# Introducing STEM Instruction into Primary Classrooms

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In the 21st century, we have grown increasingly dependent on technology. We rely on technology countless times throughout our day. In fact, there is an "app" for just about anything and everything. It is clear that there will be a growing demand for technology and STEM related jobs. As teachers, there is an increasing sense of urgency to prepare our students with the skills and knowledge needed to eventually enter a STEM-dominated workforce.

There has been a movement towards STEM education in grades K-12 in the past few years in many schools across the country and globally. The benefits to STEM instruction are endless. STEM education helps develop critical thinking skills, innovation, creativity, teamwork and resilience in young learners. There are even some schools in the country that are solely focused on STEM; however, there are also many schools across the country that have very limited STEM instruction or no STEM instruction at all. This puts these students at a great disadvantage compared to their peers that do receive STEM instruction.

As primary grade teachers, we, of course, want to provide our students with the foundational skills they will need to be successful throughout their time in school and beyond. Most models of STEM programs that exist are focused on high schools; however, the early years are critical for STEM teaching and learning (Chiu, Price, Ovrahim, 2015). While it is clear that STEM education in the primary grades is of utmost importance, many of us might ask ourselves: How? Many teachers, unfortunately, lack the time, knowledge, curriculum resources and technology needed to implement STEM instruction in their classrooms. While these obstacles certainly make it more difficult, there are relatively easy ways to begin to implement STEM instruction in your classroom.

I previously taught at a school in which a STEM curriculum was in place and we were given the instructional time, professional development and technology resources needed to successfully implement a full STEM program. This year, I started at a new school with no existing STEM curriculum, no designated instructional time or

professional development and limited technology resources. I knew that STEM instruction was of value to me and my students, so I discovered small and easy ways to begin to implement STEM instruction in my classroom. Through a process of trial and error, I have been able to overcome some of these obstacles. We will explore ways to overcome the following barriers in beginning STEM instruction in any classroom:

- Lack of instructional materials and technology
- Lack of instructional time (through content integration)
- Lack of curriculum

## Lack of Instructional Materials and Technology

At my current school, every classroom teacher is given two iPads to be used for instruction and intervention activities. At my previous school, we shared class sets of iPads to be used during STEM instructional time. I knew that two iPads would not suffice in the work that I wanted to do with my class. In order to supplement this, I had created a DonorsChoose[1] account to ask for a set of ten iPads to be used with my class. DonorsChoose is a platform in which teachers can request classroom materials or technology to be funded through donations. Many of the project requests are technology and STEM-based, as it is clear that many teachers are enthusiastic about rolling out this work with their students. While this took some time to be fully funded, I eventually received the set of ten iPads. I can now use my set of iPads for small group STEM instruction.

While my DonorsChoose project was extremely helpful in creating a technology rich environment in my classroom, it did take some waiting time. In this interim, I found that unplugged activities and the utilization of inexpensive, easily attainable objects allowed me to begin STEM in my classroom.

*Unplugged Activities*

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[1] https://www.donorschoose.org

Unplugged activities are STEM-based activities that do not use technology.  They are typically completed on pencil and paper or with affordable art or home supplies.  Unplugged activities are a great place to start teaching STEM - especially for young learners in the primary grades.  Although I now have more technology available to me in my classroom, I continue to engage in unplugged activities with my students to limit screen time.

The resource that I have found to be the most helpful in planning and delivering unplugged lessons is from Code.org[2].   This free resource includes an extensive curriculum resource for teachers.  It includes many lessons, organized by the following computer science concepts: digital citizenship, impacts of computing, sequencing, loops, events, binary, conditionals, internet, functions, variables, algorithms, computational thinking, debugging, persistence and abstraction.  Lesson plans are provided for each activity.  Many of the activities include lesson videos, printable activities, vocabulary resources, and assessment resources.  This resource is extremely user-friendly and includes little to no prep work on the teacher's end.  I was able to introduce the concept of basic coding, sequencing and loops to my first graders who had very little coding experience through these unplugged activities.  Many of the unplugged activities also include a kinesthetic component, which helps to engage and appeal to different types of learners.

*Utilization of Everyday Items*
Although technology is a big part of an effective STEM program, there are many projects and activities that can be completed with objects already in your classroom or home!  As a team-building activity, I often give my students "challenges" that they complete with team members.  I periodically ask the parents in my classroom to send in recyclables (cardboard, paper towel rolls, empty cereal boxes, milk cartons, etc.) to be used in classroom projects.  While my students sometimes just use these objects to have fun and create, they sometimes use these objects to build to solve a problem or

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[2] https://code.org/curriculum/unplugged

complete a challenge.  I have completed the following activities and challenges with my class using everyday objects:

- Build a tower 12 in. high with *index cards* and *tape* that will support a small stuffed animal
- Design a "bubble wand" using paper towel rolls
- Build a structure with cardboard, paper towel rolls and straws

These activities are engaging and exciting for young learners and are easy and inexpensive for teachers to implement in classrooms.  I have found that these activities have allowed for opportunities to teach students about teamwork, persistence and critical thinking, which are all critical components to STEM instruction.

**Lack of Instructional Time (Content Integration)**

As teachers, we know how valuable every minute of our instructional day is.  We make plans for our students to ensure that we cover the most material possible every day.  As a first grade teacher, I am responsible for teaching my students phonics, reading, writing, math, and social studies every day.  The prospect of attempting to incorporate STEM into my instructional day without allocated time was daunting; however, I have found that content integration has been an easy and impactful way to introduce my young learners to STEM instruction.  Content integration is defined as teaching and learning between two or more STEM subject areas and/or between a STEM subject area and another school subject (Sanders, 2009).  It is recommended that teachers use practices true to the Next Generation Science Standards, mathematical and literacy practices from the Common Core State Standards along with diverse instructional strategies to reinforce the interconnected nature of STEM with other content areas (Chiu, Price, Ovrahim, 2015).  This year, I have started to incorporate STEM challenges to my literacy block.  These challenges have been designed as center activities and enrichment activities.  These STEM challenges have been highly motivating and fun for my first graders.

**ScratchJr.**[3] has been a wonderful resource that I have frequently used as an enrichment or extension activity for my students.  ScratchJr is an introductory coding program designed for students aged 5-7.  This app is inspired by Scratch programming language[4] which is used by millions of people around the world.  This version allows students to create their own interactive stories and games.  Students use programming blocks with simple graphics that snap together to make a character move, speak, jump, dance and interact with other characters.  Students can even record their own voices or insert their own pictures.  This app is easy for a novice STEM teacher to learn, and is developmentally appropriate for young learners.  I would suggest that this app be utilized with K-2 students.

I was previously familiar with the ScratchJr. Platform from my previous years teaching at a STEM school; however, there are tutorials provided on the platform as well as the ScratchJr website that are user friendly and easy for prospective STEM instructors to learn from.  The ScratchJr website also has printable block images, animated genres curriculum, playground games curriculum and ways to reinforce literacy and math curriculum.  These resources are all free for educators.

I have used ScratchJr in a variety of ways in my classroom.  I first used ScratchJr as an extension activity for a realistic fiction writing unit.  After my students completed the writing process and published their realistic fiction stories, I challenged them to animate their stories by programming them on ScratchJr.  I first allowed my students to work in partnerships and explore the platform on the iPad.  After giving them the initial time to explore, I met with small groups and gave them a quick tutorial on how to utilize the blocks and edit the background and sprite (character).  I then allowed my students to use their published piece to program their story into a beginning, middle and ending.  This was an easy way to introduce the app to my students and tie the STEM component into our writing curriculum.

Once my students became more comfortable with the platform, I now use it during our literacy center block.  My students use the program to program reading responses to

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[3] https://www.scratchjr.org/about/info
[4] Scratch.mit.edu

books they read.  Because I have a limited number of iPads in my classroom, I find that it is easy to have my students work in partnerships within a small group.

**Robot Mouse**

Code and Go Robot Mouse Activity Set[5] is another simple activity that I use during literacy center time.  This is a relatively inexpensive hands-on activity that helps students build coding skills.  The set comes with a programmable robot mouse, cheese coding cards and a maze.  The students set up the maze, place the cheese at the end and then use the coding cards to plan their code to help the mouse reach the cheese.  The kit includes activity cards for kids and activity guides to help support the teacher.  I have used this resource as a literacy center activity to help reinforce sequencing words.  After programming the mouse, my students must write about how they programmed the mouse to reach the cheese using temporal words (*first,* the mouse turned right… *next,* the mouse went straight… *finally,* the mouse reached the cheese).  This is an easy way to reinforce these literacy skills because it provides students with a hands-on experience to write about.  This resource is developmentally appropriate and easy for students to learn, as it uses color-coded arrows to program the mouse to move.  This is an excellent and engaging resource for beginning coders.  This activity is relatively low cost ($60 on the website).  It is one of my students' favorite activities for literacy center time.

I found that I was able to implement STEM activities quite easily during my "how-to" writing unit.  In this unit, students were required to write in steps to teach others "how-to" do something.  Many students would pick something simple, like "how-to" make a sandwich or "how-to" brush your teeth.  This year, I incorporated STEM by challenging my students to build an index card tower that would support a small stuffed animal.  Students worked in teams to use 100 or fewer index cards to build a tower a foot high that would support a stuffed animal for 10 seconds or more.  Through this process, students were challenged to think critically, work with a team, plan and design, test, redesign and share their results.  After successfully completing the challenge, students

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[5] https://www.learningresources.com/code-gor-robot-mouse-activity-set

engaged in the literacy part of the activity.  They wrote to teach others how to successfully build the tower using sequence words and by giving helpful tips to their reader.  My students absolutely loved this activity.  It is obviously low-cost, as most classrooms are already supplied with index cards, tape and rulers.  This activity can be done with other everyday classroom materials, such as books, blocks, etc.

My school allocates 30 minutes of our instructional day for "choice time."  During this time, students are allowed to freely choose from a variety of classroom activities or art materials.  I installed my set of iPads with a variety of free coding apps that my students can use during choice time.  While I generally use this time as an intervention time to run targeted small groups with my students, I do use this time to engage in small group coding instruction with my students who choose to use iPads.  I use the following free coding apps with my first graders:

- **ScratchJr**[6] - students create their own interactive stories and games using block-based programming.  Students can embed their own sound and pictures into their stories.
- **CodeSpark Academy**[7] (Free for verified teachers) - this "learn to code" program is word free, which is perfect for young learners.  Kids apply coding skills to design games.  Teachers can sign up for a Teacher Dashboard for access to a free curriculum, classroom setup, and student reports.  Professional development in CodeSpark is offered to teachers at a low cost.

**Lack of Curriculum**

While I was previously employed at a school with a full STEM curriculum, and therefore had knowledge of what first graders should be learning, I was very concerned when I began at my new school and had no curriculum resources at my disposal. Having had experience with STEM was helpful, but for those with limited STEM background knowledge or experience, it can be stressful.

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[6] https://www.scratchjr.org
[7] https://codespark.com

Luckily, there are plenty of online resources and platforms that are *free* for teachers, and include a paced curriculum that can be very easily implemented in the classroom.  The resource that I have found to be the most helpful to me is found on Code.org.

**Code.org**

Code.org has a fully planned and paced curriculum available online.  The units are divided into courses A-F for grades K-5.  I used course B for my first graders.  The courses are developmentally appropriate for the grade level they are designed for.  Course B includes unplugged activities as well as activities utilizing technology that helped teach my students the basics of programming.  Each lesson is fully planned out with all of the resources needed linked within the lesson.  The curriculum guides can be found at the following link: https://curriculum.code.org/csf-19/

The benefits to teaching STEM to young learners are endless.  STEM helps students become critical thinkers, collaborative learners, and build a sense of confidence.  Launching a STEM program is no easy feat.  Many teachers face obstacles in terms of time, resources and technology.  However, as described, there are easy and inexpensive ways to overcome these obstacles and make STEM instruction a reality in your classroom.

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