K-12 BLUEPRINT

Learning Spaces that Support Computational Thinking

Modern learning spaces take on a variety of forms that are reflective of a school or district's goals or a program's unique intent. For the most part, these spaces emphasize project-based learning and increased STEM-based education while preparing students for jobs focused on specialized technology skills.

Hands-on Learning

Space can have a significant impact on learning. A well-designed learning space supports and facilitates learning through an environment seamlessly combining modern technology and smart pedagogy. These spaces are designed and built to support innovative ways of teaching and learning: allowing for collaboration, communication, and creativity more effectively than traditional classrooms.

Schools and districts need to ensure modular and adaptable student and educator learning spaces to build computational thinking skills: providing spaces that foster collaborative activities, project-based learning and peer-to-peer engagement rather than traditional lecture-based theater seating. These types of robust learning spaces provide high school students with the skills necessary to succeed in post-secondary/college education, entry-level employment and career advancement.

What is Computational Thinking?

Computational thinking uses algorithms, abstraction, decomposition and pattern recognition to create solutions to deal with complexity and open-ended problems. It is a strategy closely associated with programming and coding but can be applied to other problem-solving challenges.

Computers only do what they're told or learn to do. Computational thinking teaches students to think like a computer program so that whatever solution the student is formulating can be designed efficiently. Modern computer applications use computational thinking for problem solving across industries such as financial, genomics, energy, automotive, space, the arts, and many others.

The latest technologies are at the center of modern, innovation-focused learning spaces. Educators and students work on a wide variety of projects to develop computational thinking skills, including developing simulations and 3D models using powerful CAD software, creating virtual worlds using VR and AR headsets, recording and editing digital video experiences with industry-standard software, printing models of their own designs using 3D printers, CNC machines, and laser cutters, and even coding their own AI chatbots. Very few of these solutions will work on devices designed solely to browse the internet.

intel

Equipped for Problem Solving

Computation Thinking Learning Spaces typically require the following elements:

- Computer Areas
- Collaboration Spaces
- Maker Spaces
- Classroom Area
- Equipment Lab for 3D printing, CNC (Computer Numerical Control), etc.

Some specific tools and equipment one might find in a computational thinking learning space include:

- Moveable workstations
- High-performance design stations with two monitors each
- Robotics area
- 3D printers
- Large format printers
- Scanner
- Laser cut machines
- CNC machines

Hardware

A modern Computational Thinking space requires robust hardware to truly train today's students to thrive in tomorrow's workforce. Of all the available device form factors, PCs are the most appropriate for building 21st century skills as they can more easily accommodate extremely resource intensive features such as 3D graphics, video editing and various image-based applications.

Most 3D printers intended for home, education and prosumer markets (under $4,000) build 3D objects out of successive layers of molten plastic. 3D scanners analyze real world objects and convert the collected data into files which can then be used to construct virtual computer models. 3D software apps can then be employed to further refine and/or edit these models.

Digital content design and multimedia creation are areas that draw upon computational thinking. Spaces that support these disciplines should provide a comprehensive range of software and machines to realize innovative design ideas. These state-of-the-art, fully equipped facilities support programs in journalism, radio, television, video and film production. A digital content design and multimedia space will typically have, in addition to computers that can handle processor-intensive tasks such as video and audio editing, high--definition digital cameras and high-quality microphones, audio boards allowing both digital and analog technologies, and the latest multimedia design software such as the Adobe Creative Suite.

Software

A diverse array of powerful software options—able to tackle such tasks as simulation and modeling, 3D design, and gaming creation— is crucial to developing and applying computational thinking skills.

Image creation and editing apps should work with both vector and bitmap artwork, as well as software for page layout design and more. In some cases, applications often have limited 3D animation and modeling capabilities as well. Photo editing software allows users to optimize and work with a wide range of image files and formats. These apps usually include a number of built-in tools for creative image manipulation and compositing.

Most professional or prosumer grade 3D software packages contain integrated modules for modeling, texture mapping and animation at a minimum. Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) software encompasses product design, architecture, interior design and other disciplines. Digital content creation software allows users to edit various kinds of video and still imagery together with sound files in order to create a variety of end products.

User Interface (UI) and User Experience (UX) design have become indispensable elements in virtually every type of web or software application design: allowing users to create and test designs or workflows before committing to final development.

Coding is a powerful way of introducing and developing computational thinking skills. Coding programs typically introduce students to a variety of computer languages including HTML, CSS, DNA, SQL and JavaScript. Program projects may also include an introduction to mobile app development, remote server workflow, data queries, web development, and the production of data-driven applications.

Learning spaces that support coding need to, naturally, feature powerful computers able to run the latest software. Tables and workstations can be utilized in a conventional instructional setting (desks facing the teaching wall), or a more fluid seating arrangement for group discussion and project collaboration. Tools and equipment must facilitate instruction and project development.

Other Considerations

When learning is supported and empowered by modern learning spaces equipped with the latest technology, students can see the relationships between school subjects as well as between school and life outside of the classroom. Computational thinking thrives in such an environment: with students learning to solve problems in creative and innovative ways.

"There's a point where you may need specialized software or robots, or Arduino microprocessors. But before you get to that point, you can go very far by simply having a web browser, using solutions such as Scratch. There are many low-bar approaches to teaching computer science. You can check out items from many public library maker spaces now, and a lot of tech companies will give mini-grants, if you want to build up a collection of programmable tools and devices over time."

—**Jane Krauss**, *co-author of Computational Thinking and Coding for Every Student: The Teacher's Getting-Started Guide.*