



Adapting STEM for Online

Elevate @  Keypath
EDUCATION™

Today's Objective

Today we'll cover a variety of strategies for moving your STEM content online:

- Guided Exercises
- Simulations and Demonstrations
- Tutorials and Webinars
- Math Practice
- Coding Challenges
- Virtual Machines
- Group Research
- Peer Feedback

Everyone will be muted. Please type your questions into the chat.

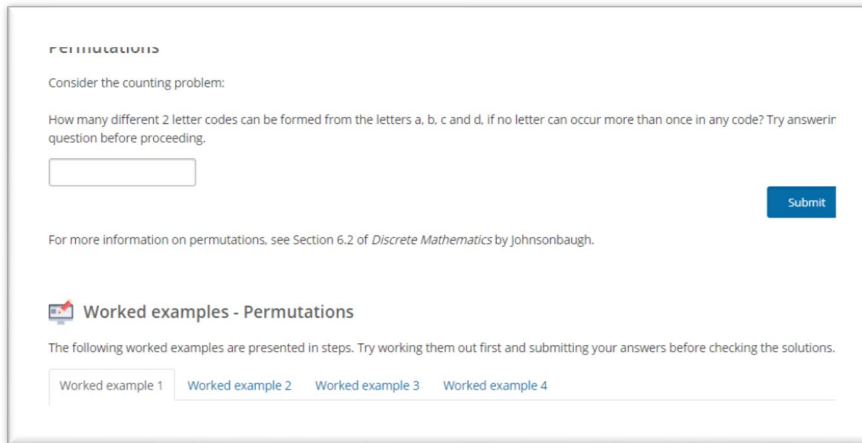
Guided Exercises

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Guided Exercises and Quick Activities

Description

Brief activities gives learners more chances to take breaks and resume learning with flexibility.



The screenshot shows a page titled "PERMUTATIONS". It contains a problem statement: "Consider the counting problem: How many different 2 letter codes can be formed from the letters a, b, c and d, if no letter can occur more than once in any code? Try answer question before proceeding." Below the text is an empty input field and a blue "Submit" button. A link for more information is provided: "For more information on permutations, see Section 6.2 of *Discrete Mathematics* by Johnsonbaugh." Below this is a section titled "Worked examples - Permutations" with a sub-instruction: "The following worked examples are presented in steps. Try working them out first and submitting your answers before checking the solutions." At the bottom, there are four tabs labeled "Worked example 1", "Worked example 2", "Worked example 3", and "Worked example 4".

Implementation Strategies:

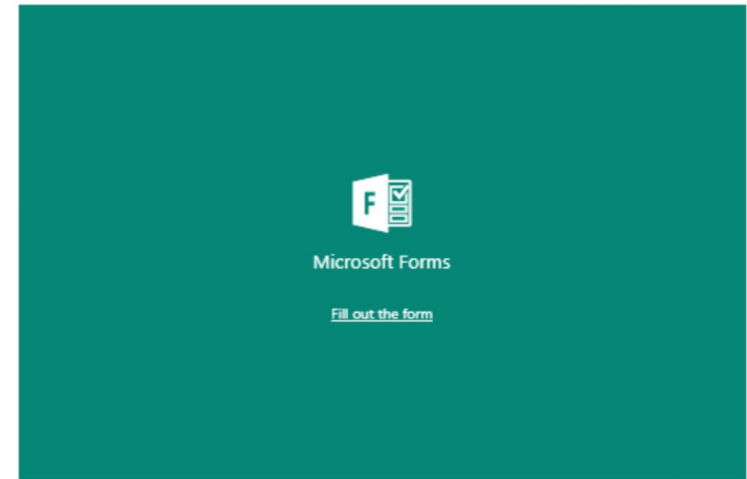
1. **H5P** is a good resource for adding bite-sized learning opportunities
2. Using a **Microsoft/Google Form** can help quickly get a sense of where students are. You can also share survey results with students to extend the activity.

What is aggression?

Purpose: To differentiate acts of aggression.

Time: Set aside 20 minutes to complete this task.

Task: Let's start off with an activity to identify what aggression is and is not. For each of the statements listed choose the correct response. Carefully compare your response to the classroom consensus and identify where you differed in opinion. We will continue the discussion of this activity in this week's collaborate session.



[Classroom responses](#)

Simulations and Demonstrations

Simulations and Demonstrations

Description

Simulation is great for designing hands-on experiences for your students.

Implementation Strategies

1. **Use what is available.** There are a variety of tools online that might already provide what you need.
2. **Use a video editor.** If you are using your own video resources, edit out unnecessary sections. Editing tools include: iMovie, Avidemux, & Camtasia.
3. **Try to keep your videos tight and condensed.** A short, 10-minute video on a single topic is better than an hour-long video of a whole lecture. It is also easier to record!
4. **Consider if you want to grade the performance of the student using the simulation.** If you do, you'll need to provide a method for the student to submit evidence of their performance to you and make sure that the simulator allows for evidence to be created.
5. **Reuse past lessons/lecture recordings where appropriate.**

Online Video Resources:

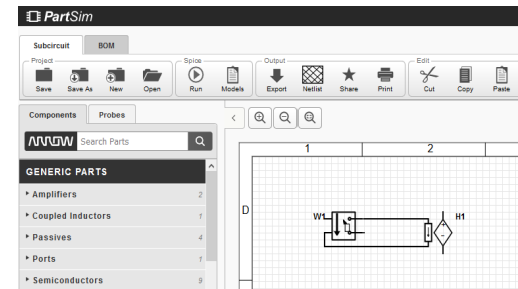
Video conferencing systems such as:

- [Khan Academy](#)
- [Khan Academy Medicine](#)
- [CrashCourse](#)
- [LinkedIn Learning](#)
(requires license)
- [TED-Ed](#)
- [freeCodeCamp](#)

Online Simulation Resources:

Video conferencing systems such as:

- [NASA STEM engagement](#)
- [Phet](#)
- [PBS learning media](#)
- [Part Sim](#)



Tutorials and webinars

Tutorials and webinars

Description

Synchronous sessions are a great way to engage students in critical discussions, demonstrations, tutorials or lectures. It is recommended that you plan your online session following the guidelines of the flipped classroom.*

Implementation Strategies

1. **Have students prepare** for your webinar by reading an article, watching a video, listening to a podcast or completing a code/math challenge on the topic you will cover.
2. **To begin, poll your students** on a critical question to raise interest.
3. **Try a mini-lecture.** Deliver a short explanation of the core content.
4. **Break students into meeting rooms**, and have them engage in critical discussion, demonstration, debate, or a group activity such as group research. Bring students back to the main meeting room to report on their activity.
5. **Debrief and summarize.**
6. **Assign follow-up activities to solidify learning.**

*DeLozier, S.J. & Rhodes. (2016) *Flipped Classrooms: a Review of Key Ideas and Recommendations for Practice*. M.G. Educ Psychol Rev.

Suggested Tools:

Video conferencing systems such as:

- Zoom
- Collaborate Ultra
- Teams
- Skype

Tips:

- Have students sign up to a webinar session based on their time availability.
- Provide an agenda of the webinar in advance.
- Make sure students will prepare for your webinar by building a preparation activity such as the following sample.

Math practice

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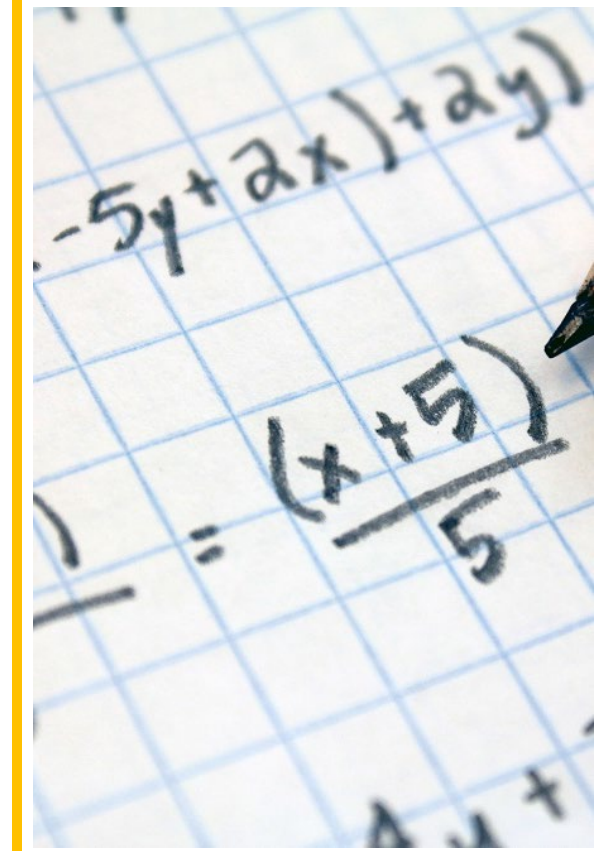
Math Practice

Description

Math can be challenging as math formulas can be difficult to handle online. You may want your students to be interacting with formulas. Thankfully there are a lot of tools out there that help make learning with formulas online easier.

Tools

1. **MathPix:** Take handwritten equations and convert them to computer equations with ease. There are both free and paid versions of the tool.
2. **Overleaf:** Collaborative equation editor. Free personal account, discounted student accounts.
3. **Wiris:** MathType equation editor that has integrations with different learning management systems such as Canvas and Moodle.
4. **Khan Academy:** Online resource that has free math lesson content.
5. Document Cameras: You could use a document camera to capture yourself writing the equations out as you would in class.
 - [Document camera 1](#)
 - [Document camera 2](#)



Coding Challenges

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Coding Challenges

Description

There are many resources available for your students learning code online. The following resources can help you get your coding activities or lessons up quickly.

Tools

- **Codecademy** Codecademy is a great paid resource that gives students a place to practice and receive automated feedback.
- **Ed LMS** Ed LMS is a coding platform for students to learn coding in a very interactive environment.
- Set up Virtual machines for your students.



Virtual machines

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Virtual machines

Description:

Virtual machines provide a safe environment to engage students in practical exercises for data science and cybersecurity courses. Setting up a virtual machine can help your students get access to the software they need.

Implementation Strategies:

1. **Check with your university.** Your institution will have to resource a suite of VMware software to make available to students. Your institution may already have virtual machines setup for student access.
2. **Create a how to guide** for downloading and installing virtual machines.
3. **Create detailed demonstrations** using VMware so students can set up virtual machines properly.

Suggested Tech Tools:

- [VMplayer/Workstation](#) (Windows, free for students and faculty)
- VMware Fusion (Mac OS, purchase only)
- [Virtual Box](#) (Free version)

For video demonstrations:

- Set up a private YouTube channel and use free screencast tools, such as PowerPoint, Screencast-O-Matic, CamStudio, Ezvid, OBS Studio, and ScreenRec
- For private/paid video : Captivate, Camtasia, Kaltura, Panopto, and Echo 360 Personal Capture

Group research

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Group research strategies

Description

Group research is a great way to stimulate online learning communities and follows the guidelines of collaborative/cooperative learning.

Implementation Strategies

1. **Choose a problem** or open-ended topic.
2. **Divide your students into groups.** You can do so based on the initial of their name, their height, the favorite music genre, etc.
3. **Provide clear instructions** of the parameters of their research.
4. **Set up a collaborative space.** Try a collaborative notebook for whole-class participation.

Suggested Tools:

Have students google or use their library catalog to do research.

Collaborative Tools:

- [OneNote](#)
- [Microsoft Word Online](#)
- [Google Drive](#)
- [Trello](#)
- [Padlet](#)
- Shared files within group tools in your LMS

Peer feedback

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Peer instruction/feedback strategies

Description

Peer instruction and feedback strategies are a useful way to engage students in critical thinking and discourse. These strategies have been found to increase student sense of ownership of their knowledge, and provides practical opportunities for students to use terminology specific to the subject matter.*

Implementation strategies:

1. **Prompt students** to consider a critical question or abstract topic with no right or wrong answer.
2. **Have students vote** through a poll or do collaborative research and post their responses on a Padlet or OneNote.
3. **Add peer review.** Have students browse through their peers' responses.
4. **Guide students** to further reflect on the initial topic through a secondary critical question and have them post their reflection on a discussion board.
5. **Establish a constructive and positive peer feedback strategy** by presenting students with critical questions that focus their reflection on their peers' responses.

*Simon, B., Esper, S., Porter, L., & Cutts, Q. (2013). Student experience in a student-centred peer instruction classroom. *International Computing Education Research Workshop*, 129

Suggested Tech Tools:

For polling:

- Microsoft/Google Forms
- [PollEverywhere](#)
- [SurveyMonkey](#)

For discussion and reflection:

- Discussion board
- Padlet
- Journals



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