DUVAL COUNTY PUBLIC SCHOOLS

ULTRA—MINECRAFT MENTOR EDITION
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A. QUALITY OF PROJECT DESIGN

There is a disconnect in the state of exceptional student education (ESE)—teaching students with varying disabilities—that has a profound effect on teaching and learning in our country. We know the importance of engaging ESE students in inclusion settings with typically developing students. Research shows that students with disabilities thrive better in classrooms with peers of varying abilities (Hicks-Monroe, 2011). There is also evidence that students without disabilities benefit from well-implemented inclusion practices (Shogren et al., 2015). However, teachers may be ill-prepared to engage students of differing abilities and subsequently resistant to inclusion settings (Alexandrei, 2017; Finch et. al, 2013; Roberts & Simpson, 2016). Teachers with training in ESE strategies are more likely to be open to inclusion, and student outcomes are likely to be positive when teachers are trained in differential teaching strategies (Alexandrei, 2017; Boyle 2013; Obiakor 2012; Sokal 2017). But both ESE and non-ESE students may experience negative outcomes in inclusion settings when teachers are not adequately trained in multimodal strategies (Hicks-Monroe 2011). Public policy in Florida is designed to improve ESE teaching practices and increase training requirements. Since 2013 Florida teachers renewing certification must have the equivalent of one college credit in teaching ESE students (Stewart, 2013). However, as we will show, this foundational training is not enough to support the differential learning needs of most ESE students, and as a result we fail to provide an equitable education. ***We need better strategies for teachers to reach all students in inclusion settings.***

Duval County Public Schools (DCPS), in collaboration with a multidisciplinary research team from the University of North Florida (UNF), Florida State University (FSU), evaluation team CIC Planning, a partnership with Microsoft, and with support from community partners, proposes **Using and Leveraging Technology to Reinvent Accessibility: Minecraft Mentor Edition**.

(*ULTRA:ME)* is an initiative that provides professional development (PD) and support to teachers in leveraging Microsoft accessibility-supportive and gamification tools to enhance instruction. Gamification software, and Minecraft in particular, has been heralded as an engaging teaching tool that can be adapted to a range of subject areas and learning needs. However, few if any rigorous studies have explored improved student outcomes using Minecraft.

With the debut of the *ULTRA:ME*, we will explore the impact of this gamification educational technology in the classroom to improve the STEM and social-emotional learning outcomes of elementary students, including high-need ESE students with neurodiverse conditions such as autism, dyslexia, ADHD, specific learning disabilities, and behavior/emotional disabilities. K-5 general and ESE science teachers will be trained on the use of this tool along with strategies to engage students and receive in-classroom coaching and support to ensure fidelity. They will then use Minecraft to teach Nature of Science lessons to all students, using state-aligned curriculum. **The central purpose of the project is to develop and assess the effectiveness of the series to improve K-5 outcomes, with a particular focus on the intervention's effects on ESE students.** By employing a cluster randomized controlled trial (RCT) **meeting What Works Clearinghouse (WWC) Standards without Reservations**, we anticipate that this project will provide evidence of a replicable approach to improving STEM self-efficacy and relative improvements in science achievement. The study will explore the impact of the instructional tool and strategies, comparing outcomes for both typically-developing and ESE students with a business-as-usual comparison group receiving standard science instruction.

Project specifics: This project is presented as an early-phase EIR project, addressing **AP1**: Demonstrates a Rationale (see logic model p. 24 & Appx I) and **AP2**: Field-Initiated Innovations—STEM. The study includes 4 cohorts (including a pilot cohort) serving 280 total teachers and 4,760

K-5th grade students (at least 10% of whom are high-need ESE students) over the 5-year grant period. For this grant, we define high-need students to be those who have a disability, designated as ESE and adhering to an individualized education plan (IEP) per district and state policy. The number of students in the district and incidence of identified disabilities can be found in Fig. 1.

Background: The innovative project proposed—*ULTRA:ME*—is a research project on PD and gamification software as an educational teaching tool, using Minecraft: Education Edition; applied to specific science instructional activities. Minecraft is a collaborative program that uses the concepts of coding and computer science, presented within an immersive learning environment, to foster creativity, critical thinking, social emotional development, and much more for its players. From its origins as a video game for home recreational use, Minecraft now has many iterations including the Education Edition developed for in-school use. The system provides an immersive augmented reality/gamification experience within which teachers can design engaging, collaborative instructional lessons. It is reported that there are currently 35 million students and teachers in 115 countries using the Education Edition of Minecraft alone (Snider, 2020) and more than 112 million users on the gaming platform worldwide (Gilbert, 2019). COVID-19 has led to more interest and use of Minecraft: Education, as households and schools look for ways to engage students remotely (Torrey, 2020). It is a low-cost software available to households and schools around the world and can be easily made available to students in either setting. As we will discuss, the program shows promise at engaging a wide range of users, and DCPS proposes to leverage the flexibility and scope to improve outcomes for ESE students.

A(1) Goals, objectives, and outcomes: *ULTRA* focuses on the use of Minecraft and widely available Microsoft educational technology tools, combined with a carefully designed PD educator series to reach the following goals: 1) Increase social-emotional and academic outcomes of students with and without disabilities; 2) Increase teacher knowledge, efficacy, and practice in supporting ESE students; and 3) Refine an innovative, replicable, and cost-effective model for PD in Minecraft: Education Edition. Project objectives and measurable outcomes are detailed below. Data sources and measurement methods are described in Section C starting on page 19.

<u>Goal 1</u>. Increase social-emotional and academic outcomes of students with and without disabilities.	
<u>Objective 1.1</u> Use Minecraft to improve student self-efficacy for STEM and motivation/engagement in STEM.	
Outcomes	**Measures**
Student self-efficacy for STEM	▪ % of students who report increased self-efficacy ▪ % of ESE students who report increased self-efficacy
Student motivation/ engagement in STEM	▪ % of students who report increased motivation ▪ % of ESE students who report increased motivation
<u>Objective 1.2</u> Use Minecraft to improve student achievement in Science.	
Student achievement in Science	▪ % of students proficient in Science ▪ % of ESE students proficient in Science
<u>Goal 2</u>. Increase teacher knowledge, efficacy, and practice.	
<u>Objective 2.1</u> Implement PD that develops teacher mastery of strategies for engaging students in STEM learning.	
Teacher knowledge/use of strategies for delivering engaging STEM instruction	% of teachers who improve by 1 or more observation rubric levels (or maintain level 3+) on <u>student engagement strategies</u> (4-level rubric)
Teacher knowledge/use of strategies that support students with disabilities	% of teachers who improve by 1 or more observation rubric levels (or maintain level 3+) on <u>targeted ESE, inclusion, and differentiated instruction strategies</u> (4-level rubric)
<u>Objective 2.2</u> Support teacher efficacy in STEM instruction for students with and without disabilities.	
Outcomes	**Measures**
Teacher self-efficacy for STEM instruction	% of teachers who report increased self-efficacy for STEM instruction
Teacher self-efficacy for STEM instruction with ESE students	% of teachers who report increased self-efficacy for STEM/ESE instruction
Teacher instructional practice	% of teachers who improve by 1 or more observation rubric levels (or maintain level 3+) across <u>all domains</u> (4-level rubric)
<u>Goal 3.</u> Refine an innovative, replicable, and cost-effective model for PD in Minecraft: Education Edition.	
<u>Objective 3.1</u> Assess the variable impacts of ULTRA PD to identify "what works and why."	
High-fidelity implementation	# participating teachers; # professional learning hours (<u>Phase 1-3</u>); # virtual PLCs attended per teacher; # in-classroom and virtual coaching hours (or coaching interactions); # total students served (**GPRA**); # high-need/ESE students served (**GPRA**); Cost per student (**GPRA**)
Identification of variable impacts of key components	% of participants passing foundational skills-based assessment (<u>Phase 1</u>); % of participants' Minecraft lesson components scoring at level 3 or above on 4-level rubric (<u>Phase 2</u>); % of participants' assistive technology plans scoring at level 3 or above on 4-level rubric (<u>Phase 3</u>); % of participants' Minecraft instructional plans scoring at level 3 or above on 4-level rubric (<u>Phase 4</u>: Design Phase); % of participant lessons scoring at level 3 or above on 4-level rubric (<u>Phase 5</u>: Classroom Implementation)
<u>Objective 3.2</u> Sustain and build toward systemic impacts.	
Sustained impacts on students and teachers.	% of teachers maintaining or increasing student achievement at annual follow-up
	% of students maintaining or increasing achievement at annual follow-up

The *ULTRA:ME* PD/student instructional model will be a year-long series, and we propose to engage 4 cohorts during the EIR grant. (see Page 25). Although the program utilizes easily accessible, popular content (which is a strength of the project for future replication), this is a one-of-a-kind offering with a goal of maximizing the potential of Minecraft for our highest-need students who are underrepresented in STEM. *ULTRA:ME* proposes to develop and implement an educational model to be used in inclusion settings and standalone ESE classrooms. **The program will include a PD series so elementary science teachers can become experts in implementing the tool; coaching, professional learning communities (PLCs), and peer mentoring to reinforce instructional strategies and for fidelity; and lessons in Nature of Science topics taught via Minecraft for Education for K-5 students.** This project is innovative because it proposes an easily replicable training infrastructure to maximize the effectiveness of a widely available, cost-effective educational technology tool that has shown promise in opening the door to STEM pathways for ESE students who are capable, but struggle with the content due to differential learning styles. If successful, this project can lead to innovations in using gamification instructional technology widely throughout appropriate ESE/inclusion settings and STEM topics.

A(2) Project is appropriate to and will address the needs of the target population*:* **ESE instruction and learning STEM in the elementary years: *ULTRA:ME* will target elementary students with learning disabilities in grades K-5.** *Target population: ULTRA:ME* targets the STEM instructional needs of ESE students in the district, focusing on K-5 grades. The district enrolls more than 20,000 ESE students (16,000 non-gifted), constituting 12-15% of the student population (FLDOE, 2020). Historically, achievement for these students has fallen behind expectations. Graduation rates for students with disabilities have fallen well below rates for students without disabilities, although ESE students' graduation outcomes have improved considerably in recent years (Fig. 1). However, ESE student performance on standardized tests has decreased slightly since 2015-16, with 26% of fifth graders scoring proficient on standardized science assessments compared to 54% for non-ESE (Fig.3). A majority (55%) of K-5 schools were identified by the State for technical/comprehensive support and instruction due to their failure to improve gains for the lowest quartile of students with disabilities (FLDOE 2019). There is evidence that this disparity is the product of lack of resources compounded with ESE status: among the 16 elementary schools that do not have a majority-economically disadvantaged population (as determined by the State of Florida), all but one (6.2%) produced sufficient gains for their lowest quartile of ESE students (FLDOE 2019).

Figure 1: Exceptional Student Data by Exceptionality 2019-20			
ORTHOPEDICALLY IMPAIRED	153	GIFTED	6,266
SPEECH IMPAIRED	2,618	HOSPITAL/HOMEBOUND	120
LANGUAGE IMPAIRED	2,315	AUTISM SPECTRUM DISORDER	1,994
DEAF OR HARD OF HEARING	274	TRAUMATIC BRAIN INJURED	29
VISUALLY IMPAIRED	60	DEVELOPMENTAL DELAY	1,171
EMOTIONAL/BEHAVIORAL DISABLED	885	OTHER HEALTH IMPAIRED	3,359
SPECIFIC LEARNING DISABILITY	5,636	INTELLECTUAL DISABILITY	1,903
Total students with disabilities: 206,783; 20,517 non-gifted			
Insufficient gains for lowest 25% ESE			
Economically disadvantaged 67.5%		Not eco disadvantaged: 6.2%	

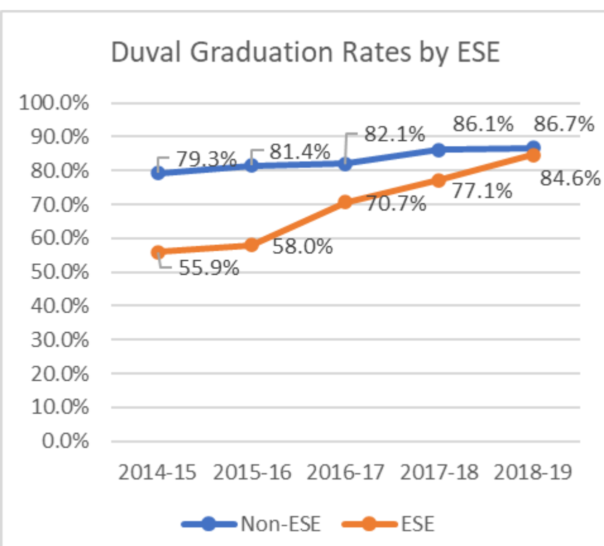


Figure 2, Florida DOE 2019

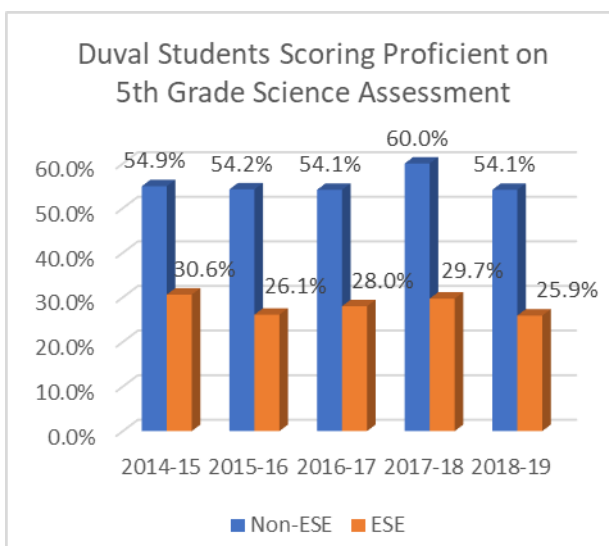


Figure 3, Florida DOE 2019

Project is appropriate for and will address the need of the target population: Early exposure to STEM content is important for all students to establish interest in and to ensure students acquire skills and knowledge early on (STEM Act 2019). The early grades represent a pivotal point in child development when many students acquire foundational skills that set the stage for future growth and learning; students who face learning challenges in their elementary years are more likely to fall behind their peers, and they will often require remedial or other support if they are to ever catch up (Schweinhart & Weikart, 1998). Therefore, the elementary years are an ideal time to engage students in foundational activities to increase interest and knowledge in STEM subjects that may ultimately impact their participation in and interest in STEM in the long term (Aschbacher 2017, DeJArnette 2012). As indicated in section A(4), there is evidence that gamification-based instructional technology has the potential to support the learning needs of ESE students. Despite a lack of focus in the literature on the early impact of this technology on ESE students, there is evidence that *ULTRA:ME* and similar initiatives are appropriate for this population.

A(3) Proposed project reflects up to date research and best practices: Gamification systems like Minecraft have been established as an effective tool for education, allowing students engaging access to content. Studies indicate potential benefits of gamification educational tools for students with various disabilities, especially for students with sensory or processing challenges (O'Sullivan, 2017). Digital games that feature interactive and multiple representations of a scientific system also enable active knowledge construction within constructivist approaches, such as learning by meaningful play and learning by making (Ke, 2016; Nebel, Schneider, & Rey, 2016).

Theory of change: The *ULTRA* project premise is built on the theoretical framework of Social Learning Theory (SLT), which determines that learning is an inherently social act reliant on communication among teacher and students (Bandura 1977; Hill, 2009). However, students with disabilities—particularly students with neurodiverse conditions—broadly struggle with processing components of interpersonal interactions, and often perceive input differently than typically developing students (Borca, 2017). To engage these students in the process of learning, *ULTRA:ME* applies differential instructional strategies to the SLT framework to align with students' learning styles and needs. *ULTRA:ME* provides an augmented reality **environment** shown to increase engagement and reduce distractions for ESE students; allows for students to engage in learning **behaviors** by partnering with peers for collaborative work; and incorporates **cognition** via highly stylized lessons. We anticipate that ESE students will engage in the learning process more readily than with standard instructional strategies, resulting in greater gains (Fig.4).

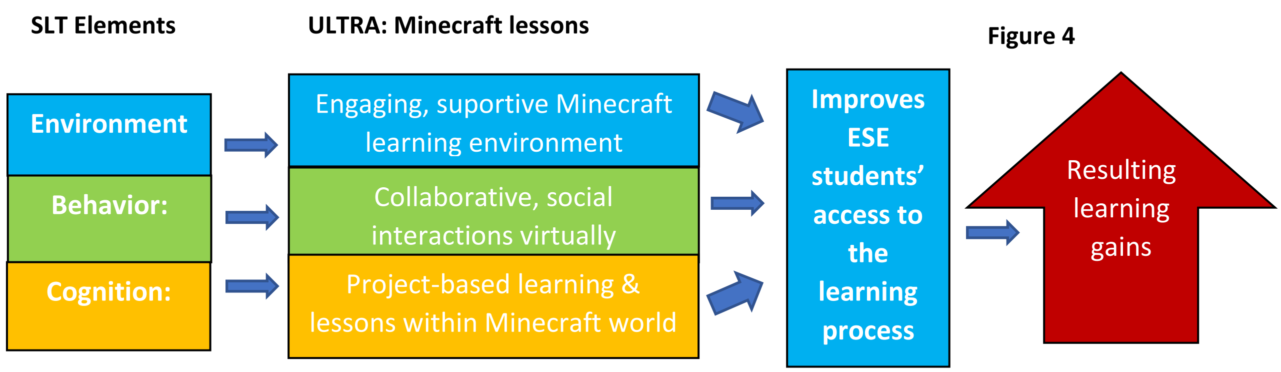


Figure 4

In addition to a strong theoretical framework, *ULTRA:ME* incorporates best practices in professional development for K-5 educators, in ESE education, and in STEM/science:

Effective practice in gamification/augmented reality: According to several studies on the impact of Minecraft: Education Edition, 98% of teachers using Minecraft reported their students' having increased problem-solving skills. with 40% of jobs in growth industries requiring soft-skills fostered by social/emotional learning. Platforms like Minecraft that develop those skills are vital to standard educational practice (Karsenti, et. al 2017). In a study focused on STEM learning and social-emotional learning in Quebec schools, 80% of students who learned with Minecraft went on to use coding at advanced levels (Karsenti & Bugmann, 2018), while another found that 71%

of teachers using gamification strategies, like Minecraft, reported improvement in student numeracy and computational thinking (Takeuchi & Vaala 2014).

Effective practice in PD and STEM instruction: The *ULTRA:ME* project utilizes demonstrated professional development practices, and applies the tool to foundational science standards. As shown in the model on p. 25, DCPS will utilize asynchronous training, bolstered by ongoing PLCs, culminating in project-based demonstrations of learning, with follow-up in-classroom coaching and modeling to support effective implementation. For this study we focus on Nature of Science as incorporated into the Florida State Sunshine Standards. We focus on Nature of Science standards in this study because of their foundational importance to an ongoing interest in science. According to the State of Florida, the emphasis on the Nature of Science in standards is justified because "proficiency in science begins with understanding science as a process of building theories from evidence and developing the same skills that scientists demonstrate," (State of Florida 2009).

DEMONSTRATES A RATIONALE: Built on these theoretical and empirical foundations, the *ULTRA:ME* Logic Model (p. 24 & Appx I) outlines key components and mechanisms through which project outcomes will be achieved. The model proposes that providing teachers with PD to enhance their knowledge of and use of strategies for (1) implementing engaging STEM instruction using Minecraft and (2) supporting ESE students will improve teachers' ability to engage all students in STEM content, while supporting the sensory/processing needs of ESE students.

A(4) Contribution of project to increased knowledge/understanding of educational problem:

Minecraft in student learning: The use of gamification strategies in education has gained support in theory and practice in recent years. Studies have shown Minecraft to be a promising teaching tool for students, particularly in areas of fostering creativity (Checa-Romero, 2018; Blanco-Herrera, 2019; Javorsky, 2019), improving collaborative skills (Davis, 2018) and teaching computer coding skills (Saito, 2016). In past studies, teachers using Minecraft reported their students' improvement in the use of coding in advanced levels, improvement in computational thinking, and numeracy (Callaghan, 2016; Ming, 2020). However, there has been little research conducted on the impact of the use of this tool on student learning gains outside of computer science, and we do not know the effect of the tool on students with disabilities. Despite gaps in the literature, gamification instructional technology is a promising tool to improve student learning because it presents content in a highly stylized interface that could facilitate learning for students who struggle with comprehension and language acquisition by utilizing visual, immersive instructional methods for increasing interest and motivation (Chapman, et.al 2018; Pusey, 2015).

Minecraft in teaching: There is also a gap in the research related to the role of Minecraft in teaching. Although studies have shown Minecraft to be a tool for transferring content knowledge to pedagogical practice (Kim, 2018), and creating engaging lessons that promote knowledge transfer (Vicari 2019), there are few rigorous studies of Minecraft as an effective teaching tool. Minecraft can be difficult to integrate into classroom use because training is required for widespread implementation. Studies note that effective integration of the tool requires training for teachers to acquire the skills needed to understand operation and how to engage it into instruction (Baek 2020), and that use of the tool can be prohibitively challenging for teachers because it was not originally intended for use in formal learning environments (Vicari, 2019). Although training content for teachers is produced by Microsoft, the publisher, PD that trains educators to integrate Minecraft into curriculum as a standard tool is not a widely available resource.

ESE students and STEM: *ULTRA:ME* is intended to have multiple benefits for neurodiverse students with disabilities. *ULTRA:ME* targets STEM—and foundational science content in particular—because this area has a strong potential to impact student outcomes in the long term.

Many ESE students struggle with academic outcomes and are underrepresented in STEM career fields, despite evidence that persons with autism, ADHD, dyslexia, and other conditions can excel cognitively in—and may disproportionately prefer—areas of STEM (Chalifant, et al. 2017). This paradox is understood to be the result of two primary factors: 1) Educators often are not trained to adjust formative assessment practices, promoting interaction, and supporting differential input methods that account for sensory processing barriers that ESE students face; and 2) ESE students often experience difficulty in social emotional regulation and interaction and reciprocal and expressive communication difficulties that result in the need for differential sensory inputs to stay focused, comprehend, and engage the content (Ravet, 2013). Exploratory studies indicate the potential for the use of Minecraft to help students with autism and ADHD to engage in social learning (Zolyomi, 2017) and creation (Staley, 2019).

At the heart of *ULTRA:ME* is the goal to improve access to STEM content for ESE students. The team seeks the answers to the following questions: ▪ Can we improve teacher efficacy in using Minecraft to teach foundational science skills to ESE students via professional development? ▪ Does the use of Minecraft in lessons facilitate gains in foundational science content for K-5 students? ▪ Do ESE students experience greater gains when using Minecraft as a learning tool when compared to their typically developing peers? ▪Does the *ULTRA:ME* improve self-efficacy and motivation for ESE students in learning STEM content? As research indicates, 1) ESE students have the potential to excel in STEM subject areas, but 2) teachers are often not prepared to engage students with neurosensory disabilities in STEM instruction, and 3) Minecraft -based instruction may provide activities commensurate with these students' learning and sensory needs. We expect that this project will contribute to an improved use of science instruction for the target students, using one of the world's most popular and accessible gaming systems.

B. ADEQUACY OF RESOURCES AND QUALITY OF MANAGEMENT PLAN

B(1) Adequacy of management plan to achieve objectives*:* DCPS has convened a highly qualified team to ensure effective management of project outcomes. The *ULTRA:ME* partnership includes accomplished academics in the fields of ESE, STEM, and instructional technology.

Implementation partner—DCPS*:* DCPS will serve as lead implementation partner. DCPS is the 6th largest school district in Florida, serving 130,000 students. DCPS participants include the Project Director/Co-Investigator, Training Coaches, and Advisory Team. Responsibilities: DCPS will serve as the fiscal agent and lead grantee of *ULTRA:ME*. The oversight, management, and coordination of this project will ultimately be the responsibility of the Project Director/Co-Investigator, who will lead grant administration. He will be supported by a Lead Coach who will be instrumental for coordination and management of the training activities under the Project Director. Two additional Coaches will support training and coaching efforts with teachers.

DCPS has the fiscal capacity to lead *ULTRA:ME*. The district's annual budget is [redacted] DCPS will employ routine cost-control mechanisms, and has a history of successfully managing large federal- and state-funded projects. The district is the recipient of a [redacted] 2017 GEAR UP grant (the district's third GEAR UP grant). DCPS also operates active awards from the US Department of Justice, Department of Defense, and Department of Health and Human Services. In all, DCPS manages more than [redacted] in federal discretionary funds, more than [redacted] in federal entitlement funds, and numerous large state projects.

Co-Investigators—Dr. Kim Cheek (University of North Florida) and Dr. Fengfeng Ke (Florida State University): The project research team includes two additional Co-Investigators who bring an expertise in Science, ESE, and Educational Psychology from UNF and FSU. They will collaborate on the project design, implementation, and evaluation strategies; and will lead the efforts in dissemination of project findings. Responsibilities: Duties include participation in meetings, consultation with evaluators on analysis and research findings; leading the development of the dissemination plan; participating in the writing and submission of findings; and providing and assisting with the development of the overall design and implementation of the project.

Evaluation team—CIC Planning Group: The third-party evaluator has an extensive background in educational research, is trained in WWC Group Design Standards, and has experience evaluating EIR and other large-scale federal grants. CIC specializes in evaluating motivational, social-emotional, and academic outcomes, and has worked in North Florida for 30 years. Responsibilities: CIC Planning Group will serve as evaluation team, with Dr. Natalie Wright as lead evaluator. CIC will oversee all evaluation duties and will work with Co-Investigators on continuous improvement and dissemination of findings.

Training partner—Microsoft: The DCPS team has partnered with Microsoft, the developer of Minecraft for Education, to assist with the development and administration of the proposed PD series. Microsoft has a special interest in supporting the STEM-related needs of students with diagnosed disabilities, with a goal of encouraging their entry into the STEM workforce.

Description	Responsible	Due	Y1	Y2	Y3	Y4	Y5
LEGEND: PD=Project Director/Co-Investigator; I=Co-Investigators; LC=Lead Coach; C= Coaches; AT=Advisory Team; E=Evaluator							
IMPLEMENTATION TIMELINE-- JAN 2021-DEC 2025							
Award received	**DCPS**	**January**	**x**				
Classroom implementation begins	**LC, C**	**January**		**x**	**x**	**x**	**x**
Hiring, contracts, purchases, startup activities	**PD, I, E**	**February**	**x**				
Advisory Team meeting (recurs fall & spring)	**PD, I, LC, C, AT, E**	**April**	**x**	**x**	**x**	**x**	**x**
Community events (NEFEC Summit)	**PD, I, LC, C, AT, E**	**Spring**			**x**		**x**
Education community event	**PD, I, LC, C, AT, E**	**Spring**					**x**

Description	Responsible	Due	Y1	Y2	Y3	Y4	Y5
LEGEND: PD=Project Director/Co-Investigator; I=Co-Investigators; LC=Lead Coach; C= Coaches; AT=Advisory Team; E=Evaluator							
Contracts completed and staff hired	**PD**	**May**	x				
Training schedule finalized	**PD, LC, C**	**May**	x				
Recruitment plan develop; recruitment begins	**PD, LC, C**	**May**	x				
Post data collection	**LC, C, E**	**May**		x	x	x	x
Devices ordered for coming year	**PD, LC, C**	**June-July**	x	x	x	x	
Cohort recruited for the coming year	**LC, C**	**June-July**	x	x	x	x	
Training series begins for the Cohort	**LC, C**	**August**	x	x	x	x	
Baseline data collected for the year	**LC, C, E**	**August**	x	x	x	x	
Advisory Team meeting	**PD, I, LC, C, AT, E**	**October**	x	x	x	x	x
Previous year data analysis, review, reporting	**PD, I, E**	**June-Dec**		x	x	x	x
Writing/ dissemination schedule finalized	**PD, I, E**	**December**		x			
EVALUATION TIMELINE-- JAN 2021-DEC 2025							
Implementation	**E**	**See detailed evaluation timeline in Appx I**		x	x	x	x
Impact	**E**			x	x	x	x
Sustained Effects	**E**				x	x	x
Final Impact Study	**E**						x

B(2) Costs of the project are reasonable*:* The costs of the proposed project are reasonable and expected, particularly in an era that relies more on meaningful educational engagement using remote learning tools. Although COVID-19 is a very new phenomenon and scant research and guidance about best practices currently exists, there is emerging information and reports that assert the need for widely available, engaging, and effective remote technology and teaching tools to provide an equitable experience to students. According to Lieberman (2020), effective COVID-19 digital learning experiences must have the following among the necessary characteristics to be successful: training on the use of interactive multimedia content; ability to conduct organized group learning; emphasis on individualized academic pacing for students; the same or similar resources and assignments provided to students learning in classrooms or who are learning remotely at home, and the ability to pay heightened attention to the most vulnerable students (Lieberman 2020). Based on this, the *ULTRA* project is an ideal initiative to support the new learning environment required for an effective COVID-19 response.

Minecraft for Education is a cost-effective solution that can be available to students in various scenarios, regardless of in-school or remote learning conditions; and is appropriate for students from kindergarten through 12th grade. Microsoft for Education can be used in classroom and home environments and can allow for individualized or group use. As a tool which has a low license fee that is already included in many school districts' Microsoft licenses, it can be an effective tool with a cost already incurred. *ULTRA:ME* training can be offered to teachers in person or remotely, and train-the-trainer models can be employed for district-wide dissemination.

The *ULTRA:ME* budget includes costs for the research team (contracting with co-investigators and the evaluation team) for project oversight and evaluation. The implementation team includes the Project Director (in-kind) and three grant-funded trainers to provide full-time project training and activities. [redacted]—in-classroom devices—is included to ensure each classroom participating has a class computer set to use. Many classrooms throughout the district move to a computer lab to work on such activities, but the *ULTRA:ME* includes classroom sets to standardize the hardware and software used by the project. Classroom sets will be re-used from program year to program year, and sets will be purchased in the year they are first needed. The study will implement a waitlist control group, so all participating teachers will ultimately receive the PD, resulting in an expected 280 teachers trained, with the potential to integrate Minecraft for Education successfully into classrooms for 4,760 students over the course of the study. The overall cost for the project is estimated at [redacted] per student.

B(3) Qualifications of key personnel*:* The *ULTRA:ME* project team includes a partnership of DCPS educators and accomplished researchers. Key personnel include Project Director and Co-Investigator, John Pauls (DCPS); Co-Investigator, Dr. Kim Cheek: (UNF); Co-Investigator, Dr. Fengfeng Ke (FSU). The Project Director and Co-investigator, John Pauls, currently leads instructional technology PD in Duval County, and is an expert in Minecraft and Microsoft tools. The additional Co-Investigators have been participants in large-scale research projects; and are leading experts in instructional technology and STEM education, as well as implications on ESE students. Qualifications are in Appx B.

Key personnel: Lead Training Coach, To be hired: DCPS has budgeted for a Lead Coach to operate as project manager, responsive to the Project Director. The Lead Coach will be hired upon receipt of the award; knowledgeable in technology and ESE instructional strategies; have a Bachelor's degree (Master's preferred), and 3-5 years of experience providing PD activities for teachers.

Additional personnel--DCPS Advisory Team: In addition to the key personnel, DCPS will commit the participation of additional staff to support project activities. This Team will consist of area experts to provide guidance to align *ULTRA:ME* with district activities, curriculum standards, outcomes data, appropriate evaluation methodology, and best practices. The Advisory Team was instrumental in the development of the *ULTRA:ME* project design for the EIR grant application.

Evaluation team: If funded, DCPS will contract with CIC Planning, an evaluation firm with expertise in research methods, program evaluation for educational contexts, educational psychology, and needs assessments. CIC Planning is familiar with the Northeast Florida region and Duval Schools. DCPS will contract with CIC Planning as a sole source provider because the Motivational Assessment tool (that will be instrumental in program outcomes, is a proprietary tool developed by CIC Planning, and currently used in other science research conducted within the district. This procurement plan is in alignment with 2 CFR 200.317-200.326.

B(4) Procedures for ensuring feedback and continuous improvement: The *ULTRA:ME* continuous improvement model includes regular reporting and communication with a number of stakeholders with differing perspectives on the project. We anticipate the model to yield rich feedback that will help improve the project design for all participants.

Local level: Regional advisory committee: Upon award, DCPS will convene an *ULTRA:ME* Advisory Team that includes representatives from Microsoft, STEM2 Hub, NEFSTEM, FDLRS, parent representatives, DCPS educators. The Advisory Team will meet twice annually to review of the status and improvement of the project. The Advisory Team will provide feedback about project activities and deliverables. Letters of commitment are attached in the Appx C.

Continuous improvement aligned with process evaluation: Continuous improvement and feedback are built into the overall evaluation plan. The Project Director will oversee the continuous improvement process along with the evaluation team. External evaluation will continually examine program processes for fidelity (see Section C2), allowing for identification of context-specific challenges in need of adaptation (Meyers & Brandt, 2015). The phased implementation will enable fidelity data to be used for collaborative problem-solving and to improve program delivery prior to expansion to Cohort 3, thereby **maximizing impact** on student outcomes (Kershner et al., 2014) and **minimizing costs** of program changes (Williams & Cockburn, 2003). Continuous improvement activities include: ▪ Regularly scheduled team check in meetings with Project Director, Co-investigators, evaluation team, and project team members for updates and troubleshooting. ▪ Monitoring of in-classroom implementation by project training team. ▪ PLC check-in teams virtual meetings held periodically during implementation. ▪ Ad hoc reports as needed. ▪ Quarterly summary reports that include project outputs in alignment with scheduled deliverables. ▪ Semi-annual summaries/reports to share on Advisory Team update calls. ▪ Annual reporting to US ED, with alignment to expected project deliverables and outcomes.

B(5) Results of project are to be disseminated in ways to enable use of information and strategies: The *ULTRA*:*ME* dissemination plan includes local, regional, and national dissemination of findings and will include communication with educators, researchers, and developer Microsoft on best practices and resources to educators around the country.

Local level: Regional training events: In the 4th year of the project, the *ULTRA:ME* team will hold a day-long training event for regional educators. This event will provide an abridged foundational *ULTRA:ME* training session, along with other best practices identified by the program.

Local level: Parent training events: Microsoft currently works with DCPS to provide support for the software used in our schools. Parents are important stakeholders in the success of students, and their buy-in is important to support the use of games like Minecraft in the school and at home. If parents are to support this learning tool, they must first understand its utility. If *ULTRA:ME* is funded, Microsoft will provide training to parents to share the strategies shown to benefit learning.

Local level: Summit with NEFEC: The Northeast Florida Education Consortium (NEFEC) is a collaborative nonprofit that supports smaller Northeast Florida school districts that neighbor Duval County. NEFEC serves 15 mostly rural school districts. The *ULTRA:ME* team will meet biennially with NEFEC to align with educators for best practices, and will work with NEFEC on a strategy to bring the *ULTRA:ME* model to the surrounding counties, many who have fewer resources.

Local/national level: Presentation at conference: The project budget includes funding for 5 team members to participate in one conference annually. The *ULTRA:ME* team will plan to apply to present at conferences such as ISTE, Microsoft World, AERA, International Conference of Learning Sciences (ICLS), Association for Educational Communications and Technology (AECT) Convention, National Conference on Science Education, Frontiers in Education. Presentation topics will include descriptions of the program design, best practices implemented, and findings of analysis. DCPS understands that COVID-19 restrictions may impact the opportunities to present and will communicate any changes in the dissemination plan to the EIR program team.

National level: Submissions of relevant findings: The final level of dissemination for *ULTRA:ME* will be the writing and submission of papers that describe the findings of the project. Papers submitted to peer-reviewed journals will be co-authored by the project director, co-investigators, and evaluation team. The schedule/plan for writing and submission will be developed as a collaborative of the co-investigators and evaluation team, led by the project director. The time budgeted to be contracted by DCPS with the co-investigators will include a plan for papers completed for submission for academic journals, book chapters, and professional conferences.

C. QUALITY OF THE PROJECT EVALUATION:

C(1) Meets WWC standards with or without reservations. The evaluation employs a cluster RCT designed to meet WWC Standards without Reservations to examine the intervention's impact on *student outcomes* (including differential effects on *ESE students*); its impact on *teacher outcomes*; the *mediating effects* of teacher knowledge/behavior/dispositions; and *implementation fidelity*, identifying the factors related to maximum effectiveness.

Sampling. The intervention will take place across 4 cohorts, including a Pilot cohort implementing in Year 2. Teachers will be recruited from across DCPS' 104 elementary schools. In each cohort, K-5 teachers who volunteer to participate will be randomly assigned to treatment and business-as-usual (BAU) waitlist comparison groups. Treatment teachers (*n*=140) will receive *ULTRA:ME* PD and implement STEM instruction using Minecraft; BAU teachers (*n*=140) will participate in standard PD, with no exposure to the intervention, and use DCPS' standard Nature of Science curriculum in their classrooms (BAU groups will receive delayed treatment after collection of outcome data). All students enrolled in teachers' classes at the time of assignment will be eligible for inclusion in the study. To avoid potential bias, joiners will be excluded from analyses. Because teachers volunteer to participate, we expect low cluster-level attrition. We also expect to meet WWC criteria for low overall and differential attrition at the student level. While randomization and low attrition are expected to yield balanced groups, we will examine **baseline equivalence** of the analytic sample for individuals within clusters using baseline achievement scores to test for equivalence that meets WWC's threshold (*Hedge's g*<0.25; WWC, 2020), applying covariate adjustments as needed (i.e., $.05 \leq g \leq .25$) in accordance with WWC recommendations.

We expect to assign 20 teachers to each group (treatment and BAU) in the Pilot year and 40 teachers to each group in Cohorts 2-4. We estimate 20 total students, and at least 2 ESE students, per teacher. Assuming a 15% student attrition rate, we conservatively estimate the final impact study to include pre- and post-achievement scores from **4,760 students** across **280 teachers**, or 85% of the original study sample. **Power analysis**, in the context of a two-level RCT accounting for clustering of students within teachers, yields a minimum detectable effect size (MDES) in the final impact study of 0.09 for student outcomes and 0.21 for teacher outcomes, estimated using PowerUp! (Dong & Maynard, 2013). Assumptions were: Power 80%; α=0.05; ICC=0.11 (Hedges & Hedberg, 2007); R2 at student and teacher levels=0.6, using pre-treatment measures of student achievement, student demographics, and teaching experience). Under the same assumptions, we estimate 476 ESE students will be included in the final study, yielding an MDES of 0.16.

Study Timeline. The intervention will span one school year per cohort. Implementation studies will be conducted in years 2-5 to assess fidelity, with annual impact studies providing formative evidence of effectiveness. Sustained effects will be assessed annually for Cohorts 1-3. In year 5, a full-scale impact study will be conducted based on the combined sample from Cohorts 1-4. The complete evaluation timeline is in Appx. I.

Research Questions. Aligned with key project components, mediators, and outcomes in the Logic Model and project Goals and Objectives, the impact study will address two general **confirmatory research questions**: ***RQ1.*** *What is the impact of ULTRA on* ***K-5 student outcomes****?* The study tests the extent to which the intervention results in improvements in student (**1a**) Science achievement; (**1b**) self-efficacy for STEM; and (**1c**) motivation/engagement in STEM, comparing outcomes for treatment and BAU groups to determine ULTRA's impact on all students receiving the intervention and its impact specifically on ESE students. ***RQ2.*** *What is the impact of ULTRA:ME on* ***teacher outcomes****?* The study tests the extent to which the intervention results in improvements in teacher (**2a**) practice; (**2b**) self-efficacy for STEM instruction; and (**2c**) self-efficacy for STEM instruction with ESE students. We also pose three **exploratory research questions**: ***RQ3***. *Does the intervention have* ***differentially positive effects on outcomes for ESE students****?* This RQ examines whether and the extent to which ESE students with specific learning disabilities experience greater gains than their typically developing peers. ***RQ4.*** *What variables* ***explain (mediate)*** *the impact of ULTRA:ME on student outcomes?* The study tests the mediation effects of teacher knowledge and dispositions in explaining student outcomes. ***RQ5***. *What factors* ***impact (moderate)*** *the effectiveness of ULTRA?* The study tests interaction effects of implementation fidelity and contextual factors (e.g., teacher tenure, ESE certification/ endorsement, school type) to determine which factors strengthen the magnitude of results.

Analysis. The impact of *ULTRA*:*ME* on **student and teacher outcomes (RQs 1-3)** will be estimated using a two-level Hierarchical Linear Model (HLM) to account for students nested within teachers (Raudenbush & Bryk, 2002). Following WWC standards, the analytic sample will include participants from treatment and comparison groups with both pretest and outcome scores. Intent-to-treat analyses will determine whether and the degree to which group differences are statistically significant (i.e., by calculating effect sizes, *Hedges' g*) using appropriate multiple comparison corrections (Benjamini & Hochberg, 1995). **Mediation analyses (RQ4)** will be conducted to determine the proportion of variance in student achievement accounted for by teacher knowledge, strategy use, and efficacy. **Moderation analyses (RQ5)** will test the interaction effects of contextual and implementation factors in predicting student outcomes.

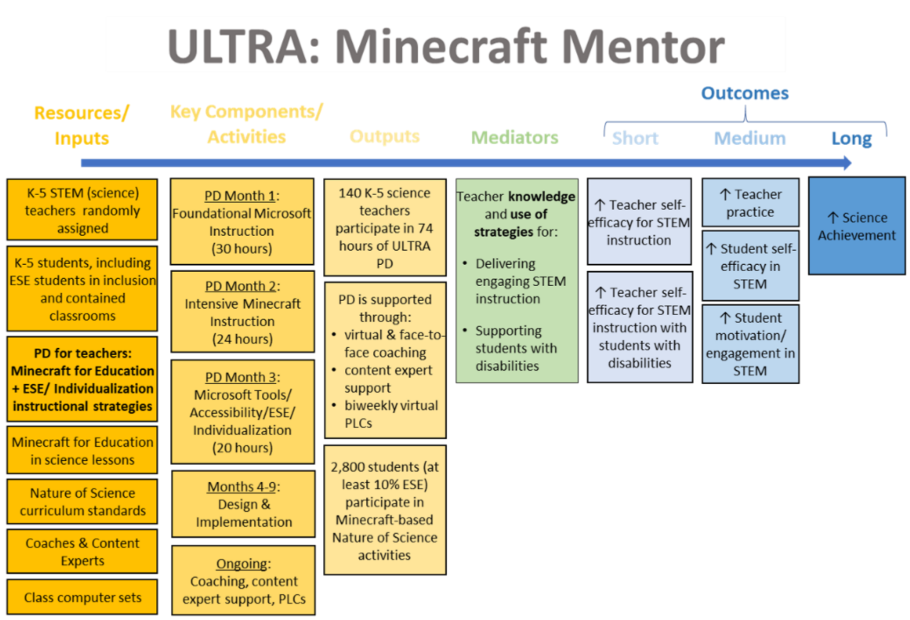
C(2) Key project components, mediators, outcomes, & measurable threshold for acceptable implementation. A critical aim of the evaluation is to examine key project components for fidelity to sustain the project's work and highlight strategies for successful replication and expansion. Thus the evaluation includes a formal **study of implementation fidelity**. In accordance with EIR evaluation guidance, the implementation study is built on the **ULTRA:ME Logic Model** (p. 24 & Appx. I), which identifies **key project components**. The Logic Model also specifies **mediators** (teacher knowledge, use of strategies), and short-, medium-, and long-term **teacher and student outcomes** (efficacy, motivation, and performance). In addition to RQ5 above, the implementation study will address *the extent to which key components were implemented with fidelity* ***(RQ6)***, examining variation across cohorts, and identifying barriers to and facilitators of fidelity.

Implementation evaluation utilizes a **mixed methods design** (Creswell & Plano Clark, 2007) to support innovative, adaptive program development (Patton, 2016) and provide context and conceptual clarity in understanding intervention components (Bishop, 2015). Qualitative methods include (see details in Appx. I): PD and coaching observations (expert-coded); focus groups/interviews with participants (transcribed and analyzed using Dedoose); and classroom observations (conducted by coaches/school leaders). Consistent with Objective 3.1 (see section A1), quantitative implementation measures, collected via program administrative data, include: Number of participating teachers; dosage (e.g., # PD hours; # coaching hours, # PLCs); number of students served (total/high-need ESE-; GPRAs 1-2); and cost per student (GPRA 6). Additionally, to aid in identifying variable impacts of each component (Objective 3.2) we will collect program-generated data on participants' demonstration of knowledge. These include the percent of participants passing foundational skills assessments and the percent scoring at acceptable levels on rubric-assessed lesson plans and classroom implementation.

Initial targets for implementation variables are included in Appx. I. In the first year, evaluation and implementation teams will refine targets, which may be further revised based on outcome data collected during the pilot year. These indicators will form the basis for an evaluator-developed implementation fidelity tool, which specifies operational definitions of key components, measurable indicators, data sources, rating criteria, and methods for aggregating across indicators and across cohorts. Implementation will be measured for the entire sample during Years 2-5, with data collected at least twice per cohort. Data will be used to calculate an overall score to determine if intervention and individual components were implemented with acceptable levels of fidelity (RQ6). The fidelity score will be included as a moderator in outcome analyses (RQ5).

C(3) Valid and reliable performance data on relevant outcomes. Outcome measures described below (aligned with Project Goals 1-2/RQs 1-4) will be collected for treatment and BAU groups along identical timelines. See Appendix I for details on data collection, measures, and scale properties. ***Students' science achievement*** will be measured using DCPS' district assessment of

Nature of Science. This is a grade level-specific, standards-based end-of-course (EOC) exam, which meets WWC validity requirements. The assessment, which will be administered at the beginning and end of each school year, is aligned with WWC review protocols for Primary Science (ver. 4.0). ***Student self-efficacy*** and ***motivation/engagement*** will be measured using the Student Motivational Climate Assessment (α=.86; Wright, 2019), which will be adapted to target efficacy and motivation in STEM. The tool exceeds WWC internal consistency reliability standards and meets criteria for measures of student social-emotional learning/behavior outcomes in WWC's *Student Engagement in School* domain. ***Teacher practice, knowledge,*** and ***use of strategies*** for (a) engaging students in STEM content and (b) providing STEM instruction to ESE students will be measured using DCPS' Collaborative Assessment System for Teachers, which is built on Danielson's Framework for Teaching (FFT). Data will be collected separately for each of four observation domains, which collectively assess instruction/pedagogy and professional responsibilities, and also includes indicators of engagement and ESE/inclusion/differentiation strategies. The FFT meets WWC validity/reliability requirements (Kane & Staiger, 2012) and is aligned with WWC review protocols for examining Teacher Excellence (ver. 4.0). ***Teacher efficacy*** will be collected via the Science Teaching Efficacy Beliefs Instrument (α=.92; Riggs & Enochs, 1990), which measures efficacy



for STEM instruction, and Motivational Climate Assessment (α=.83; Pritchard, 2011), which measures the extent to which the PD possesses characteristics that promote efficacy. These survey tools have demonstrated validity and reliabilities that exceed WWC standards.

<table>
<tr><td colspan="2">ULTRA MODEL: A year-long ULTRA module* includes online self-paced instruction, followed by an instructional period with coaching, with check-ins and support from the training team:</td></tr>
<tr><td>Month 1 (August-September): Foundational Microsoft Instructional Component: 30 hours of online instruction in the Microsoft Educator Community. Instruction will include Office 365 Teacher Academy, introductory Minecraft.</td><td><u>Participants will</u>:1) Learn foundational Microsoft tools; 2) Learn the concurrent use of foundational Microsoft educator tools along with Minecraft. Demonstration of knowledge → Complete a skills-based pass/fail assessment. Learning outcome: This sets the foundational skills for all participants.</td></tr>
<tr><td colspan="2">COACHING PROVIDED: SELF-PACED WITH SUPPORT FROM ULTRA STAFF IN BIWEEKLY PLCS.</td></tr>
<tr><td>Month 2 (October): Intensive Minecraft Instructional Component: 24 hours of asynchronous Minecraft instruction. Hosted in DCPS Minecraft Training World. Educators learn all functions, and are provided access to lesson plans, sample worlds, and build challenges.</td><td><u>Participants will</u>: 1) Learn to operate the foundational components of Minecraft for Education; 2) Learn functionality to build lessons to be used in classroom settings for instruction. Demonstration of knowledge→ .Create a Minecraft lesson component that will be assessed by a rubric. This teaches participants how to use Minecraft as an educational tool.</td></tr>
<tr><td colspan="2">COACHING PROVIDED: SELF-PACED WITH SUPPORT FROM ULTRA STAFF & CONTENT EXPERTS IN BIWEEKLY PLCS.</td></tr>
<tr><td>Month 3 (November): Microsoft Tools/Accessibility/ ESE/Individualization Component: 20 hours Microsoft 365 tools and Accessibility. Asynchronous learning in Teams Topics: Flipgrid, Teams, Skype, Forms, Sway, Immersive Reader, Microsoft Translator, Seeing AI.</td><td><u>Participants will</u>: 1) Learn the differential learning tools; 2) Understand the differential learning needs that are common for ESE students; 3) Demonstrate how to adjust lessons to these differential learning needs using tools. Demonstration of knowledge → Create assistive technology plan that will be assessed by a rubric. Participants learn to individualize for ESE & typically developing students.</td></tr>
<tr><td colspan="2">COACHING PROVIDED: SELF-PACED WITH SUPPORT FROM ULTRA STAFF & CONTENT EXPERTS IN BIWEEKLY PLCS.</td></tr>
<tr><td>Due in Month 4 (December): Design Phase: Participants create a technology implementation plan/portfolio outlining how they will use these tools during semester 2. Detailed plan, student names and individualized implementation plan.</td><td><u>Participants will</u>: Develop portfolio with peers. Demonstration of knowledge learned during professional development → The series will culminate in a science-based Minecraft instructional plan that will be used in semester 2. Coaches will be available for PLCs and face-to-face support.</td></tr>
<tr><td colspan="2">COACHING SUPPORT PROVIDED: COACHES WILL ASSIST WITH PLAN DEVELOPMENT; PLCS CONTINUE</td></tr>
<tr><td>Months 5-9 (January-May): Implementation Design: Classroom engagement with tools developed during PD sessions.</td><td><u>Participants will</u>: Use instructional methods to teach science content. Demonstration of knowledge → Observations of lessons scored against a rubric.</td></tr>
<tr><td colspan="2">COACHING SUPPORT PROVIDED: COACHES PROVIDE IN-CLASSROOM AND PLC SUPPORT</td></tr>
<tr><td colspan="2">COACHING SUPPORT MODEL:
1) Virtual PLCs and ULTRA coaching support via Microsoft Teams every other week (biweekly) throughout the year;
2) ULTRA and content expert support during virtual PLCs in months 2 & 3;
3) ULTRA virtual coaching and face-to-face support during plan development in month 4;
4) ULTRA coaching in biweekly virtual PLCs and face and monthly face-to-face coaching in semester 2</td></tr>
</table>