role.

Possible Roadblocks and Solutions

There are multiple possible roadblocks to successfully implementing computer science curriculum for k-12. One of the possible main issues is finding additional, qualified, computer science teachers in the area. We could hopefully solve this issue by advertising the position on more job sites, and explaining directly that you can become a CTE teacher with industry experience alone, then work on getting your credential while working. This may interest some

technology industry workers that are looking for a change of pace, or just to make a difference in the lives of young learners and potential future computer scientists. Another possible problem would be convincing elementary school teachers to teach new lessons. By providing the curriculum already pre-made with a simple set of instructions, and teacher training as needed, we can hopefully demonstrate how easy and beneficial teaching these concepts can be for young students.

Future Goals

After successfully expanding into middle school, we will expand the computer science program into the elementary curriculum. This would be provided to existing k-5 teachers and be taught as standalone units. The curriculum is already created and teachers can be informed on how to teach it by holding short training sessions with the computer science teachers. K-5 teachers can use computer science lessons to bolster their existing math, science, and english concepts that they are already teaching and familiar with. This allows students to approach core concepts like math from a new perspective that may make the content more interesting and understandable to different types of learners. Preparing this project proposal allowed me to analyze and account for possible problems while discovering solutions in order to bring a high quality computer science program to all of our K-12 students. I look forward to implementing this plan and sharing my love of computer science and real-time 3d with all of our students.

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Appendices

SWOT Analysis

	Positives	Negatives
Internal	**Strengths** ● Increase the Capabilities and amount of qualified real-time 3d educators in the high school settings by community outreach, training programs, certifications, and professional development events. ● Teacher competency directly impacts the outcome of students in cutting edge fields such as game design, visual effects, animation, 3d simulation, programming, and more. ● Improving the abilities of educators, and compensating them for their time, pays off for each and every student that educator interacts with.	**Weaknesses** ● Lack of qualified, or interested, staff. ● Financial compensation should be included in the budget for extra training programs ● Extra training for teachers should be encouraged and/or mandatory in order to keep our school at the cutting edge. ● Lack of technology. Real-time 3d education requires high-end computers. Luckily we have used grant money for ours. Other districts can do the same. ● Streaming platforms allow 1 computer to be shared and accessed by multiple students, reducing the initial investment.
External	**Opportunities** ● Unreal Engine and their Megagrant program, which I have been a recipient of, is a great resource that is highly passionate about bringing	**Threats** ● Overall understanding by leadership. Being able to

	educational resources about real-time 3d design to high schools across the world. ● Recently we have also been working with IBM and SpaceX to simulate satellite launches and collect data. This provides a direct path for high quality careers, and empowers students with the knowledge required to obtain them as well. ● Perkins funding as well as other technology related funding sources for education are growing, as is the demand for skilled workers. ● The field is only growing and so is the demand. Having educators that can keep up with these trends is crucial in supporting our next generation students.	articulate and communicate the value of real-time 3d education. ● Oversight. Our school is huge and my small program does not get as much attention as needed currently to expand.

Research Outline

I. Benefits of computer science education in high school.

A. Computer science helps students outperform in school, college, and workplace (Code.org, 2021).

B. Benefits of programming summer camps (Miller et al., 2018).

C. Skills developed through computer science

1. Critical thinking
2. Problem solving
3. Logic and analysis
4. Collaboration
5. Independent research
6. Math (Papadimitriou, 2003)

II. Historical role of computer science in education.

A. Exploring the state of computer science education amid rapid policy expansion (Zerbino, 2022).

B. The history and current state of computer science education in the 21st century (Patterson, 2006).

C. The increasing dependency on computers and computer science.

D. High paying job opportunities.

III. How to increase the quality of computer science programs.

A. The case for improving computer science education in high schools (Nager & Atkinson, 2016).

B. Using social gaming methods for improving computer science education (Hicks, 2010).

C. Realtime 3d with Unreal Engine for use in various industries

1. Games
2. Film
3. Simulation
4. Research
5. Application development

IV. The future of computer science education.

A. Perspectives and visions of computer science education (Hubwieser et al., 2014).

B. Integration with core classes such as math and science.

C. Benefits of making computer science a high school requirement (Lynch, 2019).

Summary

The goal of this research outline is to understand ways to increase the capabilities and amount of qualified real-time 3d, and computer science educators in the high school settings via community outreach, training programs, certifications, and professional development events, and to expand the scope of computer science programs in my school and others.