Waukegan Community Unit School District #60
Innovative STEM/Computer Science Project

Table of Contents

Absolute Priority #1 - Early Phase Rationale: Introduction

The Waukegan Community Unit School District #60 (WPS) Education Innovation Research (EIR) proposal will develop an improved **STEM -Computer Science Engineering Design Program** (STEM-CSED) in our lower achieving, high needs schools, impacting 150 teachers and more than 10,000 students. This STEM CSED project addresses the absolute priorities by **coupling a university-based comprehensive professional development model** with an existing, innovative STEM program integrating computer science, engineering, and design. The model will include: 1) high-quality professional development, 2) proven instructional methods, and 3) educational research. The proposal seeks to increase access to high-quality resources while enhancing teacher preparation in STEM and computer science to increase student interest, motivation, and achievement.

Key to this proposal is the integration of a robust K-12 computer science, engineering, and design curriculum with strong professional development partnerships from 1) Northeastern Illinois University (NEIU) Computer Science Department, 2) the NEIU Math, Science, and Technology for Quality Education Department (MSTQE), and 3) the Lake County Regional Office of Education (ROE). The STEM CSED project will seek gains in academic achievement by enhancing teacher content pedagogical knowledge via ongoing collaborative professional development.

EIR funding is crucial for all students, but especially for WPS high needs minority students. The STEM CSED project will introduce and implement relatively newer practices found exclusively in STEM and computer science as a means to address persistent achievement challenges. The STEM CSED project is designed to 1) enhance, and expand STEM and Computer Science (CS) Education and create a **K-12 Computer Science Course Pathway**; 2) increase teacher content pedagogical knowledge in both computer science, and STEM; 3) increase student academic achievement in both

Mathematics and Science; 4) increase student motivation and interest; 5) increase access to high quality resources and opportunities for future STEM careers. The STEM CSED program is aligned to the Next Generation Science Standards (NGSS) K-12 Engineering and Design Standards, The International Society for Technology in Education (ISTE) Standards, and The Common Core Mathematics Standards.

Outcomes

A major outcome of this STEM CSED project is to enhance student achievement and interest through increasing teacher knowledge and skills of STEM and computer science content. Integration of these skills into the classroom will build capacity in teachers and students alike through 1) professional development workshops and seminars, 2) using model classrooms, 3) co-teaching and 4) mentoring. In addition to building teacher capacity, this STEM CSED project will provide access to high-quality instructional resources for students.

Waukegan

WPS is a high need, urban, LEA unified K-12 district that serves a diverse student population. (Table 1). Of the 16,275 students, the vast majority are from low-income and high needs backgrounds. WPS has fifteen elementary schools, five middle schools, and one high school in two campuses. Academically, WSP60 students significantly underperform as compared to their affluent neighboring districts on statewide assessments. The 2018 state average in PARCC for students in third through eighth grades “Meeting and Exceeding Expectations” (proficiency) was 36% in reading, and 31% in math. WPS PARCC proficiency was 16% for reading and 14% for math. And the gap grows in later school years. The state average for the SAT for students “Meeting and Exceeding Expectations” was 37% for reading and 34% for math. WPS SAT proficiency was 12% for reading

and 10% for math. In addition, with lower academic achievement, WPS students are at a much greater risk of dropping out as compared to their peers (Table 1).

Table 1. Profile of Waukegan STEM CSED Schools:

	Elementary Schools (15)	Middle Schools (5)	High School (1)
Grades	K-5	6-8	9-12
Enrollment	7,921	3,745	4,609
Low Income	70%	69.8%	64%
English Learners	33%	19.4%	16%
Racial/Ethnic Background	Hispanic: 77% Black: 14.9%	Hispanic: 79.2% Black: 13%	Hispanic: 79.2% Black: 13%
Chronic Truancy	25%	32%	35%
Homelessness	2%	2%	2%
PARCC/SAT Proficiency Meets or Exceeds	Math 13% ELA 19%	Math 11% ELA 12.6%	Math 10% ELA 12%
Illinois Science Assessment	32% Proficient	39.6% Proficient	26% Proficient
Graduation Rate	-	-	71%

Funding Needs

All WPS sites qualify for Title I Schoolwide Flexibility Status. Waukegan far exceeds the 40% threshold to receive this status. In addition, Waukegan High School is on the Illinois Priority Schools list as it is in the lowest performing five percent of Title I schools. Though these designations provide a measure of funding, they do not provide adequate funding. According to the WPS ESSA evaluation rating, all WPS resources provide only a 56% adequacy of funding, significantly falling 44% short of WPS's full funding needs. These funding issues create a challenging barrier to our district's ability to offer high-quality resources and opportunities for our students.

Prior to the STEM CSED pilot programs, WPS elementary and middle school students did not have access to STEM or Computer Science education. There was only one computer science course offered at Waukegan high school. The introduction of these pilots appears to have had a significant impact. Our EIR proposal will seek to confirm and expand on early findings that the STEM CSED program's innovative STEM and Computer Science Curriculum and K-12 Pathway increase student academic achievement, attainment, motivation, and college and career readiness. **This proposal is a result of encouraging quantitative and qualitative summative assessment data** collected from the Waukegan schools that piloted the existing STEM CSED program. WPS elementary schools piloted the program as a course in the 2017-18 school year. Middle schools piloted the program as an elective course during the 2018-19 school year. Schools that were in the pilot program scored higher overall on district math assessments than the control group.

The STEM CSED program includes computer science education, robotics, and engineering and design curricula. Students in the elementary STEM CSED pilot schools had 46 minutes of STEM instruction one day per week from Fall 2017 until Spring 2018. These students were compared to students at elementary schools without the STEM CSED program. To measure the impact on student achievement from the STEM CSED program quantitative data was used from the Northwest Evaluation Association (NWEA) Math RIT score growth Spring 2017 to Spring 2018. To measure the impact on the interest and motivation of students, qualitative data was used from a survey of (49) teachers, (85) students and (8) building administrators.

Pilot Data

The results were impressive. On average, elementary students who had STEM instruction **(M= 12.85, SD = 9.367**) had higher NWEA math growth than the elementary students that did not have STEM instruction (**M= 10.64, SD =7.859**). An independent samples t-test was performed on the data to examine if the difference was statistically significant. Results indicate that STEM instruction did influence NWEA Math performance for **Spring 2017 to Spring 2018, t (552) = 2.979, p < .05 (CI. 95: .753 to 3.668).** Reject the Null Hypothesis at the .05 alpha level. STEM instruction has a statistically significant effect on math performance, with an effect size of d = .25.

Based on the success of our elementary STEM CSED program, we expanded the program to Middle School during the 2018-19 school year and plan to move the program into high school for the 2019-20 school year. The Middle School STEM CSED program was piloted at all five WPS middle schools as an elective course one day per week for a semester during the 2018-19 school year. Middle School students who participated in the STEM CSED course were compared to students that did not take the STEM CSED elective course. The preliminary data indicate that the mean average NWEA Math RIT growth for 71% of the sixth-grade students that participated in the STEM CSED program is higher than for those sixth-grade students who did not participate.

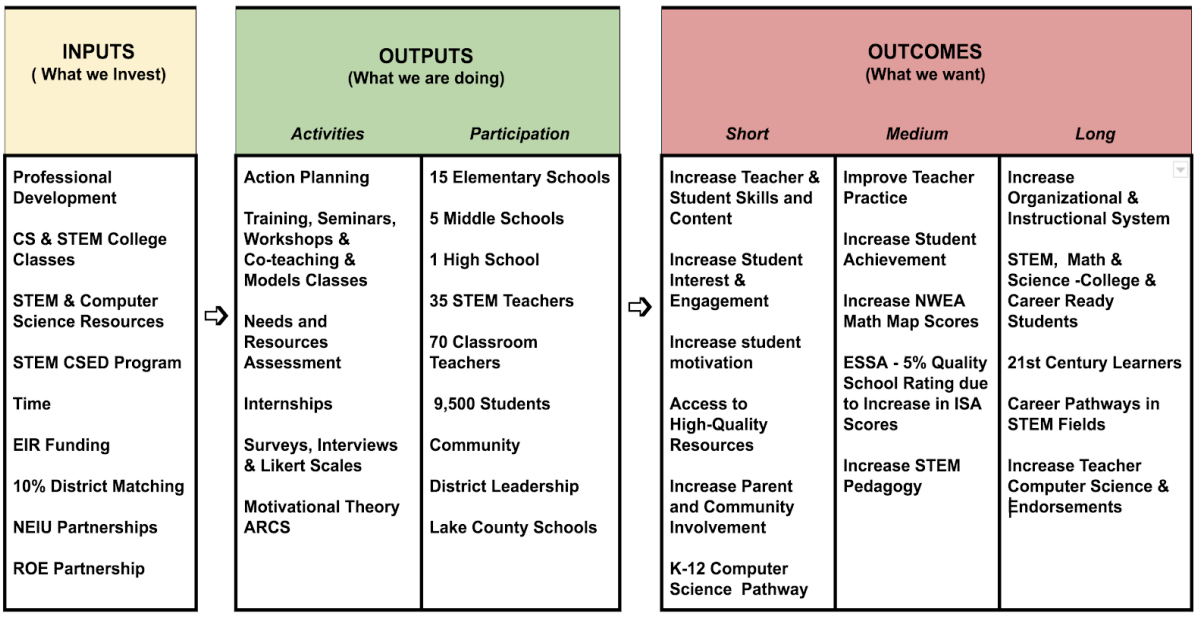
The implications are that the STEM CSED program had a statistical and significant impact on their math performance, demonstrating that STEM computer science, robotics, and engineering and design instruction increase student math performance in comparison to non-STEM instruction. In addition to the quantitative data in this project, we collected qualitative data from interviews, focus groups, and surveys of the students, teachers, and

principals at the elementary schools in this preliminary pilot group implementing the new STEM CSED program. The qualitative results were also impressive: 100% of those interviewed believed that STEM CSED instruction increased student interest and motivation, 70% percent of those surveyed believed that STEM CSED instruction increased achievement and skill transfer, 95% of those in the focus group stated that students were more engaged during their STEM CSED class and that they had no referrals or behavior issues during STEM classes as compared to other times during the school day.

The EIR grant funding would provide support to develop and improve our STEM CSED Program to include access to high-quality resources and technology as well as provide a teacher professional development partnership with NEIU and the Lake County ROE. The project would develop a K-12 STEM and CS pathway, and provide WPS teachers in the program **college course credits toward a STEM and Computer Science Endorsement**. The grant would help us expand the STEM CSED program to Waukegan High School by offering additional computer science course sequence options for students in grades 9-12. These new courses would allow high school student the opportunity to learn both Python and Java programming languages and receive college AP credit in computer science. Offering computer science credit courses options and pathways will increase Waukegan High school students' college and career opportunities.

We will use a logic model to demonstrate our rationale that investing in teacher training, STEM and Computer Science resources, instructional time, and partnerships (inputs), will enhance teacher practice and develop student skills (outputs), resulting in increased teacher STEM and CS pedagogy, student engagement and motivation in learning as well as increase student achievement (outcomes). (Table 2)

Table 2: Logic Model STEM CSED Project



<u>Absolute Priority #3:</u> Field-Initiated Innovation - Promoting STEM education, with a particular Focus on Computer Science (CPP)

The STEM CSED program uses innovative resources that integrates both the concepts and skills of computer science and computational thinking, with the engineering design process. **The curriculum exposes students as early as kindergarten to programming**, **coding, robotics, and makerspace engineering and design challenges.** These skills are included throughout the K-12 curriculum and increase in difficulty.

The STEM CSED K-12 Program incorporates Computational Thinking (CT) as a key component to the field of Computer Science and the Engineering & Design Process. Wing (2011) defines Computational Thinking (CT) as "the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent." Aho (2012) simplified this further by defining

CT as the thought processes involved in formulating problems so "their solutions can be represented as computational steps and algorithms" (p. 832).

Computational thinking is becoming a fundamental skill as important as reading, writing, and arithmetic (Wing, 2006), and while teachers should implement computational thinking and coding skills in their classrooms, many teachers are not trained in computer science, and thus unable to do so.

Studies done by the National Academy of Engineering and the National Research Council in 2009 show that STEM programs that include the EDP support allows students to frame problems, plan solutions and increase learning and academic achievement in both science and mathematics.

Research–Practice Partnerships (RPPs): RPPs are collaborations between practitioners and researchers that are formed to investigate ongoing problems and discuss solutions (Coburn, Penuel, & Geil, 2013). **NEIU and WPS will form an RPP where NEIU faculty from computer science and education work together with the STEM director of WPS and their teachers to create suitable courses to train the teachers in order for them to incorporate CT/CS in their own classrooms.** They will offer computer science credit courses and CS endorsement for WPS teachers. These courses will focus on the integration of computer science into K-8 STEM and 6-12 mathematics courses. NEIU will test and implement the curriculum, collect data, and examine the data to identify impacts and then develop an additional advanced curriculum partnership that will create and deliver rigorous, ongoing high-quality professional development in computer science and research-based instructional practices.

Through the project, the RPP with the Regional Office of Education will develop a series of tangible and sustainable STEM and CS learning tasks and resources aligned with the K-12 Mathematics Common Core Standards and The Next Generation of Science Standards (NGSS). These resources and learning tasks would be included in the new curriculum, which includes a plan for K-12 Computer Science Pathway.

WPS EIR Deliverables: (1) Develop an improved STEM CSED curriculum; (2) Develop a K-12 STEM and Computer Science CS Pathway; (3) Design professional development courses with NEIU and the ROE in STEM, Computer Science, Mathematics and Science; (4) Develop monthly co-teaching cycles and model classroom; (5) Build a website to house our STEM CSED curriculum and K-12 CS Pathways to make them available to all school districts, and (6) Publish the research findings. **The STEM CSED Curriculum will impact over 10,000 WPS K-12 students.** (Table 3)

Table 3: Waukegan Public School District 60 - STEM CSED Program

Audience	STEM CSED Content & Activities	Instructional Time	Implementation
K-2 (3,250 students)	Drag & Drop//Block programming - Code.org* Unplugged Coding & Coding Mice LEGO Wedo 2.0 Robotics* EDP - Makerspace Designing Challenges	Encore Course: All students 45 minutes/wk 4 Quarters	*Pilot 2017-18 Improved Implementation Fall 2020
3-5 (3,584 students)	Advanced Block Programming - Code.org* LEGO Mindstorm EV3 Robotics* EDP - Makerspace Designing Challenges* Intro to simple circuit programming	Encore Course: All students 45 minutes/wk 4 Quarters	
Middle School 6-8 (3,701 students)	Scratch Programming HTLM Programming - Code.org* VPython Programming LEGO Mindstorm EV3 Robotics* Programming Hardware: Arduino Circuits	Enrichment Course: Open to all students Semester: 6th-7th Full-year: 8th 200 min/week	*Pilot 2018-19 Implementation begins Fall 2020-22
High School 9-10 (2,520 students)	Introduction to Computer Science Course* PYTHON Programming Course* Integrate TI-Innovator in Trig/Algebra II & Pre/Calculus PC motherboard circuits for Beginners	CS Course Pathway Math department Open to all students	*Pilot 2019-20 Implementation begins Fall 2020-22
High School 11-12 (2,500 students)	Introduction to JAVA Programming* AP Computer Science - Code.org* Integrate TI-Innovator in Tri/Calculus & Advanced classes Introduction to Computer Applications Hardware Programming	CS Course Pathway Math department Open to all students with 9-10 CS Prerequisite	

Northeastern Illinois University EIR Deliverables: (1) NEIU CS Department will offer five sessions of **Computer Science For All** courses at WPS beginning in the Summer of 2020 and continuing through Summer 2022; (2) NEIU CS Department will offer two cohorts of WPS teachers computer science courses toward an endorsement through the **Joint NEIU-ISU TECS Program for Chicago** beginning in Fall 2020 and 2021; (3) NEIU MSTQE Department will host four two full-day professional development programs on STEM and CS pedagogy at WPS beginning in Fall 2020 through 2023; (4) NEIU CS and MSTQE Departments will develop pre/post-assessment for each course (5) an overarching survey assessment of key learning targets from the professional development and CS courses. **The Northeastern Illinois University STEM and CS credit courses will be available to over 150 WPS K-12 teachers**. (Table 4)

Table 4: Northeastern Illinois University - College Credit Course, CS Endorsement, and Pedagogy Traning

Northeastern Illinois University Courses	Course Outline Content	Cohort Dates	Audience
Computer Science for All Course (University Credit in Computer Science)	Block Coding Scratch Coding LEGO Mindstorm EV3 Robotics Python Programming Pre/Post Assessment	Cohort 1: Location: Waukegan June 2020- Aug 2020 Cohort 2; Location: Waukegan June 2021-Aug 2021 Location: NEIU June 2022	2 sections: (K-5) & (6-12) (25 teachers/section) 2 sections: (K-5) & (6-12) (25 teachers/section) 1 section: (K-12) (25 teachers/section)
MSTQE - Pedagogy Training	CS & STEM Instructional Strategies Training on classroom organization Best Practice on Technology Training Classroom Management for Grouping & Flexible Seating. Pre/Post Assessment	Cohort 1-3: Location: Waukegan 2020-23 School Years	Follow-up Training On-going
Joint NEIU-ISU TECS Program for Chicago Endorsement in Computer Science	FALL: CS201 or PHYL201 or MATH 251 (all logic or discrete math) SPR: CS200 (Programming I) SUM: CS207 (Programming II)/ TEC 275: Technology and Quality of Life (online) FALL: CS304 (Data Structures) SPR: CS331 (Computer Networks) SUM: CS300 (Web Development) /TEC 389.65: Teaching Computer Science in the Secondary School/TEC 389.66: Seminar FALL: CS301 (Computer Organization)	Cohort 1: Location: NEIU Fall 2020 - Dec 2022 Cohort 2: Location: NEIU Fall 2021 - Dec 2023	1 section: (K-12) (20 teachers/section) 1 section: (K-12) (20 teachers/section)

Lake County Illinois Regional Office of Education EIR Deliverables: (1) Professional development two-day courses during the school year at WPS, in Mathematics Methods, STEM CSED, and Five E's Phenomena Based Science. These classes will include three PD credit hours per course; (2) Develop Pre/Post-test for each course to show teacher content area growth; (3) **Create a lending library of coding and robotics resources** for teachers that participate in the computer science courses. **The ROE professional development courses will expand STEM and computer science to other low-income school districts in Lake County Illinois.** The courses would be available for no cost to WPS teachers and to the teachers in the 45 school district that make up the Lake County ROE. (Table 5)

Table 5: Lake County Regional Office of Education Professional Development Courses

Lake County ROE Courses	Course Outline/Content	Cohort Dates	Audience
STEM CSED Program K-5/ 6-12	Introduction to: Coding & Code.org LEGO Robotics EDP & Makerspace Challenges Scratch & HTML - Code.org LEGO Mindstorms	Two sessions per school year for each course. One section for K-5 and one 6-12. Pre/post tests for each course	K-12 Teachers from Lake County (20 teachers/class/year)
5 E- Phenomena Based Science K-5/ 6-12	Introduction to 5 E's Best Practice & Methods for Teaching Elementary, Middle & High School Science		
Mathematics Methods K-5 /6-12	Best Practice & Methods for Teaching Elementary, Middle & High School Mathematics		

A. Significance

(1) The National Significance of the Proposed Project:

70% of WPS students come from low-income households. STEM education is essentially a way to offer equity in opportunity and to motivate this high needs population. Numerous studies have shown a correlation between students' motivation and academic performance. According to John Keller's ARCS Model of Motivational Design, to increase student motivation

instructors must address attention, relevance, confidence, and satisfaction (Keller, 2010). Using innovative research-based resources that are student-centered and hands-on can increase student interest and motivation. Using student-centered and hands-on approaches also provide multiple opportunities at varying levels for students to achieve success which often results in a higher level of engagement, interest, and motivation among the students.

STEM education is of national significance because there is a shortage of STEM-qualified workers and STEM jobs are growing at a faster rate than non-STEM jobs. According to the Bureau of Labor Statistics, the national average wage for all STEM occupations in 2015 was $87,570, which was almost double non-STEM occupations (Fayer, S., Lacey, A., & Watson, A., 2017). However, many minority students are not going into STEM-based careers. In addition, many women are underrepresented both as STEM majors and in STEM careers (Blickenstaff, 2005).

The 2017 ACT College and Career Readiness report found only 21% of the tested 2017 graduates are considered college-ready in STEM, 37% in science and 41% in math (ACT, 2017). For underserved populations, 73-81% of students tested met the zero to one college-ready benchmark for STEM, science, or math (ACT, 2017).

Blankstein and Noguera (2015) state that the two most critical and strategic areas to improve academic success and increase learning opportunities are "(1) social-emotional development and (2) science, technology, engineering and math (STEM)." There is much research that shows that STEM education increases student achievement, especially for high needs students. In Paul Gorski's book **Reaching and Teaching Students in Poverty**, he states that the achievement gap is really an opportunity gap. He lists proven strategies that increase equity,

opportunities, and achievement for students from low SES areas. He included four of the principles of the STEM educational pedagogy in his list, "... high academic expectations; student-centered education; higher-order curricula and pedagogies; and instructional technology" (Gorski, 2013).

Having a computer science curriculum integrated with STEM can help WPS's K-12 students to be ready for future STEM careers. Research conducted by University of Chicago Outliers studied 3rd through 5th-grade students in Broward County Florida and found that students who did additional Code.org activities had significantly higher scores on the Florida State Math, Science, and English Language Arts Exams (Century et al., 2018). Using a computer science curriculum in K-12 can also help with the shortage of minority and female students who study computer science (Goode, Chapman, & Margolis, 2012).

Wing argues that "designing grade and age-appropriate curricula for computational thinking is necessary to maximize its impact on and significance for K–12 students" (NRC, 2011, p. 4). Through this EIR grant proposal, we can collaborate to improve on existing STEM and CS curricula at WPS in addition to implementing a K-12 Computer Science pathway. **Training the WPS teachers in coding and CT through courses and professional development opportunities is key to ensuring they have the confidence to use it successfully in their classrooms.**

(2) Development or Demonstration of Promising New Strategies:

In the past, teacher training consisted of preparing teachers with only the content they will need and the pedagogy for best practices on how they should teach, but they were mutually exclusive (Mishra and Koehler 2006). Shulman (1986) introduced pedagogical content

knowledge (PCK) to merge the content knowledge and pedagogy to make the content understandable to others. The technological pedagogical content knowledge (originally TPCK and later TPACK) framework extends Shulman's work by including the teaching of technology with content and pedagogy for teachers (Mishra and Koehler 2006).

Mouza, Yang, Pan, Ozden, and Pollock (2017) discuss an extension of TPACK, TPACK-CT, which includes computational thinking along with the content knowledge and pedagogical strategies. TPACK-CT focuses on using CT-related concepts and computing tools (TK-CT) in addition to the subject content and pedagogy to improve student learning outcomes.

Learning computational thinking, though, is best done in the early years of education (Grover, Pea, & Cooper, 2015; Wing, 2008). However, there is a lack of qualified teachers who can incorporate computer science and technology into their classrooms (Israel, Pearson, Tapia, Wherfel, & Reese, 2015; Koehler and Mishra 2009; Wang, 2017). Therefore, taking technology courses can improve teachers' understanding of technology, pedagogy, and content (Seob et al., 2009). We plan to focus on introducing teachers to using CT in addition to including the pedagogy and content.

WPS has started developing a STEM-CSED curriculum which began in Fall 2017-Spring 2019. **The challenge they have, in addition to improving the curriculum, is how to train the teachers in coding and CT so that they have the skills to use it in their classrooms.** Currently, K-12 teachers do not have many opportunities to receive training, particularly through courses in computer science. In order to introduce coding and computational thinking concepts to elementary and middle school teachers, **NEIU will provide computer science courses for WPS to take in addition to professional development classes.** To address the issues facing the

shortage of computer science-trained teachers for high school, **NEIU has developed a CS endorsement program for WPS teachers.** This will provide the K-12 teachers with the groundwork in computational thinking and coding that they can take with them and use in their classrooms.

The STEM CSED program focuses on student-centered instruction using flexible group and seating strategies and student product choice. **The K-12 pathway will offer enrichment and elective classes to match students interests.** Research shows a strong connection between student choice and motivation. When students are given the opportunity to choose their activities based on interest they feel empowered and in charge of their own learning. In Horn & Staker's book **Blended, Using Disruptive Innovation to Improve Schools**, they point out student motivation as an important overlooked factor in American education. They also call on schools to use "The JOBS-TO-BE-DONE THEORY", to make curriculum student-centered and focus instruction on things the students enjoy and want. (Horn & Staker, 2015)

WPS will use co-teaching and model classrooms to provide continuous support and training for teachers during the grant period and beyond. The goal of the program is to teach teachers best instructional practices around co-teaching so it transfers to all content areas of the day and becomes a school-wide practice that will build sustainability. The STEM CSED program will be using the following co-teaching methods: parallel, one teach one assist, team teaching, station teaching, and one teach one observe. A meta-analysis of co-teaching research on the effectiveness of the co-teach model as measured academic achievement, social and attitudinal outcomes has 0.40 effect size and positive results. (Remedial and Special Education, 2001). The STEM CSED program uses model classroom as a tool to train teachers on effective

instructional strategies. Teachers will get the opportunity to rotate between observing model classrooms and demonstrating or modeling lessons for their colleagues.

B. Project Design

In recognition of the rigor of the STEM CSED project, the first year will be dedicated to refining the evaluation design, building capacity and ensuring the project design and implementation are aligned to the evaluation requirements. The Project Director will meet with the Governance Council, the Management Team, the External Evaluator and our partnership organizations to develop professional development, implement timelines and select measures of continual improvement and sustainability.

The design plan includes four stages of the implementation and coursework over the five year grant period. **Year One - Planning Stage:** This stage will be dedicated to planning which will include teacher training on the PD models, setting up cohorts, organizing and scheduling the implementation, coordinating schedules with our partnerships, purchasing of innovative resources, and hiring. Teacher recruitment for Cohorts 1, 2, and 3 will begin and be available to all interested teachers. PD and University coursework will begin. The team will begin development of the improved STEM CSED program, and K-12 CS pathways. The first year an interactive website for the STEM CSED curriculum will be developed. (Table 3) The evaluation team will refine instruments and collect baseline assessment data. (Table 8)

Year Two -Stage 1: In this stage, we will begin the implementation of the improved STEM CSED program, the K-12 CS pathways, WPS Cohort 1 of teacher professional development, and of University coursework. (Table 4, 5 & 8) Pre/Post tests, teacher and student surveys, and observational data will be collected and analyzed by the evaluation team. Program revisions and recommendations for improvements will be made based on the feedback collected. (Evaluation Plan)

Year Three -Stage 2: In this stage, we will redesign the program based on feedback for teachers and students surveys. We will make adjustments to the K-12 curriculum and pathways to revise and

improve the program and coursework. WPS Cohort 2 of teacher professional development, and of University coursework will begin. The WPS Project Director, Mathematics Coordinator, and STEM Specialists will begin monthly model classroom and co-teaching cycles using Cohort 1 teachers. (Table 4, 5 & 8) Pre/Post tests, teacher and student surveys, and observational data will be collected and analyzed by the evaluation team. Program revisions and recommendations for improvements will be made based on the feedback collected. (Evaluation Plan)

Year Four -Stage 3: In this stage, we will make final adjustments and improvements to the program and coursework. The final professional development training and University Coursework will begin. (Table 4, 5 & 8) WPS Project Director, Mathematics Coordinator, and STEM Specialist will continue monthly model classroom and co-teaching cycles using Cohort 2 teachers. Pre/Post tests, teacher and student surveys, and observational data will be collected and analyzed by the evaluation team. Program revisions and recommendations for improvements will be made based on the feedback collected. (Table 8)

Year Five -Stage 4: In this stage, the Management Team will make recommendations and plans to sustain the grant programs. The WPS Project Director, Mathematics Coordinator, and STEM Specialist will continue monthly model classroom and co-teaching cycles using Cohort 3 teachers. (Table 4,5 & 8) The monthly training cycles will be established and continue beyond the grant period. The evaluation team will administer an overarching survey and collect all final data to analyze. The grant team will publish data collected.

Table 6: STEM CSED Goals, Objectives, Outcomes, and Measurable:
Goal: The goal of the STEM CSED project is to enhance STEM and computer science content knowledge and skills of teachers and to integrate these skills into the classroom to optimize and grow student interest, motivation, and achievement.
Objective 1: Enhance, and expand STEM and Computer Science (CS) education programs and create a K-12 Computer Science Pathway. Key Components: **K-12 Plan:** (a) WPS Project Director will work with the Governance Council to develop a K-12 CS Pathway course sequence. (b)WPS will implement the new CS courses during the 2020-21 school year. **Measurable Outcomes:** A complete K-12 CS Pathway with a scope and sequences for courses will be developed and implemented and available for 100% of WPS students K-12.

Objective 2: Increase teacher content knowledge and skills in computer science and STEM pedagogy of the teachers participants by at least 25%. Key Components: **K-12 Plan:** (a) NEIU and ROE will offer credit bearing courses for teachers in computer science content areas and high-quality professional development in STEM pedagogy. (b) NEIU will offer CS endorsement for WPS teachers (c) The evaluation team will develop and administer pre/post-content area tests for each course and an overarching assessment that will be given to teachers to show content area growth. (d) WPS will implement a collaborative professional learning community with monthly after-school training and quarterly in-service release days in order for there to be intensive follow-up support to strengthen the computer science education. (e) NEIU and ROE will continue to offer these newly developed courses at their institutions to sustain the project. **Measurable Outcomes:** The external evaluation team will use: overarching content pre/post-tests, course-specific pre/post-tests, teacher surveys, and teacher interviews/focus groups.
Objective 3: Increase student and academic achievement in both Mathematics and Science. **Key Components: K-12 Plan:** (a)WPS will implement an innovative and high-quality STEM CSED Program rooted in the areas of Computer science, coding, robotics, and engineering. (b) WPS teachers will engage and empower students through the provision of innovative and high-quality STEM CSED curriculum that is specifically designed based upon their interests. (c) WPS will strengthen partnerships with local businesses through the establishment of STEM-related career internship. **Measurable Outcomes:** Student academic achievement in mathematics and science will be measured by using BOY and EOY data from NWEA Math, Illinois Assessments of Readiness, Illinois Science Assessment, PSAT 8/9 and the SAT.
Objective 4: Increase student motivation and interest. Key Components: **K-12 Plan:** (a) The curriculum is student-centered and based on the concept of multiple solution paths and product choice. Research shows a strong connection between student choice and motivation. When students are given the opportunity to choose their activities based on interest they feel empowered and in charge of their own learning. **Measurable Outcomes:** The external evaluation team with the project director will create a "Student Perception Survey". This survey will be used to measure student motivation and interest.
Objective 5: Increase access to high quality resources and opportunities for future STEM careers. Key Components: K-12 Plan: (a) WPS will increase access to STEM and computer science by establishing the STEM CSED curriculum and a K-12 CS course pathway website. (b) The Lake County ROE will continue to offer their newly developed courses in math, science, computer science, and STEM methodologies to the teachers in the 45 school districts in Lake County ROE. (c) NEIU will establish a new location to host computer science courses at WPS. **Measurable Outcomes:** The STEM CSED Program website will be established to expand the reach of the curriculum. In addition, the curriculum and resources will be available to teachers and students in the 45 school district in the Lake County ROE.

C. Management

The management plan is designed to ensure that the project objectives will be achieved on time and within budget. Administrative and evaluative structures will be in place to assure adherence to timelines, monitoring the budget, and use of data-driven decision making. The **Management Team (MT) and Governance Council (GC)** will be directly responsible to oversee that objectives are achieved on time and within budget. The Management Team will: (a) review timeline and milestones; (b) monitor the budget; (c) carry out an ongoing review of the

project implementation; (d) monitor and modify project activities based on feedback received from the project evaluator.

The Governance Council will be composed of the Deputy Superintendent of Academic Supports and Programs, the Associate Superintendent of Equity and Accountability, the K-12 Directors of Teaching and Learning, the Project Director, Budget Officer, and the Project External Evaluators. The Governance Council will: (a) set overall policies for the program; (b) review evaluation reports and make recommendation on program changes; (c) meet quarterly with the management team and the evaluation team to discuss the effectiveness of the program; (d) Advertise the project; and (e) develop and monitor plans to sustain the project after the federal grant ends.

Table 7: STEM CSED Project Management Key Personnel

Name and Title	Project Responsibilities	Relevant Experience
Project Director Anne Zahn District Administrator Science, STEM, & Accelerated Programs WPS	Oversee project design, implementation, and refinement. Coordinate all project staff. Collaboration plans with community organizations. Lead Management team to develop an improved STEM CSED program and K-12 Pathway	Developed STEM CSED Program. Expert in areas such as Science and STEM curriculum. Proven Track record in strengthening the instructional capacity of educators through the STEM CSED pilot. Illinois Board of Education Science Steering Committee Member 2019.Co-PI NSF RPP grant. ISTE Technology and Robotics presenter and panel member
Co-Director Dr. Rachel Adler Assistant Professor Computer Science Northeastern Illinois University	Collaborative project team to develop and update courses suitable for WPS as well as train the CS instructors who will be teaching the courses. She will also develop surveys for assessment. She will meet regularly with the WPS team to ensure successful CS training for their teachers	PI in an NSF STEM + C grant. Created and taught the **Computer Science for All** course at NEIU for pre-service teachers as part of the grant. Authored numerous journal and research papers on CS & CT. Her experience leading a grant and creating educational courses in coding will be an important part of this project.
NEIU Staff Brittany Pines Director Math, Science, & Technology for Quality Education (MSTQE) Northeastern Illinois University	Oversee the scheduling of CS 108 courses, recruitment of teachers, the procurement of materials, and the development and implementation of the professional development curriculum.	Program Coordinator for the NSF STEM+C grant which implemented the new Computer Science course and additional CS/CT modules into the MSTQE courses.
ROE Staff Shay McCorkle Director Educational Services Lake County ROE	Lead the EIR grant work for the Lake County ROE #34. Coordinate and schedule the courses on the ROE database. Coordinate the hiring and training of instructors. Lead the marketing and teacher recruitment. Oversee the budget and administrative tasks associated with the EIR grant. Oversee the development of the ROE STEM CSED courses and sustain the professional development and lending library.	Proven Track record in strengthening the instructional capacity of educators. Oversees the Lake County ROE Department of Educational Services. Services 45 school district and over 130,000 students.
Evaluation Team Dr. Jeffrey Schagrin Dr. Lora Wolff Western Illinois University	Spearhead the project evaluation and will provide a formative and summative evaluation to the Project Director and Co-Director. Design and develop instruments for data collection and observation including: Pre/Post PD assessments, students, teacher, and community surveys, and overarching survey. Collect baseline data	Combined, Dr. Schagrin and Dr. Wolff have evaluated numerous competitive grants totaling over $12 million. Grants include: Math and Science Partnership, STAR Schools, Comprehensive School Reform, 21st Century Learning Communities, construction grants, Carol M. White PE grants, and school counselor grants. Dr.

	for teachers and students in motivation, interests, content knowledge gained and achievement. Additionally, the external evaluators will complete all required evaluation reporting.	Schagrin and Dr. Wolff have extensive expertise in both quantitative and qualitative evaluation methods.
Budget Officer Nicholas Chin Coordinator State and Federal Programs WPS	Provide oversight and management of financial aspects of the grant award, inclusive of budget reporting responsibilities. Provide leadership as a member of the MT.	Project Director: Professional Development for Arts Educators Grant Award #U351C140055; Budget Officer: Assistance for Arts Educatio Development and Dissemination Grant Award #U351D180013; Grant Manager: Title I-A, II-A, IV-A, Priority School Support, Improving Student Health and Academic Achievement Grants; WPS Student-Based Budgeting Development Team. Cumulative grant fun management experience totaling ~$25M.
WPS Staff Matthew Foster Coordinator Mathematics	Oversee the K-12 mathematics and the high school computer science pathways and implementation. Training of STEM specialist, running Mathematics PD and overseeing ROE Mathematics Methods courses	Proven Track record in strengthening the instructional capacity of educators through Mathematics.Illinois Council of Teachers of Mathematics (ICTM) President. Adjunct Mathematics Professor. Research collaboration with the University of Chicago EM4.
Management Team (MT)	The management team overseas budget, timelines, personnel, K-12 pathway & STEM CSED Curriculum development.	Project Director, Co-Director, Evaluation Team, Budget Officer.
Governance Council (GC)	Develop district policies and documents that will govern the grant goals and objectives. Provide leadership and oversee the project. These positions will be in-kind supported by WPS.	Eduardo Cesario, WPS Deputy Superintendent of Academic Supports and Programs; Dr. Jason Nault, WPS Associate Superintendent of Equity and Accountability; Dr. Kevin Brown, WPS K-8 Director of Teaching and Learning and Dr. Staci Stratigakes WPS 9-12 Director of Teaching and Learning

Table 8: The Management Plan:

Objective 1: Enhance, and expand STEM and Computer Science (CS) education programs and create a K-12 Computer Science Pathway			
Activities	**Performance Measures**	**Timeline**	**Responsible Personnel**
(a) Governance Council (GC) formed; (b) set overall policies for the program; (c) review evaluation reports and make recommendation on program changes; (d) meet quarterly with the management team and the evaluation team to discuss the effectiveness of the program; (e) Advertise the project; and (f) develop and monitor plans to sustain the project after the federal grant ends.	Produce guidance documents and handbook for the STEM CSED project available to 100% of participants. Establish an implementation timeline and budget available for 100% of participants	October 2019 - 2024 Yr 1: Meets Monthly Yr 2-5: Quarterly	WPS Deputy Superintendent, Associate Superintendent of Equity; K-8, 9-12 Directors of Teaching & Learning and the Project Director.
(a) Management Team (MT) formed; (b) review timeline and Performance Measures (c) monitor the budget; (d) carry out an ongoing review of the project implementation; (e) monitor and modify project activities based on feedback received from the project evaluator.	Develop a STEM CSED project website and Develop a K-12 CS Course Pathway available to 100% of participants Implementation of New K-12 CS Courses and Improved STEM CSED Program available to 100% of WPS students	October 2019-2024 Yr 1: Meets bi-weekly Yr 2-5: Monthly	Project Director (D), Co-Director, Budget Officer, STEM Coordinator, and Math Coordinator.
(a) Evaluation Team (ET) formed; (b) Collect baseline data for student achievement; (c) Collect feedback to continuously improve and monitor the STEM CSED program.	Create STEM CSED project evaluation system protocols handbook available to 100% of the participants	October 2019-2024 Walkthroughs & data collection: Yr 1: Monthly Y2: Quarterly	Project Evaluator and evaluation of data collection team.
Objective 2: Increase teacher content knowledge and skills in computer science and STEM pedagogy of the teachers' participants by at least 25%			
NEIU Computer Science for all Cohorts 1 & 2	Pre/Post PD assessment collected and show that participating teachers increase CS &	Cohort 1: June 2020 - Aug 2020	NEIU Computer Science Department

	STEM content knowledge by 25%	Cohort 2: June 2021 - Aug 2021	
MSTQE Pedagogy Training 2- day sessions	Teacher survey and Pre/Post data collected shows that participating teachers increase pedagogy by 25%	Fall 2020-Spring 2023	NEIU MSTQE Department
Lake County ROE Courses: (a) STEM CSED; (b) 5E's Instruction; and (c) Mathematics Methods	Teacher survey and Pre/Post data collected shows that participating teachers increase STEM content knowledge and pedagogy by 25%	Fall 2020- Spring 2023	Lake County ROE Instructors
NEIU -*The Joint NEIU-ISU TECS Program for Chicago Cohorts 1&2*	Pre/Post PD assessment collected and show that participating teachers increase CS content knowledge by 25%	Cohort 1: Fall 2020 - Dec 2022 Cohort 2: Fall 2021 - Dec 2023	NEIU Computer Science Department
WPS Project Director & STEM Specialist begin ongoing monthly Model Classroom and Co-teaching cycles.	Pre/Post PD assessment collected and show that participating teachers increase CS content knowledge by 25%	Cohort 1: Yr 3: 2021 Cohort 2: Yr 4: 2022 Cohort 3: Yr 5 & beyond	WPS Project Director, K-12 Mathematics Coordinator & STEM Specialists
Objective 3: Increase student and academic achievement in both Mathematics and Science.			
(a)Implement new STEM CSED Program; (b) Implementation of K-12 CS Course Pathways	Student quarterly NWEA and yearly standardized assessment data collected and analyzed shows that students increased academic achievement in Math and Science from BOY to EOY.	Fall 2020- Spring 2024	Management Team & Evaluation Team
Objective 4: Increase student motivation and interest			
(a) Implementation of STEM CSED program activities: programming, coding, robotics, and Makerspace; (b) Flexible Grouping; (c) Flexible seating; (d) Product choice; and (e) K-12 Course sequence options.	A survey, using Likert scale questions, will be given to all WPS students, regardless of whether their teacher was a participating or non-participating teacher. Survey results will be analyzed using descriptive statistics.	Fall 2020- Spring 2024	Evaluation Team
Objective 5: Increase access to high-quality resources and opportunities for future STEM careers			
(a) Implementation of STEM CSED program activities: programming, coding, robotics, and Makerspace; (b) Implementation of K-12 CS Course Pathways	Survey results will be broken down between students in participating and non-participating teachers' classrooms to better understand the effects of the STEM CSED curriculum and PD on student interest in STEM and motivation. Survey results will be analyzed using descriptive statistics.	Fall 2020- Spring 2024	Evaluation Team

D. Independent Project Evaluation

WWC Design Evidence and Summary: This impact evaluation uses a quasi-experimental (QED) design to assess the impact of the STEM CSED partnership on teacher content knowledge, student achievement, and student motivation. This QED design meets the **What Works Clearinghouse (WWC) Group Design Standards with Reservations** standards. This

evaluation will compare the achievement of students in **participating teachers** classrooms that received STEM CSED professional development with a sample of similar **non-participating** teachers classrooms that did not receive STEM CSED professional development. The evaluation team will estimate differences in the levels of average classroom achievement over time of treatment and comparison classrooms using a Comparative Interrupted Time Series analysis (Bloom, 2003) which relies on having multiple years of data on achievement before and after the implementation of the STEM CSED professional development. The treatment and comparison groups will have similar grade configuration, baseline achievement results, and demographic characteristics which satisfy WWC standards for baseline equivalence.

The evaluation will use quantitative and qualitative performance measures to analyze the extent to which key objectives of the STEM CSED project are effective in improving teaching and learning. These key objectives of this project include: (1) enhance, and expand STEM and computer science (CS) education programs and create a K-12 Computer Science pathway; (2) increase teacher content knowledge and skills in computer science, mathematics, science and STEM pedagogy of the teachers participants by at least 25%; (3) increase student academic achievement in both Mathematics and Science; (4) increase student motivation and interest; and (5) increase access to high quality resources and opportunities for future STEM careers. The evaluation will use quantitative and qualitative instruments and analysis to assess the research questions (below) and the effectiveness of STEM CSED objectives.

Strategies Suitable for Replication or Testing: The evaluation team will share formative and performance feedback through routine reporting on the evaluation processes and initial results. Given the scope and time-length of this project the evaluation team will keep a reflexive

journal that will be included in regular and final reporting with the WPS team and made available to other practitioners and researchers. All surveys, assessments, and evaluation tools will be made publicly available. The evaluation team will meet with with the program management team on a routine basis (e.g., monthly or quarterly) to provide regular feedback and collaborate regarding the implementation and impact of the program. The findings of the program will be shared via the website designed by project management team and key findings will be published and presented at relevant research, STEM and leadership conferences within the region and nation.

Research Questions: The following research questions will guide the evaluation of the program's impact:

- **RQ1. What is the effect of STEM CSED on the academic achievement of students in grades 3 - 12?**
- **RQ2. What is the impact of professional development on the fidelity of implementation for STEM CSED?**
- **RQ3. What are the impacts of STEM CSED on students, teachers, and community stakeholders?**
- **RQ4. What are the factors that appear to facilitate the effective implementation of STEM CSED and what are the challenges to be addressed to support future improvement and replication?**

Quantitative Instrumentation, Methodology, and Performance Measures Related to Outcomes:

All Eligible Teachers Pre/Post Tests: All eligible teachers will be given a pre- and post-test to measure their STEM CSED content knowledge. The project anticipates growth by at least 25% of the participating teachers' content knowledge. Due to the uniqueness of this project, an internally designed tool using an expert panel will be used as the instrument to measure teachers' content knowledge. The assessment will be designed by the evaluation team using an expert panel from NEIU faculty, ROE consultants, and the Project Management team. The assessment will be designed to measure teachers' mastery of: STEM CSED, content knowledge and relevant skills taught through PD, and applicable STEM pedagogy. Participating teachers' content knowledge will be compared to non-participating teachers utilizing pre-test and post-test administrations to evaluate teacher growth in content knowledge. A pre-test will be administered at the beginning of Year 1 and a post-test at the end of each of the following years to both participating teachers and non-participating teachers which will allow for the comparison of participating teachers' content knowledge to non-participating teachers. Descriptive statistics (number of teachers, mean and standard deviation) and inferential statistics including a **t**-test will be utilized to evaluate if content knowledge growth is statistically significant. This instrument will be used to analyze objective 2 and research question 4.

Course-Specific Pre/Post Tests (NEIU/Lake ROE): All participating teachers will take a pretest on the first day of each course and a post-test on the last day of each course. The project anticipates growth by at least 25% in participating teacher content knowledge in these courses. All course-specific pre/post tests will be designed by the NEIU faculty team and ROE instructors. Data will be analyzed using descriptive statistics (percentages, means, and standard deviations). This instrument will be used to analyze objective 2 and research question 2.

Classroom Walkthroughs: Classroom walkthroughs will be conducted during Year 1 to establish a baseline for instructional strategies, pedagogical knowledge and teacher content knowledge at WPS. Walkthroughs will be repeated each year to better understand the effects of the professional development provided within the classroom on student achievement and engagement. The evaluation team will create a rubric using portions of the NGSS Lesson Screener and STEM research-based instruments cited by Dr. Daphne Miller and Dr. Alina Martinez as part of the National Science Foundations efforts to enhance the learning and teaching of STEM (Erickson, Martinez, Minner, & Wu, 2012; Martinez, Minner, & Freeman, 2012). The classroom walkthrough tool will require evaluation team members to observe the learning environment in a STEM classroom for a minimum of 20 minutes. Walkthroughs will occur over six days each year. Over the course of each year, the team will observe a

minimum of 50 classrooms, totaling no less than 1000 minutes. Currently, the district utilizes walkthroughs so this process is familiar to teachers and those conducting the observations. Data collected through the walkthroughs will be analyzed using descriptive statistics (number of classrooms, mean and standard deviation). This instrument will be used to analyze objectives: 1, 4 and 5; research questions: 2, 3 and 4.

Teacher surveys: An electronic survey, using Likert scale questions, will be given to participating teachers to better understand the impact of the PD, teacher confidence using STEM CSED, and teacher perception of implementation and impact. Results of the survey will be analyzed using descriptive statistics (mean and standard deviation). The survey will be designed by the evaluation team with input from the management team, NEIU faculty, and Lake County ROE instructors. This instrument will be used to analyze objectives: 1, 2, 4 and 5; research questions: 2, 3, and 4.

Student Surveys: A survey, using Likert scale questions, will be given to all WPS students, regardless of whether their teacher was a participating or non-participating teacher. Surveys (approximately 10 items) will be administered in grades 3 - 12 (two versions of the survey will be available to ensure the language is appropriate to the grade level: 3-6 and 7-12; the versions will be parallel and only differ in vocabulary. Grades K-2 will not be surveyed due to their age. The survey will be designed by the evaluation team with input from the Management Team. Survey results will be broken down between students in participating and non-participating teachers' classrooms to better understand the effects of the STEM CSED curriculum and PD on student interest in STEM and motivation. Survey results will be analyzed using descriptive statistics. This instrument will be used to analyze objectives: 4 and 5; research questions: 3 and 4.

NWEA MAP MATH: NWEA Map Math data will be used to measure the impact of STEM CSED and teacher PD on student achievement. The MAP is regularly administered to WPS students three times per year (fall, winter, spring). The evaluation team will compare the MAP Math scores from those students in participating teachers' classrooms to those in non-participating teachers' classrooms. The evaluation team will use baseline MAP data collected from previous years scores and will compare it to data collected throughout the five year period. Descriptive statistics (number of teachers, mean and standard deviation) and a **t**-test will be utilized to evaluate if content knowledge growth between students in participating teachers' classrooms and those in non-participating teachers' classrooms is statistically significant. This instrument will be used to analyze objective 3 and research question 1.

ISA, SAT Suite, IAR (formerly PARCC), AP Computer Science: Student math and science performance will be analyzed using assessment data from the Illinois Assessments of Readiness (formerly PARCC), SAT Suite of Assessments, the Illinois Science Assessment (ISA), and Advanced Placement Computer Science. Student scores from participating teachers' classes will be compared to those from non-participating teachers' classes to evaluate student academic growth in math and science. A **t**-test will be utilized to evaluate if math and science academic growth is statistically significant. This instrument will be used to analyze objective 3 and research question 1.

Qualitative Instrumentation, Methodology, and Performance Measures Related to Outcomes:

Teacher Interviews and Focus Groups: All participating teachers will be invited to participate in qualitative data collection during each year of the project. The purpose of the interviews and focus groups will be to better understand the perceived effectiveness of the PD, implementation within classrooms, perceived impact on student motivation and achievement, and teacher identified next-steps and needs related to STEM CSED. All teachers who received PD will be invited to participate in either interviews or focus groups. Focus groups will be conducted face-to-face by a member of the evaluation team. Focus groups will be approximately 4-6 participants. Individual interviews will be conducted with those teachers who are unable to make focus group sessions. Interview and focus group questions will be developed by the evaluation team and reviewed with the planning and project implementation team prior to beginning. Both interviews and focus groups will be audio-recorded and transcribed. Focus groups and interviews will continue each year until saturation (the time when no new data is emerging). The transcripts will be reviewed for accuracy and any changes made. Then the transcripts will be coded individually be the evaluation team. Once coded, the evaluation team will compare coding and resolve any differences. Themes will be developed. This instrument will be used to analyze objectives: 1, 2, 4 and 5; research questions: 2, 3, and 4.

Teacher Surveys: The teacher surveys (mentioned above under Quantitative Instrumentation) will include open-ended questions. These open-ended questions will help to better understand the perception of the overall success of STEM CSED, examples of applied learning tasks, and next-steps for WPS for its STEM CSED. This instrument will be used to analyze objectives: 1, 2, 4 and 5; research questions: 2, 3, and 4.

Student Surveys: The student surveys (mentioned above under Quantitative Instrumentation) will include open-ended questions in grades 7 - 12. These open-ended questions will help to better understand the perception of the overall success of STEM CSED. This instrument will be used to analyze objectives 4 and 5; research questions 3 and 4.

Monitoring: The evaluation team will monitor participating K-12 teachers' enrollment in the graduate courses, workshops, and other activities monthly throughout Years 2 - 5 to ensure that enrollment remains at 80% or higher and participants complete STEM CSED related activities. Course assessment data will be monitored to ensure at least 80% of teachers are passing each course. The evaluation team will provide this information monthly to the Management Team and will include it in its regular reporting.

Appendix 1:
Evaluation Objectives and Corresponding Research Question and Instrument Table:

Objective	*Research Question*	*Quantitative Instrument*	*Qualitative Instrument*
O1. Enhance and expand STEM CS education programs and create a K-12 CS Pathway	RQ4. What are the factors that appear to facilitate the effective implementation of STEM CSED and what are the challenges to be addressed to support future improvement and replication?	- Classroom Walkthroughs - Teacher Surveys	- Teacher Interviews and Focus Groups - Teacher Surveys
O2. Increase teacher content knowledge and skills in computer science, mathematics, science and STEM pedagogy of the teacher participants by at least 25%	RQ2. What is the impact of professional development on the fidelity of implementation for STEM CSED?	- All Eligible Teachers Pre/Post Tests - Course-Specific Pre/Post Tests (NEIU / Lake ROE) - Teacher Surveys	- Teacher Interviews and Focus Groups - Teacher Surveys
O3. Increase student academic achievement in both Mathematics and Science	RQ1. What is the effect of STEM CSED on the academic achievement of students in grades 3 - 12?	- NWEA MAP Math Data - Illinois Assessments of Readiness (Math) - Illinois Science Assessment - SAT Suite of Assessments (Math) - AP Computer Science	
O4. Increase student motivation and interest	RQ3. What are the impacts of STEM CSED on students, teachers, and community stakeholders?	- Student Surveys - Teacher Surveys - Classroom Walkthroughs	- Student Surveys - Teacher Surveys - Teacher Interviews and Focus Groups
O5. Increase access to high quality resources and opportunities for future STEM careers	RQ4. What are the factors that appear to facilitate the effective implementation of STEM CSED and what are the challenges to be addressed to support future improvement and replication?	- Student Surveys - Teacher Surveys - Classroom Walkthroughs	- Student Surveys - Teacher Surveys - Teacher Interviews and Focus Groups

Appendix 2: Evaluation Instrument Timeline

Figure 1	Yr 1 (19-20)				Yr 2 (20-21)				Yr 3 (21-22)				Yr 4 (23-24)				Yr 5 (24-25)			
Evaluation Activities	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
All Eligible Teachers PRE Overarching Content Tests			X		X															
All Eligible Teachers POST Overarching Content Tests															X		X			
Participating Teachers Course-Specifics Pre/Post Tests				X				X				X				X				
All Elligble Teacher Surveys			X	X			X	X			X	X			X	X			X	X
Student Surveys (All Students)			X								X								X	
NWEA Map Math Test for All Students	X	X	X		X	X	X		X	X	X		X	X	X		X	X	X	
Participating Teacher Interviews/Focus Groups			X	X			X	X			X	X			X	X		X	X	X
Classroom Walk-Throughs and Observations		X	X			X	X			X	X			X	X			X	X	
Standardized Achievement Exams (ISA/PSAT/IAR/AP)			X								X				X				X	