Emerging EdTech in the STEM Classroom

Lindsay Hawkins, Shayna Pond, Bradly Cusack, Matthew McDonald
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Time Frame 2 - 3 hours

Essential Question(s)

How can a technology-enriched learning environment prepare students for postsecondary opportunities in a tech-driven world?

Summary

This professional development session applies research-based practices to support the use of educational technology (EdTech) in the classroom. Through exploring Scratch coding on a Raspberry Pi, 3D printing with TinkerCAD, and Swivl robots, participants will connect EdTech to science and engineering practices and identify potential hurdles to their implementation in the classroom.

Learning Goals

- Apply research-based practices to support the use of educational technology (EdTech)
- Through the lens of science and engineering practices, connect the impact of EdTech to a tech-driven world
- Identify potential hurdles for the student learning experience with EdTech

Attachments

- 3-2-1—Emergining EdTech in the STEM Classroom.docx
- 3-2-1—Emergining EdTech in the STEM Classroom.pdf
- Extended Matrix of NSTA Science and Engineering Practice—Emerging EdTech in the STEM Classroom.pdf
- First Word Last Word Coding—Emerging EdTech in the STEM Classroom.docx
- First Word Last Word Coding—Emerging EdTech in the STEM Classroom.pdf
- First Word Last Word Communication—Emerging EdTech in the STEM Classroom.docx
- First Word Last Word Communication—Emerging EdTech in the STEM Classroom.pdf
- First Word Last Word Robot—Emerging EdTech in the STEM Classroom.docx
- First Word Last Word Robot—Emerging EdTech in the STEM Classroom.pdf
- First Word Last Word Technology—Emerging EdTech in the STEM Classroom.docx
- First Word Last Word Technology—Emerging EdTech in the STEM Classroom.pdf
- NSTA Science and Engineering Practices—Emerging EdTech in the STEM Classroom.docx
- NSTA Science and Engineering Practices—Emerging EdTech in the STEM Classroom.pdf
- Presentation Slides—Emerging EdTech in the STEM Classroom.pptx
- Resource Note Sheet wQR—Emerging EdTech in the STEM Classroom.docx
- Resource Note Sheet wQR—Emerging EdTech in the STEM Classroom.pdf
- Scratch Task Cards—Emerging EdTech in the STEM Classroom.pdf
- Swivl Scavenger Hunt—Emerging EdTech in the STEM Classroom.docx
- Swivl Scavenger Hunt—Emerging EdTech in the STEM Classroom.pdf
- TinkerCad Basics Station—Emerging EdTech in the STEM Classroom.pptx

Materials

- Presentation Slides
- Sticky Notes
- Markers
- Posters (3 for a group of 12-17, 6 for 18+ participants)
- NSTA Science and Engineering Practices handout
- Extended Matrix of NSTA Science and Engineering Practices handout
- First Word, Last Word handouts (Coding, Communication, Technology, and Robot)
- Swivl Scavenger Hunt
- Instructional Strategy Note Sheet
- TinkerCAD Task Cards
- Scratch Task Cards

10 minutes

Engage

> **Facilitator's Note**
>
> Before the session begins, print all handouts, gather a few pads of sticky notes, and set up your stations and posters prior to the start of the session. Posters can be any large sheet of paper with the name of each technology on a different poster. Determine which slides you will use (see "Associated Activity" noted in the Explore section) and set up all stations that groups will be rotating through during the session.

To begin, display **slide 3**.

Using the First Word, Last Word strategy, activate prior knowledge of technology use in the classroom from your participants.

- Have participants form 4 groups and pass out to each group a different **First Word, Last Word** handout**.**
- One group member will fill in the first word of the acrostic, then pass it to the next group member.
- When the word is complete, have groups share out their group's acrostic and briefly discuss and come to an agreement on the chosen word's appropriateness with the whole group.

Once you have finished, inform your audience of the objectives and essential question for the PD on **slide 4** and **slide 5**.

In this PD you will:

- Apply research-based practices to support the use of educational technology (EdTech).
- Through the lens of science and engineering practices, connect the impact of EdTech to a tech-driven world.
- Identify potential hurdles for the student learning experience with EdTech.

And the essential question:

- How can a technology-enriched learning environment prepare students for postsecondary opportunities in a tech-driven world?

60 minutes

Explore

Associated Activity

If the participants of today's activity have already seen or participated in the LEGO Mindstorms PD Activity on Learn, please go ahead and skip slides 6-7 as that PD can be a companion activity to this one. Also, if after this activity, you might like to explore a more in-depth look at one particular technology, the LEGO Mindstorms PD can be found at the link above.

Depending on the note above, transition to either **slide 6 or 8**. On **slide 6**, show the quote to the participants and then play the video on **slide 7**. This video is meant to help set the foundation for coding in the upcoming activities by showing how important clear and sequential instructions are to communicating, particularly with a piece of technology.

In the next activity on **slide 8**, participants will rotate through a series of stations, each exploring a different educational technology. The three stations for today are:

- Raspberry Pi and Scratch programming
- Swivl Bots
- 3D Printing with Thingiverse and TinkerCAD

Stations

There are three technology stations that will be explored by participants in this professional development session, Swivl, Raspberry Pi, and 3d Printing with TinkerCad. For the Swivl station, a computer connected to the internet, the Swivl Scavenger Hunt, and the Swivl bot is required. The Raspberry Pi station should have a Raspberry Pi microcomputer setup with Scratch installed and the Scratch Task Cards printed or available in a digital format. Finally, the 3D Printing station will need a 3D printer, an internet-connected computer, and the TinkerCAD task cards. If a large group of more than 12-15 is expected, set up multiples of each station as resources allow.

These stations may be adjusted to meet the needs of your participants or highlight the technology available at the site. If you adjust the stations, ensure that you also modify the information on the slides and other documents to align with these changes.

Split the participants into small groups, and assign each a starting station. Participants now have twenty minutes to explore the technology by completing a task card. Participants follow directions on the task cards, working as far as they can in the activity before time. After each station, give 2-3 minutes for them to take notes over what they experienced on the Instructional Strategy Note Sheet.

Time And Group Sizes

For the station rotation activity, groups should be only 2-3 participants to encourage hands-on participation by all group members. Depending on the available time, you may want to make a few adjustments to the task cards. The Swivl station can easily be shortened to reviewing the Swivl robot in use in a classroom. For Scratch and TinkerCAD, have them work through as much of the task card as possible while still having a bit of time to take notes after each station.

10 minutes

Explain

Using a modified Four Corners strategy, have participants choose which educational technology they explored that they liked the most or think would be possible for them to implement in the classroom and go stand by the poster for that technology. At the top of the poster, participants, as a group, should divide the page into two with a marker and complete an I Notice...I Wonder... responding to the prompts:

- *What did you notice about the technology you explored?*
- *What do you wonder about implementing these technologies in your classroom?*

Then, below the I Notice...I Wonder..., have participants record:

- *How can these technologies be implemented to help students prepare for a tech-driven world?*
- *What are some potential hurdles in their implementation, and do you have ideas for mitigating their eff*ect?

Participants should respond on their poster and then return to their seats. We will return to these posters after the next activity.

Extend

Once participants have returned to their seats, transition to **slide 18** and introduce the **NSTA Science and Engineering Practices** (a handout is included to print if you prefer). Inform participants that students need to connect what we have done to engineering practices in real life. Give participants a few minutes to go over the practices and think about which practice they think each technology meets.

On **slide 19**, have participants do a Gallery Walk looking at each poster, and using a sticky note, put what practice they think the technology meets and attach it to the poster for that technology. Does everyone agree with the assessments? Facilitate a brief discussion to see if a consensus can be achieved.

Evaluate

The session will wrap up with a 3-2-1 strategy, on **slide 20**. The prompts are below:

- *What are 3 classroom activities that you could enhance with these technologies?*
- *What are 2 different ways that these technologies prepare students for a tech-driven world?*
- *What is 1 hurdle that must be overcome when implementing these technologies into the classroom, and how could you do it?*

Finally, have participants rate today's session by following the QR code and filling in the evaluation form.

Follow-up Activities

Some questions you may want to share at the end of the session to prepare for a follow-up with participants after they've implemented their created lesson or activity:

- *What activity did you implement with students?*
- *How did students approach the task?*
- *What challenges did students experience?*
- *How did they problem-solve or "troubleshoot" these challenges?*
- *How did the task promote student's critical thinking?*
- *How did the learning experience support NSTA practices?*

Research Rationale

The use of STEM-integrated technology in the classroom requires teacher preparation and intentional planning for student engagement. Teacher preparation must ensure that the collective total knowledge of all involved teachers is adequate, which can be accomplished through training and professional development that emphasizes “content knowledge, practices, implementation approaches, the connection between and among STEM disciplinary knowledge and skills, and assessment of learning outcomes” (Ntemngwa, 2018). Authenticity is needed, as the relationship between engineering and technology is more easily understood by students if science and math classes are carried out in the context of everyday life (Erdem, 2019). In order for lessons using STEM-integrated technology to be successful, teachers must provide clear lab instructions with embedded resources, such as YouTube videos, and create reasonable activities that are practical, fun, and/or doable under time constraints (Bhounsule et al, 2018). Finally, promoting an atmosphere where failure with problem-solving is acceptable must be cultivated: this can be accomplished using reflective self-assessment wherein students focus on themes such as group dynamics, problem scope, time management, and iteration/testing (Bitetti et al, 2018).

Resources

- Bhounsule, P.A. et al (2018). Control systems and robotics outreach to middle-school girls: Approach, results, and suggestions. Presented at 2018 ASEE Gulf-Southwest Section Annual Conference, Austin, 2018. Berlin: Research Gate. DOI: 10.1109/FIE.2018.8659344
- Bitetti, S. et al (2018). Examination of student self-assessed learning in a project-based freshman robotics course. Presented at the 2018 IEEE Frontiers in Education Conference (FIE), San Jose, CA, 2018.
- Erdem, A. (2019). Robotics training of science and arts center teachers: Suleymanpasa/Tekirdag case. *Journal of education and training studies*, 7(7), 50-61. DOI: 10.11114/jets.v7i7.3943
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- Ntemngwa, C. & Oliver, J.S. (2018). The Implementation of Integrated Science Technology, Engineering and Mathematics (STEM) Instruction using Robotics in the Middle School Science Classroom. *International Journal of Education in Mathematics, Science and Technology* (IJEMST), 6(1), 12-40. DOI:10.18404/ijemst.380617