Meeting the Absolute Priorities:

Absolute Preference Priority One: As demonstrated in the project Logic Model, the rationale for ESU 2 EIR EMPOWER (E^3) is based on three research-based studies showing promise.

The first is a study supporting instructional coaching for teachers as a way to improve teacher skills and student engagement.

The second is based on studies related to student self-efficacy and confidence in STEM/CS course work as predictors of later student success in high-level science and math courses.

The third is based on studies related to the use of mentors to increase student aca-demic achievement, especially in minorities, students of poverty, special needs students, and females.

And finally, the promising practice of project-based learning will be explored and expanded to include credit-recovery as a suitable method of credit attainment for students failing traditional teacher-led instructional formats or on-line course credits.

Absolute Preference Priority Two: Project E^3 meets absolute priority two by developing and implementing evidence based, field-initiated innovations. This includes instructional coaching systems that support district-wide STEM/CS philosophies and practices, formalized student mentoring programming, expanded learning opportunities for underrepresented populations, and the development of project-based credit recovery opportunities for students.

Absolute Preference Priority Three is at the core of this proposal with the infusing of a STEM and Computer Science focus that includes professional development, mentoring, project-based activities, and the adoption of a nationally recognized and award-winning Computer Science curriculum, Project Lead the Way K-12 district-wide implementation.

Meeting the Competitive Preference Priorities:

Competitive Preference Priority: E^3 meets the CPP in several aspects. Both E^3 districts are designated rural with a NCES location code of 33 for Schulyer Elementary and Middle Schools and 42 for Schuyler High School.[1] Raymond Central has a NCES location code of 42 for all buildings in the district. Fremont and Schuyler just experienced unprecedented devastation and disastrous flooding with students in the E^3schools being displaced by flooding. Saunders County (Raymond Central SD) and Colfax County (Schuyler SD) have been declared **federal disaster areas** meaning resources previously available to schools to provide expanded opportunities for teachers and students are now being utilized to meet basic instructional and transportation needs. Travel to schools that usually takes ten to fifteen minutes now exceeds over an hour due to the washing away of bridges and roads.

Schuyler Community Schools is a minority majority district with an ELL population nearly six times the state average. Raymond Central, while not poor, only meets the state average for student achievement in most categories, with perceptual surveys revealing a lack of relevance for students in instruction and classroom tasks. Further analysis reveals that STEM and Computer Science offerings in both districts are limited and not embraced by staff.

A. Significance (Up to 25 Points)
(1) The potential contribution of the proposed project to increased knowledge or understanding of educational problems, issues, or effective strategies. (2) The extent to which the proposed project involves the development or demonstration of promising new strategies that build on, or are alternatives to, existing strategies.

ESU 2 EIR EMPOWER (E^3) proposes to build on current research about the outcomes of instructional coaching to support teacher improvement of STEM/CS instructional strategies in **small rural schools** in eastern Nebraska and its relationship to student engagement and achievement.[2] In addition to building teacher skills and attitudes towards STEM/CS instruction, E^3 will build on research related to student perceptions concerning their ability to be successful

[1] NCES data files available in the “other Attachments” section. Data may be downloaded from: https://nces.ed.gov/ccd/districtsearch/

[2] Personal, professional coaching: Transforming professional development for teacher and administrative leaders https://ies.ed.gov/ncee/edlabs/regions/midatlantic/askarel_46.asp

with higher level math and science courses by exploring the importance of student self-efficacy for doing STEM/CS work.[3]

The study will also expand research into the impact of mentoring for **rural students** with special focus on sub-groups including underrepresented students like **minorities, low social economic status, females, and students with disabilities or special needs**. [4]

In addition to building on current promising practices, this project proposes to develop an **innovative approach** to credit recovery for students failing to meet traditional classroom instructional settings through project-based credit acquisition.[5]

ESU 2 EIR EMPOWERING (E^3) Rural Students for a Bright Future

Educational Service Unit 2 (ESU 2) serves predominantly rural and small school districts in eastern Nebraska. The schools have expressed concern over new state science standards that break from the traditional Nebraska standards in that the new standards focus more on what students can do than what they know. While it may seem simple, this transition involves new instructional and assessment methodologies. STEM education is as much a philosophy of how lessons are developed and delivered as a content area. Computer Science, in particular, is seen as a content add-on and not part of a comprehensive curriculum. In addition, students have personal perceptions about STEM topics, including the belief boys are better than girls in math & science, or STEM is something smart kids do. These perceptions are most prevalent among underrepresented groups including students of poverty, minorities, special education students, and females. But most especially, teachers do not feel comfortable approaching STEM and Computer Science topics as they themselves have not been provided the opportunity to develop STEM thinking.

[3] Exploring the foundations of the future STEM workforce: K–12 indicators of postsecondary STEM success. https://ies.ed.gov/ncee/edlabs/regions/southwest/pdf/REL_2016170.pdf
[4] US Department of Education Student Mentoring Program Final Report https://ies.ed.gov/ncee/pubs/20094047/pdf/20094047_body.pdf
[5] The Impact of Project-Based Learning on Minority Student Achievement: Implications for School Redesign https://eric.ed.gov/?id=EJ1105713

One reason STEM is so significant is that it teaches students to think critically. "STEAM experiences boost critical thinking, teaching students to take the time to be more careful and thorough in how they observe the world."[6] Critical thinking is a foundational skill in learning.

While not a Common Core state, Nebraska Content Standards align with Common Core and therefore statements about Common Core can be applied to Nebraska. "The Common Core. . . stresses critical-thinking, problem-solving, and analytical skills that are required for success in college, career, and life."[7] It must however, be thoughtfully taught. "Explicit attention to the fostering of critical thinking skills and sub-skills, as well as dispositions, should be made an instructional goal at all levels of the K-12 curriculum."[8]

STEM instruction boosts student engagement. A review of research including work found in the *Handbook of Research on Student Engagement*[9] shows the key role student engagement plays in student success in general. More specifically to STEAM, since 2011 through five US Ed and California Education Department grants (including an AEMDD and PDAE grant) field evaluators Nick Parker Ed.D. and Joanne Lehman have conducted over 500 K-5 class-room observations using a student engagement and task complexity analysis tool based on the work of Phil Schlechty.[10] They found students demonstrate higher order thinking up to 6x more often in classes of teachers using high engagement strategies like those found in STEM/CS instruction.

Students of poverty with unique cultural backgrounds in extremely rural locations are not likely to have the opportunity to develop skills in creativity through STEM and Computer

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[6] Greene, Jay P., et. al, *Arts Education Matters: We Know, We Measured It*, Education Week, December 2014. Bowen, D. H., Greene, J. P., & Kisida, B. (2014). Learning to Think Critically: A Visual Art Experiment. Educational Researcher, 43(1), 37-44. doi:10.3102/0013189X13512675
[7] Common Core English Language Arts Standards, http://www.corestandards.org/ELA-Literacy/
[8] Dilley, Anna, et. al., *What We Know About Critical Thinking: Part of the 4Cs Research Series*, Partnership for 21st Century Learning, 2015.
[9] Fredricks J.A., McColskey W. (2012) The Measurement of Student Engagement: A Comparative Analysis of Various Methods and Student Self-report Instruments. In: Christenson S., Reschly A., Wylie C. (eds) Handbook of Research on Student Engagement. Springer, Boston, MA
[10] Phil Schlechty, Engaging Students: The Next Level of Working on the Work (Jossey-Bass, 2011).

Science (CS) unless those opportunities are provided through school. And while STEM activities take place in rural locations, the pool of STEM/CS professionals to provide inspiration are limited or non-existent. Through innovative teaching methods to integrate and strengthen standards-based STEM/CS instruction in the classroom, this project will enhance student academic performance in all core academic subjects. E^3 looks at ways to foster students' academic potential by encouraging active participation in learning.

Understanding traditional ways of teaching aren't always effective when promoting STEM/ CS thinking E^3 promotes integrating STEM/CS across the curriculum. However, teachers cannot provide these opportunities if they do not understand or appreciate the possibilities STEM/CS provides learners. These include creativity, personal expression, highly engaging, and personalized experiences. Science, Engineering, Technology, Math and Computer Science, in fact all forms of STEM/CS thinking, are the soul of critical thinking and provide tangible and relatable connections to the world. Unfortunately, schools are not currently making those connections.

Lack of teacher training: Most K-12 teachers need more STEM/CS education training. Self-contained elementary teachers have minimal STEM/CS education. Wayne State College's multiple subject credential program is one of the few teacher education programs in Northeast Nebraska and even though it includes math and science methods education courses, College of Education faculty have found this to be inadequate to develop the skills, understanding, and comfort level needed for elementary teachers, with no prior background knowledge in STEM/CS to foster a rigorous STEM/CS curriculum in their classes. In addition, teachers with poor experiences in math and science, unintentionally display negative or uncomfortable feelings for the subjects in class, thus creating potential negative attitudes for the subjects in their students.[11]

[11] Teachers' Self-Efficacy Beliefs as Determinants of Job Satisfaction and Students' Academic Achievement: A Study at the School Level. https://eric.ed.gov/?id=EJ746776

Secondary teachers are not required to take STEM/CS courses beyond graduation requirements, unless they plan to become math or science teachers. This means high school students choosing not to take advanced math or science courses are not exposed to STEM/CS—thus building on the stigma that STEM/CS are only for the really smart kids. Despite these challenges, there is hope and a plan to integrate STEM/CS across the K-12 curriculum to increase student engagement and success. E^3 proposes to use a four-step approach to create a districtwide STEM/CS culture designed to improve student engagement and achievement.

1. First, teachers will participate in STEM Leadership Academies each year, adding new teachers each year until STEM/CS experiences are the daily way of doing business and not special camps or courses for gifted students.
2. In addition to building teacher skills through instructional coaching cycles, student attitudes and self-efficacy in "doing" STEM/CS will be improved through a formalized mentoring program, geared to supporting underrepresented populations including minorities, low social-economic status, special education, and females.
3. An innovative approach to credit recovery for students not meeting traditional classroom expectations will be developed. Currently, when students fail a course, it is sometimes not due to the inability to grasp course content and instead is because of poor work, inconsistency, or behavior. E^3 will develop STEM/CS project-based opportunities for students to prove mastery of content. Beginning in middle school, each course offering will develop mastery-level projects for students to display and prove their knowledge of content as an addition to or as an alternative to traditional teacher-led and teacher-assessed course outcomes. Both districts'

credit-recovery is either on-line courses or summer school. Project-based experiences for credit recovery will be evaluated as a model for improving course completion and graduation rates.

4. The E^3 districts will implement formalized Computer Science curriculum in grades K-12 and adopt the nationally acclaimed Project Lead the Way programming.

Implementation of new curriculum as specialized as a Computer Science for districtwide adoption must include full support of the entire district. Providing three years of PD in STEM/CS and instructional coaching is the key to successful districtwide implementation of Computer Science. In addition to improving teacher perceptions and ability to implement STEM/CS opportunities, students will be supported to improve self-efficacy in their own math and science skills.

On February 20th, 2019 the E^3 planning group from ESU 2 met with stakeholders to identify the interventions to be developed and delivered through the E^3 program. Diane Wolfe facilitated the process of identifying high priority needs for the E^3 districts. The interventions identified were: (1) Increase STEM/CS opportunities for students by providing PD to support teachers in implementing STEM/CS (2) Increase access to STEM/CS experiences for under-represented populations (3) Improve student self-efficacy in doing STEM/CS, and (4) Provide opportunities for students to earn STEM/CS credits through project-based activities. (5) Sustain a STEM/CS focused district into the future. These five goals reflect the districts' board goals for students.

Through this detailed and expansive planning process, project E^3 identified the following goals necessary to ensure all students in E^3 schools are truly **STEM/CS** experienced.

ESU 2 EIR EMPOWER Project Goals
Goal 1: Increase student engagement in STEM and Computer Science activities for all students in grades K-12.
Goal 2: Increase access to non-traditional experiences and supports in STEM and Computer Science for underrepresented students in grades K-12. (female, minority, special education, and low SES students)
Goal 3: Increase self-efficacy of aptitude for STEM and Computer Science for underrepresented students in grades K-12. (female, minority, special education, and low SES

students)
Goal 4: Increase the number of students completing advanced STEM and Computer Science course work in high school.
Goal 5: Develop a plan to sustain the program beyond Federal funding.

B. Quality of Project Design and Management Plan (Up to 35 Points)
(1) The extent to which the goals, objective, and outcomes to be achieved by the proposed project are clearly specified and measurable.

The E^3 planning procedure was an eye-opening experience that helped guide the development of this EIR proposal. By working with the math and science content experts at Educational Service Unit 2, we are assured the project is tightly aligned with state, federal, and global STEM and Computer Science standards.[12] E^3 is designed to build on each previous years' activities to fully integrate an efficient approach to high-quality and comprehensive STEM/ Computer Science programing. The goals, objectives, and progress measures of this project were designed to include input from all necessary stakeholders.

ESU 2 EIR EMPOWER Project Goals
Goal 1: Increase student engagement in STEM and Computer Science activities for all students in grades K-12.
Measurable Objective 1.1: 80% of all teachers in project schools will participate in STEM leadership academy professional development by 2024 • **Progress Measure 1.1.1:** In year one, 24 teachers will participate in STEM leadership academy professional development that includes 10 instructional coaching sessions in a gradual release method. • **Progress Measure 1.1.2:** In year two, 24 additional teachers will participate in STEM leadership academy professional development that includes 10 instructional coaching sessions in a gradual release method. • **Progress Measure 1.1.3:** 24 In year three additional teachers will participate in STEM leadership academy professional development that includes 10 instructional coaching sessions in a gradual release method. • **Progress Measure 1.1.4:** By year four and following the previous three years of formalized STEM Leadership academy, teachers will provide self-sustaining STEM coaching to non-academy participants to increase STEM trained teachers to include 60% of all classroom teachers. (131 of 219 total teachers) • **Progress Measure 1.1.5:** By year five, and following formalized STEM Leadership academy, teachers will provide self-sustaining STEM coaching to non-academy participants to increase STEM trained teachers to include 80% of all classroom teachers. (175 of 219

[12] Nebraska Content Standards: https://www.education.ne.gov/contentareastandards/

total teachers)

Measurable Objective 1.2: All project schools will implement Project Lead the Way STEM/Computer Science curriculum in grades K-12 by 2023.

- **Progress Measure 1.2.1:** All PLW Launch modules will be implemented in grades K-5 in years 4 and 5 of the project.
- **Progress Measure 1.2.2:** All PLW Gateway modules will be implemented in grades 6-8 in years 4 and 5 of the project.
- **Progress Measure 1.2.3:** PLW Computer Essentials and Computer Principals will be delivered in year 4 of the project at both Schuyler and Raymond Central High Schools.
- **Progress Measure 1.2.4:** PLW Computer Science A and Cybersecurity will be delivered in year 5 of the project at both Schuyler and Raymond Central High Schools.

Measurable Objective 1.3: Student Engagement Observation Scores will increase each year of the program.

- **Progress Measure 1.3.1:** Students of year 1 participating STEM Leadership Academy teachers will increase student engagement ratings from baseline.
- **Progress Measure 1.3.2:** Students of year 2 participating STEM Leadership Academy teachers will increase student engagement rating from baseline.
- **Progress Measure 1.3.3:** Students of year 3 participating STEM Leadership Academy teachers will increase student engagement rating from baseline.
- **Progress Measure 1.3.4:** Students of PLW trained teachers will increase student engagement rating from baseline.
- **Progress Measure 1.3.5:** All Students in each school will increase student engagement ratings from year 1 all-school baseline scores.

Goal 2: Increase access to non-traditional experiences and supports in STEM and Computer Science for underrepresented students in grades K-12.

Measurable Objective 2.1: By the end of year one, Design and deliver a virtual student mentoring program for underrepresented students by matching students with female, minority, childhood low SES and disabled STEM and Computer Science Mentors.

- **Progress Measure 2.1.1:** By spring of 2020, mentors will be identified and assigned to a minimum of 10 middle school/high school students and provide a minimum of 6 on-line mentoring connections each year.
- **Progress Measure 2.1.2:** By spring of 2021, mentors will be identified and assigned to a minimum of 20 middle school/high school students and provide a minimum of 6 on-line mentoring connections each year.
- **Progress Measure 2.1.3:** By spring of 2022, mentors will be identified and assigned to a minimum of 30 middle school/high school students and provide a minimum of 6 on-line mentoring connections each year.
- **Progress Measure 2.1.4:** By spring of 2023, mentors will be identified and assigned to a minimum of 40 middle school/high school students and provide a minimum of 6 on-line mentoring connections each year.
- **Progress Measure 2.1.5:** By spring of 2024, mentors will be identified and assigned to a minimum of 50 middle school/high school students and provide a minimum of 6 on-line mentoring connections each year.

Measurable Objective 2.2: By Spring of 2020, E^3 staff will develop and deliver STEM/Computer Science face-to-face mentoring events for all mentored students.

- **Progress Measure 2.3.1:** By spring of 2020, from the pool of mentors, a minimum of one mentor per month will provide an after-school or weekend mentoring event each month school is in session.

- **Progress Measure 2.3.2:** By spring of 2021, from the pool of mentors, a minimum of two mentors per month will provide an after-school or weekend mentoring event each month school is in session.
- **Progress Measure 2.3.3:** By spring of 2022, from the pool of mentors, a minimum of three mentors per month will provide an after-school or weekend mentoring event each month school is in session.
- **Progress Measure 2.3.4:** By spring of 2023, from the pool of mentors, a minimum of four mentors per month will provide an after-school or weekend mentoring event each month school is in session.
- **Progress Measure 2.3.5:** By spring of 2024, from the pool of mentors, a minimum of five mentors per month will provide an after-school or weekend mentoring event each month school is in session.

Measurable Objective 2.3: By Summer of 2020, E^3 staff, in partnership with Wayne State College, will develop and deliver Summer STEM/Computer Science residential camps for middle and high school students.

- **Progress Measure 2.2.1:** A minimum of 30 middle school/high school females will participate in a week-long residential STEM/Computer Science summer camp each year of the project.
- **Progress Measure 2.3.2:** A minimum of 30 under-represented students, both male and female, will participate in a week-long residential STEM/Computer Science summer camp each year of the project.

Goal 3: Increase self-efficacy of aptitude and need for STEM and Computer Science for all students in grades K-12.

Measurable Objective 3.1: Using a 10-point self-rating scale, student self-efficacy of aptitude for Math will increase each year by at least 5%.

- **Progress Measure 3.1.1:** Student beliefs of being able to be successful in math will improve from baseline surveys each year by grade level.
- **Progress Measure 3.1.2:** Student beliefs of being able to be successful in science will improve from baseline surveys each year by grade level.
- **Progress Measure 3.1.3:** Student beliefs of being able to be successful in computer science will improve from baseline surveys each year by grade level.

Measurable Objective 3.2: Using a 10-point self-rating scale, students will have increased awareness of the need for STEM and Computer Science Content.

- **Progress Measure 3.2.1:** Student beliefs for the need to acquire math skills will improve from baseline surveys each year by grade level.
- **Progress Measure 3.2.2:** Student beliefs for the need to acquire science skills will improve from baseline surveys each year by grade level.
- **Progress Measure 3.2.3:** Student beliefs for the need to computer science skills will improve from baseline surveys each year by grade level.

Goal 4: Increase the number of students completing advanced STEM and Computer Science course work in high school.

Measurable Objective 4.1: Develop project-based modules for each middle school and high school STEM course to improve student course completion.

- **Progress Measure 4.1.1:** Beginning with 7th grade general math and increasing by one course per year, all middle School math courses will include alternative project-based modules for all middle school math courses to increase the percentage of students passing math courses each semester.

- **Progress Measure 4.1.2:** Beginning with 7th grade general science and increasing by one course per year, all middle school science courses will include alternative project-based modules for all middle school science courses to increase the percentage of students passing science courses each semester.
- **Progress Measure 4.1.3:** Beginning with 9th grade general math and increasing by one course per year, all high school math courses will include alternative project-based modules for all high school math courses to increase the percentage of students passing math courses each semester.
- **Progress Measure 4.1.4:** Beginning with 9th grade physical science and increasing by one course per year, all high school science courses will include alternative project-based modules for all high school science courses to increase the percentage of students passing science courses each semester.

Measurable Objective 4.2: By year 5, PLW Computer Science course offerings will be in full implementation.

- **Progress Measure 4.2.1:** During year 4, PLW Computer Essentials will be delivered in the fall semester in both high schools.
- **Progress Measure 4.2.2:** During year 4, PLW Computer Principles will be delivered in the spring semester at both high schools.
- **Progress Measure 4.2.3:** During year 5, PLW Computer Science A will be delivered in the fall semester at both high schools.
- **Progress Measure 4.2.4:** During year 5, PLW Cybersecurity will be delivered in the spring semester at both high schools.

Goal 5: Develop a plan to sustain the program beyond Federal funding.

- **Progress Measure 5.1:** By December 2022, an E^3 sustainability team is formed and begins planning to maintain E^3 activities.
- **Progress Measure 5.2:** By August 2023, the E^3 sustainability team delivers a plan to sustain all aspects of E^3.
- **Progress Measure 5.3:** By March 2024, the E^3 sustainability team delivers a plan to sustain the additional E^3 staffing to the greatest extent possible.

Please see page 12 for the E^3 Logic Model

(2) The extent to which there is a conceptual framework underlying the proposed research or demonstration activities and the quality of that framework.

A Research-Based Professional Development Model

The first step in the process will be working with district curriculum directors and administrators to fully unpack and review the Nebraska Math and Science Standards. ESU 2's math content expert Dr. Kelly Georgius and science content expert, Dr. Ashley Rasmussen, will lead those efforts. During the process, curriculum committee members will align content standards through a STEM/CS lens, integrating and collaborating in all content areas when and where appropriate. Once that work has been completed, teachers will be selected to participate in the extensive PD necessary to learn how to integrate the standards to current classroom practices.

The E^3 PD model integrates the teacher support structures including coaching being successful used in other ESU 2 federal grant projects. The model follows the Center for Public Education's **Five Principles of Effective Professional Development.** [13]

[13] *Teaching the Teachers, Effective Professional Development in an Era of High Stakes Accountability.* Alexandria: Center for Public Education, 2013.

ESU 2 EIR EMPOWER (E^3) Logic Model

Inputs- resources	**Inputs- activities**	**Outputs**	**Short Term Outcome**	**Intermediate Outcome**	**Long Term Outcome**
Previous research studies on instructional coaching, student mentoring, project-based learning, and Knowledge gained over past years of arts PD projects involving instructional coaching 1.0 FTE project director with extensive grant/project development experience and 2 .40 FTE site coordinators 1.0 FTE Mentor and summer activity with established connections across the region and state Wayne State College 2 partner districts Guskey's studies of effective PD Schlectly's studies on student engagement	STEM Leadership Academy PD. "Student centered coaching cycle" (Diane Sweeney) that begins with PD, goal setting, in class modeling, co-teaching and finally independent practice with observation. Each phase includes debrief either in person or via internet. School embedded professional development from Discovery Ed. Mentoring programs and Summer camps for students Project Lead the Way programming for Computer Science. Sustainability team & plan for long term outcomes of this project.	**People Served** Over 175 teachers trained serving over 2,700 students 8 school principals in participating schools **Materials/Resources** Create network of STEM/CS mentors STEM/CS Integrated lesson plans available online for teachers in and out of the grant to use Highly effective PD sessions shared via established statewide networks New models for collaboration shared via established statewide networks and on established and highly trafficked websites Sustainability plan to ensure long term outcomes of this project.	Increased teacher knowledge of STEM/CS content, skills, integration strategies, teaching best practices and technology Teachers engage in goal setting and coaching cycle to continuously improve their practice Teachers participate in regular reflective process Teachers begin to use effective teaching strategies learned in project Increased student engagement and attendance Improved student behavior & attitudes about STEM/CS Students are more successful in school.	Teachers regularly implement STEM/CS integration lessons Teachers use effective teaching strategies learned in project PD and supported by in-class coaching. Increased collaboration between classroom teachers Increased time students do STEM/CS Teachers effectively prepared to teach STEM/CS and integrate STEM/CS in their teaching of core content. Students demonstrate higher levels of engagement. Students demonstrate increased use of higher-level thinking. Increase # of students meeting or exceeding standards on NE MAP assessment. Increased annual use of program website	Teachers sustain use of teaching practices including higher order thinking practices Teachers sustain use of effective teaching strategies learned in PD and supported through in-class coaching—without additional support Sustain increased time doing STEM/CS across the curriculum E^3 treatment student scores on the NE MAP Assessment will increase from 2018 baseline by 50% more than students in control group schools. Sustained increased student use of higher level thinking and creativity Teachers continue to use online resources such as website creation and video conferencing to share student projects with authentic audience

Process Evaluation: Using data determine to what level $E^3$is meeting bench-mark goals. Determing what works/doesn't work using the Fidelity Matrix. Are there unintended outcomes? If so, what are they? How do we respond?

Impact Evaluation: Judging the Merit/Worth of the project. Did it achieve project goals? If so, can the evaluation determine a strong causal relationship. Did the project outcomes result in "evidence of promise"?

- **Principle 1:** The duration of professional development must be significant and on ongoing to allow time for teachers to learn a new strategy and grapple with the implementation problem.
- **Principle 2:** There must be support for a teacher during the implementation state that addresses the specific challenges of changing classroom practice.
- **Principle 3:** Teacher's initial exposure to a concept should be active and varied so they participate in experiencing the new practice first hand.
- **Principle 4:** Modeling has been found to be highly effective in helping teachers understand a new practice.
- **Principle 5:** The content presented to teachers should not be generic but specific to their grade level or content needs.

Using these five principles, the E^3 PD model integrates teacher support structures including coaching being successful used in other ESU 2 federal grant projects.

PD and support will be as follows. Each year, teachers will engage in over 50 hours of training, coaching and in class collaboration per year. This number is based on research that suggests the need for approximately 50 hours of instruction, practice and coaching for a new teaching strategy to be effectively learned and implemented.[14] (Principle 1)

Each teacher will attend a day in the spring as well as a two-day summer institute to accomplish *Stage One: Introduction to New Teaching Ideas*.[15] Instruction will focus on **foundational skills in STEM/Computer Science, technology**, **STEM thinking strategies**, and **research-based best teaching practices**. Learning will be active and first hand so the teacher will know what their students will be experiencing. (Principle 3) This training will focus on the concepts teachers actually teach at their grade levels, not generic lessons. (Principle 5)

Stage Two: Support During Classroom Implementation will begin in the late fall of 2019 or winter of early 2020. (Principle 2) To ensure that all teachers can implement the STEM/CS

[14] www.k12.wa.us/Compensation/pubdocs/Guskey2009whatworks.pdf
[15] Gulamhussein, Allison. *Teaching the Teachers, Effective Professional Development in an Era of High Stakes* Accountability. Alexandria: Center for Public Education, 2013.

strategies taught in the professional development, a coaching cycle model will be implemented.

Diane Sweeney's Student-Centered Coaching is one such model. A coordinator/coach will visit the teacher's classroom and meet with the teacher to establish goals for student learning in STEM/CS and best practices in teaching. The coach will model a lesson or series of lessons with the teacher's students (Principle 4) which has been effective in changing teacher beliefs as they see their students succeeding with a new teaching practice.[16] After each lesson, the coach and teacher will debrief to give both opportunities to discuss how the lesson went and how to improve it in the future. In the next lessons the two will co-teach. Again, after these sessions a debrief/ goal setting session will follow. In additional sessions of the cycle the teacher will teach independently while the coach observes and provides feedback based on previously established goals. Each teacher will participate in ten coaching experiences throughout the year.

By fostering a coaching relationship with teachers, the STEM Leaders can formatively assess each teacher's skills and work with each one personally to maximize their effectiveness in the classroom. The targets will include the STEM/CS skills and the related pedagogy.

Foundational concepts and integration techniques for STEM/CS principals

The STEAM Leadership team will train teachers in foundational concepts and integration techniques for STEM/CS principals. They will follow up with classroom modeling of the strategies and reflective coaching sessions with each individual teacher.

Each grade level will have evolving and age-appropriate objectives. The Nebraska Science and Math Standards will be used to support lessons. Evolving objectives in science might involve 3rd Grade students studying the wildlife photography of Thomas Mangelson and create an analysis of the biome, the animal classification, and explore the problem of environmental

16 Guskey, T.R. (2002). Professional development and teacher change. Teachers and Teaching: theory and practice, 8 (3), 381-391

impact on animals and then develop a potential solution to the problem.

In creating STEM/CS education examples, some characteristics stand out. First, student work evolves over time. Next, input from others will help them shape and develop their skills and support collaboration skills and perspective taking. Sharing their ideas and thoughts with others develop social-emotional awareness, and class cohesion. Engagement in the classrooms will reach new highs as each student becomes invested in their solution to a real-world issue. By asking students to use science and math skills to demonstrate the concepts they are concerned about, students were more attuned to specific details, higher order thinking and metacognitive skills. Finally, observers of the projects were struck by the uniqueness of each one. Since each student was working to represent their vision of each challenge, no two projects will be the same. This supports feelings of self-worth and respect for others' perspectives and ideas, thus building on student self-efficacy in applying STEM/CS activities to real-world problems.

(3) The adequacy of procedures for ensuring feedback and continuous improvement in the operation of the proposed project.

The E^3 leadership team took time to ensure every aspect of STEM/ CS was fully supported and developed a comprehensive plan of action with timely progress measures and outcomes clearly defined. The plan includes strong coordination between the participants, clearly delineated activities and comprehensive outcomes for evaluation and feedback from stakeholders. Each goal has a specific measurable outcome. Each outcome is a reflection of several data points collected and evaluated formatively, not at the end of an activity. The director, coordinators and project staff, will implement a systematic data collection system. The evaluators will develop a process-focused **Project Implementation Fidelity Matrix** (see p. 25) to measure progress towards meeting benchmarks and with the Leadership Team (LT), provide site-level and project-wide data reports to be reviewed in the monthly LT meetings with the evaluators. The LT will meet monthly and an Advisory Committee (AC), comprised of representatives from each school, will review program implementation and help the LT make mid-course corrections as necessary.

C. Adequacy of resources and Quality of the Management Plan (Up to 20 Points)
(1) Adequacy of management plan to achieve the objectives on time and within budget, including clearly defined responsibilities, timelines, and milestones for accomplishing tasks.

E^3 begins with a robust and extensive PD approach that considers the capacity of ESU 2 staff and their relationship with support systems and national leaders in providing quality services. It was determined that Discovery Education's (DE) STEM Leadership Academy has the experience, research base, and capacity to lead the STEM/CS PD portion of this project.

Schuyler Community Schools began a relationship with DE several years ago and utilized STEM Leadership Academy with their high school through state School Improvement Funds. The results were promising. Evaluation results for mapping student achievement were thwarted when the state changed assessment systems during the middle of the intervention and student engagement was never evaluated as part of that process. However, the planning committee agrees that expansion of the implementation of STEM Leadership Academy to all grade levels and buildings is necessary to build on preliminary success of the high school.

Besides Schuyler Community Schools, the planning group identified a second district to participate. Schuyler demographics include a majority minority, high poverty, and below state average student achievement. Raymond Central is nearly opposite in demographics like poverty, minority enrollments, and student achievement. However, district perceptual surveys on student engagement and relevant content are extremely low.[17] Therefore, this project will involve two very opposite districts for the purpose of identifying the impact of the proposed interventions on both rural districts, one that scores below the state average and one that scores slightly above the

[17] Fall 2018 BrightBytes student perceptual survey results.

state average, even with low poverty levels and virtually no English Language Learners.

	Enrollment	Teachers	School Classification	ELL	Gifted	F&R	Special Education
Raymond	688	52	Great	*	17%	20%	13%
Schuyler	2,071	143	Good	37%	12%	68%	11%

	ELA % Proficient	Math % Proficient	Science % Proficient	Graduation Rate	College Going Rate
Raymond	55%	56%	65%	96%	81%
Schuyler	39%	43%	49%	86%	74%
State	51%	51%	68%	89%	74%

The E^3 management plan outlines specific tasks, responsible parties, and timeline for year one. Each year, the leadership team and advisory council will meet to review progress and make adjustments to the timeline and activities in accordance to project goals and objectives. This ability to monitor and adjust will ensure all aspects of the research are thoughtfully addressed and documented to support replication of E^3 by other entities and improve the body of evidence on research-based interventions and strategies for STEM/CS education in small rural schools.

ESU 2 EIR EMPOWER (E^3) Management Plan Timeline

Activity	**Responsible Parties**	**Time Frame**
Project Director (Dir.), Project Coordinators (PC), and Mentor Coordinator (MC) are reassigned/hired, notify schools and partners of award.	Dir., LT, Business Office (BO)	Within 60 days after project award
Dir will negotiate and secure contracts for STEM Leadership Academy, TechBook/Streaming	Dir., BO	
Finalize contractual agreements with Evaluator, colleges, schools, and other partners.	Dir., BO	
Monthly Leadership Team Meeting (Ongoing)	Dir., LT, evaluator	
Organize STEM Leadership training, assist schools in developing EMPOWER implementation plans.	Co, school counselors, Principals	
Meet with Wayne State College (WSC) to begin summer experience planning.	CTETs, WSC business department chair, PC	
Begin development of mentoring program.	CTETs, WSC, LMS	
Evaluators/LT meet to finalize grant fidelity matrix & benchmark evaluation targets	LT, Evaluator, Project Personnel	
E^3 info meetings at schools to outline program expectations for classroom teachers.	PC, Co, LMS, Principals	
Identify first cohort of teachers to participate in STEM Leadership Academy	Co, school counselors, Principals	Within 75 days of project award
Evaluators/LT conduct first Fidelity Matrix review	Dir., LT, Evaluators	
Secure matching and in-kind agreements with districts.	Dir., PC, ESU 2 admin.	Within 90 days of project

Outline site coordinator responsibilities, timelines	Dir, PC, ESU 2 admin.	award
Begin classroom baseline observations in control and intervention schools.	Evaluator	
Identify courses to begin project-based credit recovery projects.	PC, Co, LMS, CTETs	
Develop mentoring agreements and secure opportunities for students.	PC, Co, ESU 2 admin.	
Develop STEM Leadership Academy dates schedule sessions.	Dir, PC, Co, LMS, school counselors, principals.	
Advisory Committee meets (will meet bi-annually)	Dir., Partners	
Develop and deliver STEM Launch and community informational event	Contracted trainers, LMS, Co, teachers, principals	October, 2019
Begin delivery of PD STEM Leadership Academy	Co, school counselors, principals	November, 2019
Begin recruitment of students for summer STEM/CS camps at WSC	PC, Co, LMS, CTETs	Spring, 2020
Evaluators/LT conduct 2nd Fidelity Matrix review	Dir., LT, Evaluators	
Deliver summer STEM/CS camps at WSC	PC, Co, LMS, principals	Summer, 2020
Review project-based credit recovery projects for validity, rigor, and content.	PC, ESU 2 PD staff, Dir., district curric. directors	
Evaluators/LT conduct 3rd Fidelity Matrix review	Dir., LT, Evaluators	
File Year One Annual Yearly Report	Dir., LT, Evaluators	Sep. 2020
Repeat Year One Program Activities	Dir., LT, Evaluators	Fall. 2020
Revise, edit, and monitor all program deliverables.	Director & above staff	Dec. 2020
Organize and recruit Sustainability Planning Team	LT and schools	2021-24

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(3) The potential for continued support of the project after Federal funding ends, including, as appropriate, the demonstrated commitment of appropriate entities to such support.

E^3 will revolutionize STEM/CS education for small and rural schools in eastern Nebraska. This project has the eyes of the state upon it. As this program comes to fruition, E^3 leadership, schools, and students will begin the process of disseminating the program through normal media outlets. In addition, the ESU 2 website has developed an E^3 web presence. Finally, E^3 teachers, staff, and schools will apply to present at regional, state, and national educational conferences.

Schuyler has demonstrated sustainability with its investment in STEM Leadership Academy and is currently purchasing the on-line resources to support STEM Leadership Academy at the high school. E^3 resources will support expansion to other buildings, but the district is prepared to sustain the resources moving forward. Raymond Central has committed to supporting the necessary products/resources through normal instructional materials resource adoption cycles.

ESU 2 is optimistic the research study proposed will provide sufficient evidence of significance that in the future, a Mid-Phase grant application will be submitted to build on the lessons learned in this Early-Phase program and will allow for the expansion of the project to a broader base of districts, including the control districts identified in the evaluation section.

D. Quality of Project Evaluation (Up to 20 Points)

(1) Extent to which the methods of evaluation will, if well-implemented, produce evidence of the project's effectiveness that would meet the WWC Evidence Standards with reservations.

E^3 will meet the WWC Group Design Standards with Reservations by using a Quasi-experimental design and establishing equivalence of the treatment and the comparison groups at baseline. Establishing equivalence is made easier because all schools are in the same region.

(Schuyler and Raymond Central as treatment schools with Crete and North Bend as control/comparison schools.) The student population of treatment (2,759) and control schools (2,680) is similar in SPED rates, SES status, and state assessment results. All schools measure and report data using the same metrics and data systems which are managed by the state department of education. Mr. Bareilles will collect student data using those systems to access test results and other data. By using control schools within the region, any additional support provided outside of E^3 will be available to both treatment and control schools.

Possible confound: It is possible over five years principals, STEM and other teachers from treatment schools will move to control schools and begin implementing the same or similar programs as in E^3 schools thus sharing/implementing E^3 components. If this happens, the schools' ability to serve as comparison/control sites would be compromised. In that event, the evaluation team and program leadership would need to determine other possible control schools.

(2) The extent to which the evaluation will provide guidance about effective strategies suitable for replication or testing in other settings.
(3) Extent to which the evaluation methods provide valid and reliable performance data….

The program evaluation will be guided by three program evaluation questions derived from a model developed by Gajda and Jewiss at the University of Vermont in 2004[18]: (1) What are the *desired outcomes* of this program? What are the goals? What are we trying to accomplish within the next month/quarter/year(s)? (2) How will we get there? What *activities* will enable us to reach our outcomes? (3) What will *indicate* that we are making progress toward the desired outcomes?

Mr. Bareilles will collect student data to access test results and other data. Teacher practice will be measured by Dr. Parker's supervision of 150 yearly classroom observations of E^3 teachers and 50 of control teachers to determine if there is a change in teacher practice and

[18] Rebecca Gajda and Jennifer Jewiss, "Thinking about How to Evaluate Your Program? These Strategies Will Get You Started," *Practical Assessment, Research & Evaluation* 9, no. 8 (2004).

student engagement. The data will be analyzed by Dr. Mark Baron as described below.

Impact Study on the effect of implementation of the E^3 model

The evaluation includes an impact study on the effect of implementation of the model on student achievement as measured by the state assessments in English/Language Arts and Math. These assessments return scaled scores of student performance, but our focus will be on a summary characterization for each subject area. Student achievement will be characterized as either “0” for “not proficient,” meaning the student has not met the grade-level target for learning in the tested content area, or “1” for “proficient,” meaning the student has met the grade-level target for learning in the tested content area.

The study will be a Quasi-Experimental Design in which achievement of students from schools receiving the treatment (study classrooms) is compared to achievement of students from similar schools not receiving the treatment (comparison classrooms). Once the samples are constructed for treatment and comparison, Dr. Baron will confirm the equivalence of the samples at baseline by using the structure of the hierarchical linear regression model described below, but with the data from pre-treatment assessments (2018 and 2019) as the dependent variable.

The effects will be estimated by a three-level (student, classroom, school) hierarchical linear regression model with dependent variables the proficiency levels which are observed in 2020, 2021, 2022 (exploratory), and 2023, 2024 (confirmatory). The model is designed to control for and to measure the impacts of the following co-variates: student achievement in 2018 and 2019 (baseline), student gender, socio-economic status, student race, grade level, teacher experience, percent of non-white students in the school, and percentage of low-income students in the school.

We will explore the effect of the treatment model on student achievement after one year of the program (based upon change from baseline), look to confirm a small positive effect in student achievement after two years, and look to confirm a moderate positive effect after three years.

Additional exploratory analysis will be conducted on key subgroups of students: females, minority, low socio-economic status, and special education.

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(4) The extent to which the evaluation plan clearly articulates the key project components, mediators, and outcomes, as well as a measurable threshold for acceptable implementation.

The evaluation plan will assess the E^3 goals and measurable objectives. While each goal has measurable objectives in the event of funding, these will be more closely examined by the LT and Advisory Group and finalized by early 2020. As described, the evaluation team will collect student and implementation data using the methods listed.

To formatively assess progress towards meeting these goals within 90 days of award the evaluators will develop a Program Implementation Fidelity Matrix to measure progress meeting short-, mid-, and long-term goals, and finalize an implementation timeline. The **Program Implementation Fidelity Matrix (PIFM)** is a progress measure tool that (1) takes each goal and benchmark, (2) determines each goal's short-, mid-, and long-term targets, (3) list the level of achievement to meet the target, (4) assigns each target a point value, and (5) using the sum of the target scores measures progress toward meeting the goal or benchmark. The evaluators will develop a PIFM (a 40+ hour task) for regular review to determine E^3's implementation level. They were trained in the i3 Fidelity Matrix in a prior i3 grant and developed the PIFM tool and methodology based on that experience and have now used it in ten different US Ed. grants.

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The PIFM will include program-wide, staff-specific, and school-level subsections. Each will be given an overall weight which totals 100 points. An overall score of 85/100 will be the measurable threshold for acceptable program implementation.