Professional Development Proposal: Implementing a Mixed-Grade Level Approach to STEM

Learning

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STEM Leadership Seminar

I.   **Title** - Implementing a Mixed-Grade Level Approach to STEM Learning

II.   **Background -** The information that follows is based off an $11.000 grant, STREAM (science, technology, research, engineering, arts, and mathematics) Forward that I co-wrote, received, and implemented in my school district.

We know students learn best when they are truly engaged in what they are learning. They learn best when they have the opportunity to explore, debate, discuss, examine, defend, and experiment with new concepts and skills. STREAM Forward will incorporate all of these learning strategies in a hands-on group setting where students will have the chance to practice these skills in a meaningful and interesting context. Students will be encouraged to take risks without the fear of failure in this stress-free, reassuring environment.

When implementing a mixed-grade level approach to STEM learning, learning-conducive-instructional strategies tied to the needs and to the interests of students and teachers as well as individualized by specific course requisites should be in place for successful implementation. Additionally, essential STREAM teaching practices were introduced as project expectations including *fostering curiosity, accepting failure, evolving and growing as a learner* and *learning in a community.* STREAM education helps to bridge the gap between ethnic and gender gaps sometimes found in science and math fields.

The implementation of STREAM Forward impacted all students in grades three through five by building upon their understanding of Science, Technology, Research**,**

Engineering, Art, and Mathematics, and encouraged students to be competitive in the economic and global society. The STREAM Forward courses were designed to foster learning across grade levels in a safe and healthy environment. Students were encouraged to innovate, to lead, to listen, to collaborate, and to persevere while taking risks and failing forward. The STREAM Forward courses facilitated student growth, boosted problem-solving confidence and developed team-building skills.

III.   **Curriculum Topics, School Names, Number of Educators, Grade Levels**

Nine educators from Franklin Regional's Newlonsburg Elementary School in Murrysville, PA were involved in the professional development experience. The educators ranged from grade levels three through five, the art teacher and the gifted support teachers (who co-wrote the grant). According to schooldigger.com, the makeup of the school is listed in Figure A.

Newlonsburg Elementary School	
Student/teacher ratio:	16.4
Number of students:	247
Racial breakdown:	
White:	83.8%
Asian:	9.3%
Two or more races:	2.8%
Free/discounted lunch recipients:	18.6%

Figure A

The major objective of the project was to encourage students and teachers to gain a deeper level of understanding of STREAM education in a collaborative environment through the gathering of evidence and the solving of challenging problems with multiple solutions. The course offerings gave student the choice to choose courses that stimulated their academic, artistic, and athletic growth. STREAM courses infused disciplines through the designing, constructing and collaborating of course projects. The courses supported the district's philosophy with regards to Professional Learning Communities, commitment to STREAM integration, and standards-driven rigor. STREAM Forward also incorporated the district's 339 Plan (Pennsylvania Department of Education's Academic Standards for Career Education and Work) as the STREAM Forward learner had the opportunity to select a course based on interest or skill level, and learned how the course related to a profession within the STREAM field.

In addition, STREAM Forward endorsed mixed-grade classrooms during school hours. Students from grades three, four and five worked together in small groups or teams to create products of varying magnitudes with their newfound knowledge. STREAM Forward encouraged and promoted mentor-mentee relationships with middle school students (who volunteered and were identified as being "experts" in the field) who attended the classroom sessions and assisted the elementary students in their STREAM courses.

Multiple sessions of professional development encouraged the teachers, principal and grant recipients to openly discuss the many different STREAM courses the teachers could implement in their classrooms for the six-week course. The teachers were given time to

work together and brainstorm ways that they could integrate engineering activities into their current curriculum or always wanted to implement but didn't have the time or resources. While the teachers paired in groups and discussed some topics they'd like to cover, the grant recipients were there to answer any or clarify questions that arose. The grant recipients also served as resources to the teachers to assist them in any curriculum they already implemented and any STREAM activities that would enhance the lesson. There were multiple suggestions given for STREAM lessons and resources in the PD sessions.

IV.   Standards Addressed

As a result of the professional development and the teachers gaining a better awareness and understanding of the grant, a total of seven STREAM Forward classes were created:

1.) I am a Movie Director
2.) I am a Programmers
3.) I am a Robotics Artist
4.) I am a Detective
5.) I am an Electrician
6.) I am a Physicist
7.) I am a Robotics Engineer

Because of the numerous courses, I will address only the Next Generation Science Standards for fourth grade that were covered in the courses.

Next Generation Science Standards

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3) **Planning and Carrying Out Investigations** Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) **Constructing Explanations and Designing Solutions** Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1) Apply scientific ideas to solve design problems. (4-PS3-4) **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1) **Developing and Using Models** Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1) **Constructing Explanations and Designing Solutions** Generate and compare multiple solutions to a problem based on how well they meet the criteria and	**PS3.A: Definitions of Energy** **PS3.B: Conservation of Energy and Energy Transfer** **PS3.C: Relationship Between Energy and Forces** **PS3.D: Energy in Chemical Processes and Everyday Life** **ETS1.A: Defining Engineering Problems** **PS4.A: Wave Properties** **PS4.C: Information Technologies and Instrumentation** **ETS1.C: Optimizing The Design Solution** **ETS1.B: Designing Solutions to Engineering Problems**	**Cause and effect** Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1) **Energy and Matter** Energy can be transferred in various ways and between objects. (4-PS3-1), (4-PS3-2), (4-PS3-3), (4-PS3-4) **Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1) Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) Patterns can be used as evidence to support an explanation. (4-ESS1-1), (4-ESS2-2) **Cause and Effect** Cause and effect relationships are routinely identified. (4-PS4-2) Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1), (4-ESS3-2) **Systems and Systems Models** A system can be described in terms of its components and their interactions. (4-LS1-1), (LS1-2)

constraints of the design solution. (4-PS4-3) **Engaging in Argument from Evidence** Construct an argument with evidence, data, and/or a model. (4-LS1-1) **Planning and Carrying Out Investigations** Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1) **Analyzing and Interpreting Data** Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2) **Constructing Explanations and Designing Solutions** Identify the evidence that supports particular points in an explanation. (4-ESS1-1) Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)		

https://www.nextgenscience.org/

V. **Pre-questions Survey**

The teachers in this particular school had a good handle on STREAM education.

They were involved in Project Lead The Way, Discovery Education and/or was

already implementing STREAM in their classrooms.

Prior to the implementation of this grant, both co-writers were (are are) teacher leaders. They worked closely with the assistant superintendent and building principal on the grant proposal, heard and took into consideration where the district was headed in regards to STEAM education, and the resources already in the school.

The intent of the pre-survey was to gather information regarding class sizes, how the course would relate to STREAM education and the 339 Plan (career readiness). The pre-survey questions were as follows

Course facilitator:

Course name:

Course description:

Ideal class size:

Room location (first choice):

Room Location (second choice)

Course relation to STREAM:

Course career connection:

Technology supplies you will NEED (general idea - specifics needed at a later date):

Craft supplies you will NEED (general idea - specifics needed at a later date):

Supplies you HAVE:

Number of volunteers you are requesting:

Please provide a brief outline of session 1 of 5:

Please provide a brief outline of session 2 of 5:

Please provide a brief outline of session 3 of 5:

Please provide a brief outline of session 4 of 5:

Please provide a brief outline of session 5 of 5:

and give an example of a possible culminating event or activity:

VI.   Brief Description of the Professional Development Training

The professional development training occurred over the course of three sessions lasting roughly twenty minutes with a time span of roughly three weeks. The time span was allotted to the teachers so they could think of the best STREAM course they wanted to implement based off of the suggested material shown to them in the PD sessions, along with comprising a list of resources that would be needed, to have the time to talk with other teachers if they would like to work together, observe and become familiar with the STREAM resources suggested, and to and to come to the next session with any questions.

In addition to the PD and course design, teachers were encouraged to use their Professional Release Days to create an outline of their course including any materials needed. This was offered as a way to not incur additional work for the teachers. Finally, the teachers were allowed to use the PD and course design for their Differentiated Supervision Model for the school year, which is how the state of Pennsylvania evaluates their teachers.

VII.   Brief Outline of Activities in each course

Most of the courses were done indivudally expect the Robotics Artist in which a fourth-grade teacher and art teacher teamed together.

1.) I am a Movie Director – *How do you use electronics to create a documentary?*
Use iPads and iMovie to create a short documentary film on how technology is being used in our school. You will learn how to create and use storyboards, incorporate video clips, pictures and sound, and interview students, teachers, and principals. *Lights, Camera, Action!*

2.) I am a Programmers – *How to programmers' code?*

Build a real robot using a programmable Hummingbird Duo as the brain. You will use your imagination to create a realistic animal for the Newlonsburg Zoo using servos, sensors and LEDs, and then bring your animal to life through code using Snap!

3.) I am a Robotics Artist – *How can a robot be an artist?*
Combine technology and art by using a SPHERO robot as your tool for design. You will create abstract paintings inspired by the work of Abstract Expressionist, Jackson Pollock, by coding the SPHERO robot to produce a one-of-a-kind work of art.

4.) I am a Detective - *What is CSI?*
Step into the role of a Crime Scene Investigator to learn the skills and strategies necessary for solving crimes. You will learn about and use fingerprinting, handwriting analysis, observation skills, and chromatography to help solve a series of crimes.

5.) I am an Electrician - *How do circuits work?*
Explore circuitry and design in this exciting course highlighting copper tape and LEDs. You will craft and code technology by creating an original design of circuits with personalized effects.

6.) I am a Physicist – *How does a Fidget Spinner work?*
Engage in Fidget Spinner fun through a variety of exciting STEM challenges. You will learn the science behind Fidget Spinners, create your own spinner, experiment with the spinners, and much, much more!

7.) I am a Robotics Engineer – How do you program a robot?
Apply teamwork and problem-solving skills to the building and programming of EV3 Lego Robotics. You will build an EV3 robot, learn beginning coding skills and employ logic to accomplish a sequence of challenges and tasks.

References