Building 21st Century Skills through Technology

The 4Cs-critical thinking, communication, collaboration, and creativity-are the basic skills all students need in the 21st century (National Education Association, 2014).

There are four stages to the SAMR framework: Substitution-Augmentation-Modification-Redefinition. During the **substitution** stage, technology replaces a tool to carry out the same function, but it does not change the learning environment. For example, a washing machine is a technology tool that people substitute for washing clothes by hand. The hand and washing machine serve the same function; most people substitute the washing machine for their hands to make the process more efficient. In the school setting, students use word processing programs to draft academic writing, as opposed to pencil and paper. These are both technology integration at the substitution level.

The **augmentation** stage occurs when technology contributes to a change in the learning environment to improve the functionality of the learning experience. Allowing students to save their documents automatically to the cloud, as opposed to manually saving them, is an example of augmentation. The functionality of saving work has changed.

The **modification** stage leads to the integration of technology that causes a significant change in the learning environment and allows educators to redesign learning tasks in new and meaningful ways. This is the first step of using technology to alter learning tasks and experiences. Imagine that a history assignment called for students to create a timeline of the last century, highlighting one major event each decade. Normally, students would present their work using a piece of paper and pencil by drawing the timeline and writing the events on the paper, or using a computer to type their timeline.

The **redefinition** stage occurs when technology redefines learning and results in innovative teaching and learning environments that would not have been possible without the integration of technology. Learning activities at this level use multiple technology tools including the ability to work on projects and documents simultaneously with peers, collaborating with people around the world, and creating digital and tangible projects infused with technology.

Tech Strategy: Research information online (SAMR level: Augmentation)

Asking students to research online provides opportunities to reason effectively because they have to decide what information to use and why. Encourage students to provide sources to support their reasoning. This evidence also supports their ability to think critically. According to the Common Core standards, as early as kindergarten, students should have opportunities to participate in shared or individual research. At this early level, the teacher may conduct research with the students about butterflies as they learn about the life cycle. As they continue on in school, these research projects can become more intense and involved. By high school, students are expected to

- "Conduct short as well as more sustained research projects to answer a questions (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation" (CCSS-ELA Writing W.11-12.7).

- Choose a problem to solve. Within this assignment, they will be expected to use multiple sources, synthesize this information, and present the information to others.

Here are some other practical augmentation tech strategies to support reasoning effectively:

- Create a space online where students can view and share resources that support their ideas or views on the course topic.
- Ask open-ended and productive questions to guide the discussion on online discussion boards.
- Create a survey on Google Forms, and ask students to answer reflective questions about a classroom experience.
- Encourage the use of Google Docs so students can save work, share work, and have opportunities to take part in reviewing and providing feedback to peers.
- Provide students with digital media, videos, and notes before class to review so when they come to class, they will be more prepared to critically discuss and practice reasoning.

Tech strategy: Share student-created digital media presentation on social media (SAMR level: Redefinition)

Here are some other practical redefinition tech strategies to support reasoning effectively. Ask students to

- Create their own video, blog, or digital story to support their reasoning/
- Creating something using digital games (e.g., Minecraft), and then record the games and reflect on what was created.
- Use Google Docs and Google Hangouts to work on a group project and then share their project with the online community via social media.
- Use Skype within the classroom so they can interact with others in a different location or from a different culture.
- Create an e-portfolio demonstrating their learning. This e-portfolio should include artifacts like sample work, text, audio, video, and pictures.

Tech strategy: Use voice-recorded reflections of systems change (SAMR level: Augmentation)

Here are some other practical augmentation tech strategies to support systems thinking?

- Provide online resources regarding systems and how they work. For example, students may better understand a specific ecosystem if they can see it and visualize it with pictures and videos. Suggested tools include YouTube, iTunes U, Keynote, PowerPoint, and Prezi.
- Send home a list to families of online games (e.g., Minecraft, SimCity, Civilization, and Gamestar Mechanic) that support systems thinking.
- Ask students to use an online journal or blog to record thoughts about systems thinking. Possible tools include Edublogs, Kidblog, Penzu, Notability, and Evernote.
- Integrate an online discussion on systems thinking through the course management system, Google Apps for Education, or Wikispaces.

- Suggest that students use graphic organizers. A sample list of available online graphic organizers can be found here: www.educatorstechnology.com/2012/02/list-of-free-graphic-organizers-for.html?m=1. Students can use Popplet or Educreations.

Tech strategy: Use mobile apps to support systems thinking (SAMR level: Modification).

Here are some other practical modification tech strategies to support systems thinking.

- Provide students with the opportunities to engage in virtual labs to explore issues of sustainability, and resource allocation. Use Google Earth to look deeply at different parts of the world through an environmental perspective.
- Allow students to explore games that involve robotics and computational thinking where they can build and create such as eTextiles, also known as wearables (www.ccm.ece.vt.edu:8088/etextiles/), Scratch (https://scratch.mit.edu/) and ABCya.com.
- Integrate age appropriate mobile apps either by allowing students to choose an app from a list of suggested apps or downloading apps on tablets for students to choose. A sample list of mobile apps to promote critical thinking can be found here: http://tinyurl.com/4Csmobileapps.

Tech strategy: Create a system-Choose your topic and technology tool (SAMR level: Redefinition).

Here are some other practical redefinition tech strategies to support systems thinking?

- Encourage students to engage in a global issue, like climate change. They can engage via social media, blogs, service groups, and other online forums. Have them exhibit their real engagement through a Storify of their Twitter engagement on a hashtag and share what they've learned with their fellow students.
- Ask students to create an online resource or video explaining how a problem affects the local, national, international, and global communities. Within this video, they will advocate for this cause, share their video via social media, and elicit feedback from others. Tools to use to create and edits videos are iMovie, YouTube Capture, WeVideo, Magisto, and Storyboard That.
- Share online resources with families and students that encourage students to create and think about systems thinking. For example, PBS kids created an online world to encourage systems thinking in young children (http://pbskids.org/kartkingdom). This online game will also allow players to play online and interact with other players around the world.

Tech strategy: Use Google Apps for Education to communicate (SAMR level: Augmentation)

The tools offered within Google Apps for Education certainly add another level of function and improvement to the 21st century skill of communication and communicating effectively.

Here are some other practical augmentation tech strategies to support communicating effectively:

- Use Quizlet to study and review course topics. In order for students to communicate effectively, they have to understand what they are learning first.

- Using tools such as Notability and Evernote, record notes and information and then share this information as a way to communicate.
- Create a Padlet page and ask students to communicate their thoughts on a topic, or create small groups and have each group record their ideas on their own Padlet page.

Tech strategy: Share and receive ideas through technology-driven social interactions (SAMR level: Modification)

Here are some other practical modification tech strategies to support communicating effectively:

- Use OneNote to combine drafting narrative text, inserting photos, taking screenshots to communicate and share ideas.
- Instead of relying solely on words, use Skitch by Evernote to communicate visual ideas and provide annotations to help direct the audience's attention on the most salient points.
- Facilitate classroom lectures in a flipped style by using Nearpod to communicate lessons and allow students to communicate back and share their learning.

Tech strategy: Videoconference to communicate across cultures (SAMR level: Redefinition)

Here are some other practical redefinition tech strategies to support communicating effectively:

- Use Google Apps for Education to collaboratively research and share research. Other helpful tools are Notability, Evernote, and Keynote.
- Ask students to create informational videos using YouTube or iMovie.
- Have students use voice-recorded technology such as VoiceThread or Knovio to create a presentation on a course topic and then share and allow for peer and teacher feedback.

Tech strategy: Create a class wiki to collaborate with others (SAMR level: Augmentation)

Here are some other practical augmentation tech strategies to encourage collaboration:

- Use a shared document tool (e.g., Google Docs, Evernote, Padlet) where students can collaborate with each other by combining their ideas to develop a final end product.
- Students collaborate with one another regarding a course topic. They can participate and develop new ideas though virtual sharing sessions within a course learning system (e.g., Blackboard Collaborate, Adobe Connect, Google Hangouts).
- Create groups and give each group a hashtag to identify their group. The groups would then be assigned something to research and a cause to share with others. The groups would collaborate and find information on their topic. They would then use a social media tool (such as Twitter) and share the resources using their group hashtag.

Tech strategy: Develop Personal Learning Networks and study groups to collaborate with others (SAMR level: Modification)

Teachers and students can develop Personal Learning Networks (PLN) and online study groups to provide 24/7 connected learning with others and opportunities to problem solve collectively on course content.

Some tools to use to collaborate within PLNS and study groups are Flowdock, Thinkbinder, Groupboard, Twiddla, and Pinterest.

Here are some other practical modification tech strategies to encourage collaboration:

- Student teams work collaboratively to compile similar topics on a webmix, using an application such as Symbaloo.
- Create an EDUblog classroom account and have the students join the class, and then blog about course related information. Students will also use a whiteboard app (e.g., EduCreations, Flowboard, Web Whiteboard, Simple Surface) to collaborate within their groups, and then share on their blogs and respond to classmate blogs as well.
- Student teams collaborate and create a presentation using an online tool of their choice (e.g., VoiceThread, Prezi, Google Slides).

Tech strategy: Co-create and share digital stories with a partner school in another country (SAMR level: Redefinition).

Here are some other practical redefinition tech strategies to encourage collaboration:

- In small groups, students co-create a digital book or movie and co-publish this work on the Internet for others to see. Possible tools include WattPad, iMovie, and YouTube.
- Connect students from different cultures, provide opportunities for students to research and ask questions and collaborate with one another. Possible tools include Google Hangouts and Skype.
- Problem-based learning provides opportunities for collaboration and connection to real life problems. Students could blog about their experiences with the online community.

Tech strategy: Use mind mapping and brainstorming sessions to inspire creative thinking (SAMR level: Augmentation)

There are many online tools that can help facilitate this process. For example, Popplet is a free tool that allows students to create mind maps and brainstorm. Mindmeister can also be used as a tool for brainstorming. Students and teachers can share their thoughts and ideas in a collaborative way.

Here are some other practical augmentation tech strategies to encourage creative thinking. Ask students to

- Create digital posters using Glogster.
- Embed digital photos and texts suing Prezi.
- Create interactive timelines using Timetoast.

Tech strategy: Allow students to choose digital tools or resources to encourage creative thinking (SAMR level: Modification)

Students need opportunities to explore real-world problems and develop solutions using digital tools (KSTE, 2007). When students can choose a topic that pertains to them, this can help them become advocates and problem solvers in addition to being creative thinkers. Also, one student may find using Notability helpful while another one prefers to use OneNote or VoiceThread. Allowing students to decide what tool to use prompts creativity. This blog lists 18 apps that support creativity: www.edutopia.org/blog/apps-for-creativity-diane-darrow. The choices are endless.

Here are some other practical modification tech strategies to encourage creative thinking. Students can

- Showcase their work by creating infographics using tools such as Easel.ly or Piktochart.
- Use screencasting tools to prompt creative thinking such as Screenr, Camstudio, or iMovie.
- Record ideas and sound using EduCreations.

Tech strategy: Create a makerspace to inspire creative thinking (SAMR level: Redefinition).

Here are some other practical redefinition tech strategies to encourage creative thinking. Encourage students to

- Code and create their own website for a cause that is important to them. What they create can then be shared with a broader audience.
- Engage in robotics, which will foster their engineering, science, math, and problem-solving skills. The student creations can be shared with a virtual community. Examples of useful tools are Bee-Bot, RobotBASIC, EZ-Robot, and LEGO Robotics.
- Create interactive 3-D timelines to focus on a variety of historical, life, and legal events. They can publish the timelines online and analyze them for historical correctness. Examples of useful tools are Tiki-Toki, Timeglider, and Timetoast.

Tech strategy: Build case studies and problem-based learning opportunities for innovative thinking (SAMR level: Modification).

Here are some other practical modification tech strategies to implement innovations. Provide opportunities for students to

- Interview experts on course topics through the use of videoconferencing tools such Skype, Adobe Connect, ZOOMHD, GoToMeeting, and WebEx. These virtual meetings will help generate ideas for students and help with the innovation process.
- Use interactive video tools to watch videos created by their teachers or experts in the field so that they can edit and engage with video and share their creations. Examples of tools to use include TED-Ed, eduCanon, EDPuzzle, and Zaption.
- Design and share presentations based on real life problems and cases using tools such as Keynote, PowToon Studio, Prezi, #Slides, and Google Slides.

- Create an assigned end product using a format that they choose. For example, a geographic model of their favorite city. Provide tools for creative thinking, innovation, and practice such as SketchUp to help get students ideas going. Include a reflective component where students document their process, and make changes based on what they have created.