STEM MINDS
Science Technology Engineering Math

Video Game Design in the Classroom

Competency

Educator uses video game design in the classroom to engage students and support twenty-first-century learning.

Key Method

Educator uses a range of tools and pedagogical strategies to teach students to create video games.

Method Components

What is coding?

To put it simply, coding is the language that computers speak. Much like human languages, many different coding languages are used around the world, all of which have different strengths and uses.

To use computers as a tool to shape the world around us, we need to learn these languages. Luckily, coding languages are based on a system of rules. When we are writing code, we are providing a set of instructions for a computer to follow in a way that it understands. Once we understand the fundamental rules that underpin coding as a whole, we can start to apply those rules to all the different coding languages and their unique syntax.

What is the relationship between coding and video games?

Video games are created with code! A huge portion of our students dream of becoming video game designers when they become adults, but a large number of them don't recognize exactly what is happening behind the scenes in their favorite games! From graphics to gameplay, points systems to levels, coding is behind it all.

Why should students learn to code?

One of the reasons most often shared for why students should learn to code is "to prepare them for the jobs of the future." This is a worthwhile goal; jobs in STEM fields are growing at a rate of close to 8%, compared to just 3.7% for non-STEM jobs. Over 70% of jobs in STEM are actually computing jobs or use computer science in a major way (US Bureau of Labor Statistics, 2021). Learning to code can be a valuable skill in the workforce.

However, there are still many students who will not end up in a STEM field. Nevertheless, these students should still learn how to code!

Coding is an enjoyable pursuit for many, and one of the goals of twenty-first-century education should be to move students from being digital consumers to digital creators. That is to say, rather than being passive users of technology, students should have a deeper understanding of how technology is shaping their lives and societies and how they, in turn, can use technology to make a positive impact in the world. To truly understand how technology works, one must understand the fundamentals of code and computer science. When students learn to code, what they are really learning is how computers work.

Furthermore, coding is an important and effective way for students to learn key twenty-first-century skills such as communication, collaboration, critical thinking, and creative problem solving.

Why are video games a good way to teach coding?

More than 70% of youth under the age of 18 regularly play video games, and an enormous number of students dream of becoming a video game designer when they become adults.

To put it simply, video games are built with code (on top of integrating creative areas such as art and graphics, music, storytelling, and more). Because of the innate interest students already possess and the direct connections between coding and video game design, video game design can be one of the most effective ways to engage students in learning how to code.

Video games are inherently very hands on and visual. Because students already have a base-level knowledge of how many kinds of video games operate, they are able to better envision what they want to accomplish and, therefore, how they can work to get there.

What else does video game design teach students?

Of course, teaching and learning about video game design is effective in its own right, separate from coding. Plus, not all tools designed to support youth in learning about video game design directly integrate coding.

There are many opportunities for students to extend their experience in dozens of directions through video game design, including:

1. **Art.** From character designs to custom backgrounds to lifelike animations, art is a huge component of an effective video game.

2. **Storytelling.** All video games have some element of stories, no matter how simple. Character dialogue, narration, narrative structure, and more—video games are an excellent way for students to build and apply their language and literacy skills.
3. **Communication.** From ensuring your players understand *how* to play your game to making an engaging and accessible storyline to pitching your video game, communication is a huge component of effective video game design. This is another excellent opportunity for students to build and apply their language and literacy skills.
4. **Collaboration.** Can you make a video game on your own? Sure. But most famous game design studios have dozens (even hundreds) of team members working to bring a video game to life. Students are able to collaborate to design a video game in many different ways in order to explore a range of roles and even "careers" within the video game design industry.
5. **Endless cross-curricular connections.** From creating a game that teaches players about a specific scientific concept to recognizing that video games integrate a ton of math concepts, the ways you can connect video game design to other areas of the curriculum are almost endless.

Foundations of Effective Video Game Design Instruction

While introducing STEM in the classroom has increasingly become a stated priority of schools and governments across the globe over the last decade, understanding how to effectively integrate video game design in the classroom at the elementary level often goes undiscussed.

Based on research by the Computer Science Teachers Association and other best practices, the 5 foundations of effective video game design instruction are:

1. **Demonstrate thorough video game design knowledge and skills**

No, you do not need to be an expert in order to integrate video game design in the classroom. However, educators do need to experience video game design themselves and build their skills in order to effectively teach video game design to K–12 students.

Educators should have a solid understanding of fundamental coding concepts (e.g. sequence, conditionals, loops, functions, etc.) and core video game design terms and principles, and also have the ability to recognize common student misconceptions and areas of difficulty.

By taking this time to familiarize themselves with the foundations of video game design, educators will be both better equipped and more confident in their abilities to bring high-quality video game design instruction into their classroom.

2. **Implement evidence-based practices as responsive classroom practitioners**

Every classroom is unique, but there are general principles and evidence-based practices that should guide all educators in bringing high-quality video game design instruction to their students, including:

1. *Hands-on learning.* While there are fundamental theoretical concepts underpinning video game design, students need hands-on experience to truly understand and develop the skills they need.
2. *Troubleshooting.* When it comes to video game design, it is not a matter of *if* you will make a mistake, but *when*. On top of learning the fundamental principles of video

game design and getting hands-on experience, students also need explicit instruction and practice with troubleshooting strategies.

3. *Multiple pathways.* There is almost always more than one way to achieve a given outcome when designing a video game. Effective educators account for this inherent flexibility when assessing student work while still encouraging students towards efficiency and simplicity in their work.
4. *Process vs product.* While the ultimate goal is to have a working video game, effective educators recognize that it is the process of designing, troubleshooting, and refining projects rather than the final project itself that truly carries the greatest weight in assessing and evaluating student learning.

3. Design learning experiences using pedagogical content knowledge

While many pre-made lessons and activities exist to support educators in bringing video game design instruction to their classroom, educators must be able to evaluate and modify these resources as well as create their own original learning experiences in order to meet the needs of their unique group of students.

4. Continuously develop knowledge, practice, and professional identity

It can be tempting for an educator beginning their journey with video game design in the classroom to stay within their comfort zone with simple and familiar lessons and activities. However, students may quickly advance past these learning experiences and require more advanced and novel experiences.

Therefore, effective video game design instruction means the learning is never done! Educators should be continuously evolving their own skills and looking for ways to engage students in increasingly complex learning.

5. Advocate for equity and inclusion in the classroom

Educators must recognize that the world of STEM—and video games, more specifically—has not been equitable in the past and remains so. Women/girls, racialized people, people with disabilities, and other marginalized groups remain deeply underrepresented in the world of video games and video game design.

These problems will not fix themselves. Cultural biases about who belongs in the world of STEM and video games exist in us all, even at a subconscious level. Beyond merely teaching video game design, educators must take an active role in promoting equity and inclusion in their instruction and overall classroom environment in order for all students to achieve success and recognize their potential.

Supporting Rationale and Research

Zilberman, A., & Ice, L., “Why computer occupations are behind strong STEM employment growth in the 2019–29 decade.” *Beyond the numbers: Employment and Unemployment*, vol. 10, no. 1 (U.S. Bureau of Labor Statistics, January 2021). https://www.bls.gov/opub/btn/volume-10/why-computer-occupations-are-behind-strong-stem-employment-growth.htm

Shumway, S. (2008). *Design activity: Students designing their own video games.* Technology & Children, *12*(3): 12–13. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1061&context=ncete_publications

Baumert, D. (2017, January 3). *Video games in the classroom*. New Jersey Education Association. https://www.njea.org/video-games-in-the-classroom/

Barack, L. (2020, December 9). *4 ways schools use video game design to spark interest in computer science*. K–12 Dive. https://www.k12dive.com/news/4-ways-schools-use-video-game-design-to-spark-interest-in-computer-science/591741/

Game development in the classroom. (n.d.). TKI | Te Kete Ipurangi. Retrieved July 30, 2021, from https://elearning.tki.org.nz/Teaching/Future-focused-learning/Game-development

The psychology behind why gaming helps students learn. (2015, November 2). My Tech Decisions. https://mytechdecisions.com/mobility/game-based-learning-is-where-vygotsky-meets-dweck/

Canada Learning Code. (n.d.). *Learning for the digital world: A pan-Canadian K–12 computer science education framework*. https://k12csframework.ca/wp-content/uploads/Learning-for-the-Digital-Future_Framework_Final.pdf

Canada Learning Code. (n.d.). *Teachers learning code digital toolbox: Quick start guide*. https://www.canadalearningcode.ca/wp-content/uploads/teacher-quick-start-guide.pdf

Reach. (August, 2017). *Field report on K12 computer science.* https://drive.google.com/file/d/0B2eCjHNmaBGZeGpwTGlRTUJKZlU/view

Computing at School. (n.d.) *Computational thinking: How do we think about computing so that computers can help?* https://community.computingatschool.org.uk/files/8221/original.pdf

International Society for Technology in Education (ISTE), Computer Science Teachers Association (CSTA). (2011). *Computational thinking teacher resources: Second edition.* https://cdn.iste.org/www-root/2020-10/ISTE_CT_Teacher_Resources_2ed.pdf?_ga=2.206381526.472047317.1620655308-1370069785.1620246492

International Society for Technology in Education (ISTE). (n.d.). *Computational thinking competencies*. https://www.iste.org/standards/computational-thinking

Computer Science Teachers Association (CSTA). (2012) *Special issue computer science K–8: Building a strong foundation.* https://csteachers.org/documents/en-us/25b0b43f-0817-4c08-9210-f1a96f2b1c7d/1/

Goode, D., et al. (January 21, 2020). *Computer science for equity: Teacher education, agency, and statewide reform.* https://csteachers.org/documents/en-us/8fe1ba43-45fd-4360-8820-2e0dd33a1252/1/

Google. (May 26, 2014). *Women who choose computer science: What really matters.* https://csteachers.org/documents/en-us/c0015462-38a7-41e2-b9fb-b48107953e28/1/

Sawyer, E. (2016, January 5). *Why STEM's future rests in the hands of 12-year-old girls*. TechCrunch. https://techcrunch.com/2016/01/05/why-stems-future-rests-in-the-hands-of-12-year-old-girls/

Smith, L., et al. (September 2017). *Cracking the code: The prevalence and nature of computer science depictions in media.* https://csteachers.org/documents/en-us/db6c4cf7-62d6-4d0f-921c-658a540cc10f/1/

Resources

Standards
Computer Science Teachers Association K–12 Standards.
https://www.csteachers.org/page/standards

Lesson Plan Template
https://dl.dropbox.com/s/gkw7sn841l5kb76/Lesson%20Plan%20Template.docx?dl=0

Terms and Concepts
https://dl.dropbox.com/s/a057nkmj49triej/Video%20Game%20Design%20Terminology.pdf?dl=0

Submission Guidelines & Evaluation Criteria

To earn the micro-credential, you must receive a passing evaluation for Parts 1 and 3 and a "Yes" for Part 2.

Part 1. Overview Questions

Please write your responses below (1000-word limit for the 5 questions in total).

1. Describe your role in education. What grade and subject or content area do you teach? What should we know about you and your classroom?
2. What is your current level of experience and confidence with teaching video game design?
3. Identify at least one asset and one barrier you anticipate to integrating video game design into your classroom.
4. Why do you believe it is important to teach students about video game design?
5. What are you hoping to gain through this micro-credential?

Passing: Response provides reasonable and accurate information that outlines the prior experience of the educator and the context of their classroom/teaching. Educator specifies a learning goal that describes what they hope to gain from this experience. Educator outlines their current mindset and experience when it comes to teaching video game design in sufficient detail.

Part 2. Work Examples/Artifacts/Evidence

To earn this micro-credential, submit the following three artifacts.

Artifact 1: Certificates of Completion

1. Certificate of completion for a STEM Minds Teacher Professional Development Workshop related to your STEAM Hub course (see Artifact 2, below)
2. Certificate of completion for ONE of the following STEAM Hub courses:
    a. Video Game Design with Bloxels
    b. Video Game Design with Flowlab
    c. Video Game Design with MakeCode Arcade
    d. Video Game Design with Unity

Artifact 2: STEAM Hub Course Final Project

For the STEAM Hub course you selected above, please submit a copy of your final project. It must include:

- the full project file (please do not submit screenshots)
- any relevant share settings appropriately set to allow anyone to view the project

Artifact 3: Lesson Plan

Submit a lesson plan showing how you will bring this video game design experience to your classroom. This lesson may be a “stand alone” lesson or may be one in a larger unit. Please indicate this context for the lesson somewhere in the lesson plan. You may choose to use your own lesson plan template or may use the suggested template in the Resources section. Your lesson plan must include the following information:

1. What core concepts you plan to introduce to students and how you plan to do so
2. What project(s) students will be asked to create, and how they will have the opportunity to test and refine them
3. How you intend to foster an inclusive and collaborative culture in your classroom, with a focus on historically underrepresented groups instead (including girls/women, students with disabilities, ELL students, etc.)
4. How you plan to address common student misconceptions/areas of difficulty
5. What troubleshooting strategies you intend to introduce to students (please also include *how* and *when* you plan to introduce these strategies)
6. What opportunities students will have to communicate about video game design
7. How you intend to assess and evaluate student work (with a focus on process over product)

Part 2. Scoring Guide

Artifact	“Yes”	“Almost”	“Not Yet”

Artifact 1: Certificates of Completion	The certificate of completion for both the course and the professional development workshop were provided.	N/A	One or both of the certificates are missing.
Artifact 2: STEAM Hub Course Final Project	The project provided meets the expectations as outlined in the project rubric within the STEAM Hub course at a level of 80% or higher.	The project provided meets the expectations as outlined in the project rubric within the STEAM Hub course at a level of less than 80%.	The project was not provided.
Artifact 3: Lesson Plan	The lesson plan includes all of the following: 1. Core concepts to be addressed 2. Project description 3. Inclusion and collaboration strategies 4. Anticipated student misconceptions/ areas of difficulty 5. Troubleshooting strategies to be taught 6. Opportunities for student communication 7. Assessment and evaluation plan	The lesson plan includes some of the following: 1. Core concepts to be addressed 2. Project description 3. Inclusion and collaboration strategies 4. Anticipated student misconceptions/ areas of difficulty 5. Troubleshooting strategies to be taught 6. Opportunities for student communication 7. Assessment and evaluation plan	The lesson plan includes only one or two of the following: 1. Core concepts to be addressed 2. Project description 3. Inclusion and collaboration strategies 4. Anticipated student misconceptions/ areas of difficulty 5. Troubleshooting strategies to be taught 6. Opportunities for student communication 7. Assessment and evaluation plan

Part 3. Reflection

Please write your responses below (1000-word limit for the 5 questions in total).

1. Throughout this experience, what steps did you take to foster an inclusive and collaborative culture in your classroom? What impact did this have on you and your students?
2. How did this micro-credential process influence how you teach video game design and/or other subjects?
3. What were the most common issues your students faced in their learning? How did you address these challenges?
4. In what ways did your students engage with collaboration, communication, critical thinking, and creative problem-solving through this experience?
5. How would you describe your students' overall experience with video game design? If you had to do it again, what would you do differently? What would you do the same?
6. What are your next steps for growth as an educator in this area?

Passing: Response provides reasonable and accurate information that outlines their approach to inclusivity in teaching video game design. Educator explores how the experience influenced their teaching and their next steps for growth. The response outlines the impact on the students and their experience in sufficient detail.