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Tools for Teachers a STEM for Success Guide

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Tools for Teachers

STEM for Success Guide

Overview

This guide was created through the generous funding of Howmet Aerospace Foundation. Our aim is to capture the experiences and best practices of STEM educators in New Jersey during the COVID-19 pandemic through focus groups. This led to the development of digital resources for hands-on STEM that would be useful for student learning in an online world.

There is a pressing need due to the pandemic to provide educators and parents with tools that support effective online education for students. Facilitating, organizing and engaging in STEM activities is challenging. In order to promote discovery, engagement and learning, a system for sharing and supporting essential practices is needed. To do this, we provide here an open source, freely distributed guide to aid anyone interested in working to provide STEM instruction and activities for students, including parents, educators, and other stakeholders. This guide provides a framework of the considerations from crisis management through approaches to modes of online instruction, to implementation, whether in the classroom, at home or in another setting. It also provides instruction specific to the basics of effective communication, facilitation, and organization in remote and digital learning situations for hands-on STEM.

Beyond this, lessons designed to aid the learners and tied to hands-on, minds-on STEM activities and a system of role models and subject matter expert live connections are included through our STEM resources and YouTube channel. In this way everyone interested in STEM can begin to develop the culture of STEM in their own community, classroom, and lives.

What's Included?

This guide is designed to assist anyone interested in designing a set of educational experiences online. It helps participants understand what they want to attain, access resources to attain it and develop a plan to successfully achieve it. These materials seek to help anyone more effectively organize and accomplish their goal of educating students in STEM online.

We cannot anticipate every situation, every learner, or every set of goals that might be sought. Instead, we have worked to clearly elucidate the core principles that must be understood and provide a set of prompts to guide reflection and decision-making so obstacles can be identified and overcome. We stress the idea that instructional design is a collaborative, iterative, incremental process that needs to be tailored to particular situations for a specific set of learners who are desired to reach a specified goal having attained some set of outcomes. The text and content presented here will help those charged with this endeavor to understand how to perform this task effectively and efficiently given the unique situations and challenges presented to our communities due to COVID-19.

Goal

Our goal is to assist educators to find a secure foothold during a crisis and identify effective paths forward for implementing online instruction.

Objectives

Participants will be able to:
(1) Recognize the steps of crisis preparedness,
(2) Apply basic critical reflection to understand the needs and their proper responses, and
(3) Identify key questions resources, options, and priorities.

Outcomes

The outcome of this guide is that participants will be more prepared for a crisis, and to effectively utilize the tools available to them for online instruction.
The materials are fully online, self-paced, and asynchronous (no online meetings). These materials won't tell you the answers to every question. They will assist you by providing the right questions to ask, to yourself, your support team and your bosses/supervisors.

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Tools for a rapid transition to online instruction

1.1 Setup

"Helping people in crisis is a complex interdisciplinary endeavor. Because human beings encompass physical, emotional, social, religious, and spiritual belief systems, no one theory is adequate to explain the crisis experience or the most effective approach to helping people." (Thompson, 2004, p. 48). Similarly, teaching during a crisis is equally complex. Especially when all educators are required to rapidly shift to an online/remote education environment, with potentially new mediums and methods of instruction. These materials won't tell you the answers to every question. They will assist you by providing the right questions to ask, to yourself, your support team and your bosses/supervisors.

1.2 Self-reflective questions

When considering implementing an online/remote mode of instruction, one place many people begin is with a self-reflective question. This is meant to help you understand where you place priorities and how versed you are with some of the basic concepts you might encounter.

The following questions highlight different areas that raise concerns and might pose challenges for anyone moving to online instruction. However, even though they all fall under this single broad heading, each one would lead to a very different path for seeking help and resolution. Moreover, when the many combinations are seen side-by-side, the challenge can seem daunting since everyone will face their own unique set of challenges on this path. The good news is that all of the different situations described by these questions are common to educators and there are many easily accessible answers and supports. Moreover, most educational systems have experts to help you as you work towards a solution. As the saying goes, knowing is half the battle, and now having the right way to ask for help can take you down the right path.

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HIGHEST PRIORITY CONCERN POLL

How comfortable are you with online instruction?

- Very uncomfortable
- Somewhat uncomfortable
- Somewhat comfortable
- Very comfortable

What is your experience with online learning?

- No experience
- Participated in teleconferencing (Zoom, facetime, WebEx, google hangouts,
- etc.)
- Hosted a webinar or virtual meeting
- Attended online courses or training
- Taught an online course

As you think about the challenges of taking your course online and working with students, which of the following is your highest priority concern?

- Lack of experience with online education
- Lack of familiarity with online teaching tools (LMS, APIs, APKs, etc....)
- Lack of time to transition my courses
- Not sure how-to effectible transition my course for use online
- Applications of methods of instruction and assessment
- Interaction with learners
- Technical support
- Other:

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Remain Calm and Check Your Status

2.1 What is survival mode?

To get started we need to look at where you are, what you're facing, and what you have to work with. "A crisis is a temporary state of disorder and disorganization, characterized primarily by the individual's inability to address particular situations using customary problem-solving methods, and by the potential for a radically positive or negative outcome. Crisis means both danger and opportunity" (Zepeda Herrera, 2000).

2.2 Stay calm

Assume you are being asked to suddenly teach your course online. This may generate many concerns and lead to many questions. Our advice is to take a deep breath and stay calm. There are two steps to take first, which we will discuss below. Depending on your present situation and knowledge of instructional methods, your path forward may look very different from others' way forward. As the instructor, it will be up to you to determine the resources you have to bring to bear on this task, the priorities of the challenges, and of course, the time frame to attain the desired level of results.

Ask yourself these questions:

- What must I do?
- How much time do I have to do it?
- What is the outcome I want to see?
- What is the minimum level of quality I can accept?
- Who can help me?
- What resources do I already have that can assist me?

2.3 Understand your situation

Let's start with the two areas you can reflect upon and research, "Instructional style" and "Priority/needs assessment". This will help you better understand your current choices and preferences. Finding videos on YouTube or repurposing things you already use may be quick and easy or take hours to redesign and install online. On the other hand, recording your own videos or live streaming a lecture may be easy or take even more time to set up and debug technical issues. There is no one right answer for everyone but everyone has many good answers and effective options to make this work.

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2.3.1 Instructional style

First is the style of the online course you want to develop. Novice instructors often just try to translate the face-to-face experience and emulate that in a virtual world. This may not be the best idea for several different reasons. First, when running an online course, the instructor often has to perform technical support during live streams. Second, many students do not pay full attention during a class lecture or miss class entirely while lost in the sea of faces. In a peer to peer online streaming course, this becomes a different interaction. Also, managing questions and group interactions can be addressed in a variety of ways.

Many skill-driven practical courses don't translate well online and we won´t discuss them here. For example, a lab dissection course or automotive repair class, etc. Some components of these courses can be handled online but the practical/skill section presents additional challenges that will require specific accommodations.
Let us review the full range of possible online interactions from teacher-led to student-directed.

2.3.2 Modes of online interaction

1. Direct instruction (lecture delivery)
In this mode, the teacher pushes content to the group as with a standard lecture style. In the extreme, there is no contact with students, nor are there staged questions whether directly from students or channeled through a third party. Online this can be done by posting videos or hosting a streaming talk like a webinar.

2. Virtual classroom lecture + Q&A
This mode attempts to emulate the classroom and may include preset places where students can ask questions or the instructor prompts responses from students.

3. Concierge learning (instruction with individual tutoring)
This mode presents lessons to groups and sets out tasks followed by tutoring interactions either by the instructor or assistants. This can be the lecture + recitation model or a tutoring model for specific subjects and topics.

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4. Bloom's 2 sigma (Apprentice and Master)
This mode was presented by Benjamin Bloom (1984) and highlighted the effective practice of a master teacher interacting with a set of apprentices, sometimes at different levels, to design individualized adjustments to a task, and to move the apprentices along the expert track toward their own mastery of a set of skills and practices.

5. Group interaction facilitation
This “mode” seeks to have the group work together in smaller cohorts to collaborate on tasks. Often short lectures are followed by facilitation of interaction and learning.

6. Connectives (content-driven instruction)
This mode gives the learner a collection of materials and topics that are interrelated and allows them to find a way forward for themselves. Milestones and assessments are used for formative feedback and grading. This mode typically requires more up-front work to organize and produce the content with specified task paths and choices of materials to select in lessons.

7. Virtual independent study (goals and support)
This mode allows learners to follow their own paths and parallels inquiry or project-based learning. The degree of freedom often depends on the topic/challenge provided and the number and diversity of learners.

At the same time, it is a good idea to figure out what resources you have available. Also, think about your own preferences for the style of teaching, tools you are familiar with and how readily you adopt new methods and tools. These two factors, resources and preferences, work together to help you set priorities for building and executing your course.

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2.4 Identifying and prioritizing your tasks

Many educators have a curriculum map that explains how everything fits together with units and lesson plans. However, online courses utilizing a modular design move into even smaller components, modules and or learning objects. Being able to visualize and identify options is a key next step. There are many tasks that confront you when planning and developing an online course or instructional materials. Creating a list of tasks and sorting them into categories will help you to understand the challenges you face and roles you may need to adopt. At the same time, some tasks may be time sensitive, require obtaining technology, or require authorization and so require attention to them first.

Graphic Organizers

Complex systems present difficult challenges when working to understand them. You can examine these systems more easily by identifying generalized categories. As elements change, the dynamic system presents different challenges based on the perspective of the examination. Using graphic organizers as a visual tool aids in understanding the relationships present in the system. These include an outline, tables, graphics, graphic organizers, mind maps, concept maps, etc. These tools provide a picture of the elements, their relationships, interactions, and possible actions within the system. In general, a graphic organizer is any means of visually representing data and their relationships. This can be as simple as a bulleted list or table and as complex as weather maps or data dashboards.

Visual Organizers

A simple graphic organizer serves as the basis for a number of discussions. The figure below shows three elements that exist within a system and have some connection or interaction. Without context, the diagram lacks useful information. Adding the context and meaningful labels provides a step towards a clearer discussion of the system.

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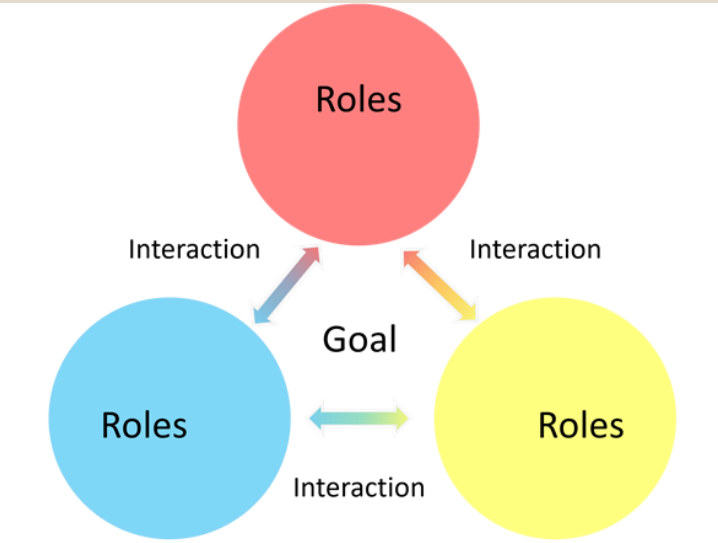
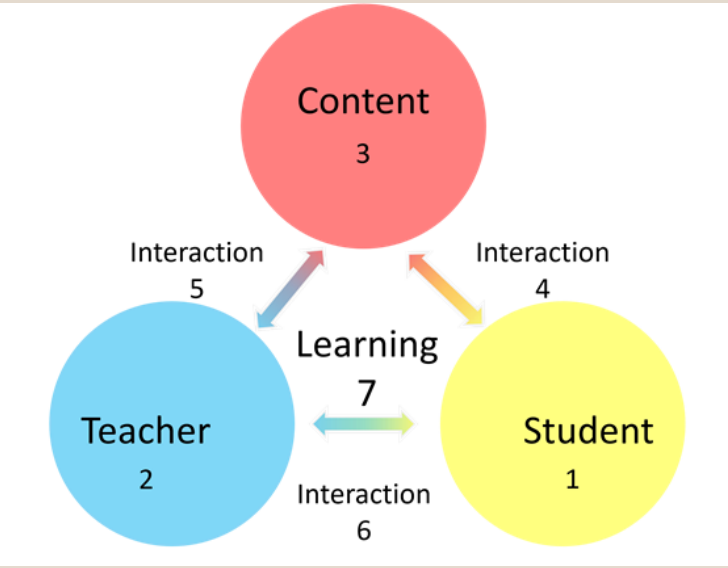


The Example of Learning

Education presents a complex system that we now examine as an example of visual organization. In the context of education, the goal becomes “learning” (7). Then the roles become “student” (1), “teacher” (2), and “content” (3).



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The Interactions:

Interaction (4): Students (1) interface directly with the content (3). This occurs through specific instructional material and other outside sources such as media, movies, and the web.

Interaction (5): Teachers (2) interface with the content (3) as part of their formal education, as they prepare lessons, and in continuing professional development. Also, they interact with the content (3) in other informal ways through discussion with colleagues, readings, and information sources.

Interaction (6): Lastly, students (1) and teachers (2) interface at the point of instruction. This exchange occurs formally in the classroom during instruction. Also, this relationship develops in less formal ways while instruction unfolds over time.

This model assists in understanding some basic interactions in the context of education. However, it oversimplifies the educational system. As context and perspective change, so will the visualization needed to understand the situation (Lipuma & Leon, 2020).

2.5 Embrace your role

Having reviewed the series of conceptions of education, the next step will be to identify and embrace a role. This will provide a perspective and a range of actions as you select and describe the scope of work that is to be undertaken. In addition, this narrowed view will provide direction and a set of support systems and resources most institutions provide. Then, a clearer picture of the landscape of the situation and work to be done will come into focus.

2.5.1 Goals, Objectives, Outcomes, Purpose, and Success (GOOPS)

When considering the development of your online course there are some key terms to understand for yourself: goals, objectives, outcomes, purpose, and success (GOOPS). It is important to start by clearly defining each term and giving the relationship between them. The first two terms are often thought of together and may seem identical to many people. Goal is the overarching destination toward which an endeavor is directed. It is where you are trying to go or the end that you hope to reach. Next is the term objectives, which are

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the smaller sub-goals that are set and worked towards in order to help attain the overall goal. In turn, if the smaller tasks become the context being examined, then the objectives become the goal of those smaller projects that are intended to help achieve the main overall mission that was set by the individual or group. It is how you are going to get to your final destination or the steps and milestones along the path you are traveling. For some people, objectives are larger than goals and so goals become the steps along the path. Though either can work, for this text we will assume goals are larger aims than objectives.

The third term is outcomes, which are the results of an undertaking. If the goal is attained, the outcomes will be what has been produced or accomplished. The outcome is what happened when the task was attempted. Some people label goals and objectives as the planned outcome while the realized result as the shown or actual outcome.

Next is the idea of purpose, which is the reason behind the undertaking and the motivation for undertaking the task. It is why you are working towards the goal and the objectives. Creating the outcomes is often the purpose of an endeavor and thus the focus of the goals and by examining the outcomes it is possible to gain insight into the purpose of the process being examined.

Finally, we have the idea of success, which is one of the most difficult terms to agree upon. Generally, success is the agreed upon measure of judging a result usually as a positive end to an undertaking. The reason it is so difficult is that how it is interpreted and measured can be different for each person. Just looking at our simple case, if you attain a goal, that might be success. However, what if you do not attain the goal but do attain the objectives? That might be considered success. For others, as long as an outcome was produced, there was success. Each situation may dictate different measures of how to judge results. Making this even more complex, goals and objectives may not be chosen correctly and outcomes

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not observed but the purpose still attained. In that case, the result may be successful. Nonetheless, for educational situations, the more aligned these elements are, the more easily the instructional design can be put into effect and adjusted. Without any structure or means of understanding desired aspects of a process, the more difficult it is to make course corrections or find alternative paths

2.5.2 Examples of GOOPS for education

The following links provide examples of GOOPS in educational contexts:

- What are learning objectives?

http://batchwood.herts.sch.uk/files/Learning-Objectives.pdf

- How can we align learning objectives, instructional strategies, and assessments?

https://educationaltechnology.net/how-can-we-align-learning-objectives-instructional-strategies-and-assessments/

- Goals, objectives, and learning outcomes.

https://www.youtube.com/watch?v=g_Xm5IljYKQ&t=59s

- What are essential questions? Explained by experts.

https://www.chalk.com/resources/essential-questions/

Chapter 3

Gather resources and plan

This section will help you leverage your resources to make attainable your desired outcome in the given time.

3.1 Critically think through and understand your situation

Curriculum and instructional design (CID) outline what is to be learned by students and the aligned methods that may be used to assist them to learn effectively. It is an iterative, incremental process that needs to be tailored to particular situations for a specific set of learners, who are desired to reach a shared goal, having attained some set of outcomes. Often aspects of your work on the curriculum—plan for the class or activities—is dictated by your organization or aided by the instructional design experts working on this with you. Only you can determine the limits and constraints on the scope of your work.

Earlier we discussed your own GOOPS—Goals, Objectives, Outcomes, Purpose, and Success—that helps you to outline the needs and desires for the scope of the learning to be facilitated. As you consider the CID, you should consider aspects of the intended learning being delivered tied to the Goals, Expectations, Target learners, Situation (GETS) that guides you in developing your instructional design. GETS will assist you to implement the GOOPS by aligning your materials to the specific learning circumstances.

These articles, written by Dr. James Lipuma and Cristo Leon, provide an overview of Curriculum and Instructional design (CID).

- Planning for Institutions and Educational Systems.

Lipuma, J., & Leon, C. (2020, April 30). Curriculum Instructional Design: Planning for Institutions and Educational Systems [Blog]. James Lipuma´s Blog. https://www.jameslipuma.com/curriculum-and-instructional-design-planning-for-institutions-and-educational-systems/

- Interacting Impacts.

Lipuma, J., & Leon, C. (2020, May 18). Curriculum Instructional Design: Interacting Impacts. James Lipuma's Blog. https://www.jameslipuma.com/curriculum-instructional-design-interacting-impacts/

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- The Interface.

Lipuma, J., & Leon, C. (2020, April 30). Curriculum Instructional Design: The Interface. James Lipuma´s Blog. https://www.jameslipuma.com/curriculum-and-instructional-design-the-interface/

- Scope of Work.

Lipuma, J., & Leon, C. (2020, May 4). Curriculum Instructional Design: Scope of Work. James Lipuma´s Blog. https://www.jameslipuma.com/curriculum-instructional-design-scope-of-work/

- PIERS Planning Process.

Lipuma, J., & Leon, C. (2020, May 6). Curriculum Instructional Design: PIERS Planning Process. James Lipuma´s Blog. https://www.jameslipuma.com/curriculum-instructional-design-piers-planning-process/

3.2 Constructive alignment

"Your course does not exist in a vacuum."

The course and its learning activities do not exist in isolation. Typically, most courses fit into a sequence and rely upon some established sets of norms. Within the course, there is a particular sequence of activities that are structured to move the student along a given path. Each one of those activities has specific elements that are constructively aligned to achieve objectives for a given purpose. As you gather the specific pieces into larger and larger structures, having a cohesive understanding of how they all fit together is important. In that way, your goals and outcomes, with the mechanisms used to accomplish them, can work together and be measured by your metrics of success. Before proceeding onto instructional design, it is worthwhile to learn about some larger concepts that provide context and relationships.

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The following blogposts provide an overview of this:

- Curriculum Instructional Design: Critical Learning Path and Constructive Alignment

Lipuma, J., & Leon, C. (2020, April 30). Curriculum Instructional Design: Critical Learning Path and Constructive Alignment [Blog]. James Lipuma´s Blog. https://www.jameslipuma.com/curriculum-and-instructional-design-critical-learning-path-and-constructive-alignment/

- Curriculum Instructional Design: Pedagogical Content Knowledge

Lipuma, J., & Leon, C. (2020, April 27). Curriculum Instructional Design: Pedagogical Content Knowledge [Blog]. James Lipuma´s Blog. https://www.jameslipuma.com/curriculum-and-instructional-design-pedagogical-content-knowledge/

- Curriculum Instructional Design: Importance of Critical Reflection

Lipuma, J., & Leon, C. (2020, May 21). Curriculum Instructional Design: Importance of Critical Reflection. James Lipuma´s Blog. https://www.jameslipuma.com/curriculum-instructional-design-importance-of-critical-reflection/

We have now moved into the purview of instructional design. For additional information please visit the following videos:

- What is instructional design?

https://www.youtube.com/watch?v=w0iQgStGND4&t=35s

- Instructional design overview

https://www.youtube.com/watch?v=4ayIoU0Bwxk

When considering online/remote modes of instruction a modular approach is typically used. Learning objects are used to accomplish this by creating small standalone digital assets that are able to be reused, transferred and duplicated, and shared as needed.

Chapter 4

Creating learning objects

4.1 Learning objects

As discussed in the articles provided in Chapter 3, instructional design is at the level of the educator interfacing with the learner to deliver the content effectively. As this happens in the course for each subject, there is a natural breakdown for the flow and order of what is to be taught and how that instruction will occur. There are many ways to plan and many methods of instruction. Each of these have means of formative and summative assessment. These topics are too large and complex to be discussed here. However, especially for online instruction, the use of learning objects allows for a more effective modular design and enhanced learning.

If the unit of study is large and overarching aspects of the subject, then the lessons are the smaller sections within that. Within a lesson would then sit a collection of learning objects which are even smaller self-consistent groupings of learning that fit together so that the content, methods of instruction, and assessments work together for the content, situation, and timing of that instructional piece.

4.2 Elements of learning objects

Learning objects are built up from four basic elements. Not every learning object has all of these but the pieces of the design usually falls into one of these categories:

Knowledge objects: the direct or explicit instructional items produced to convey content, define terms, provide demonstrations, situate content, extend learning, etc.

Activity: Learner centered actions to be taken to illustrate learning, build understanding, practice and extend lesson content, involve others in social learning aspects, etc.

Assessment & evaluation: Formative and summative actions designed to provide feedback for the instructor about the state and progress of students as well as effectiveness of learning materials. Note: there are many terms used in this arena. Assessments are measures of learners, while evaluation concerns measure of the program and materials.

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For assessments, typically there are diagnostic tools used to gain a picture of the learner at some fixed point usually prior to instruction. Formative assessment is the ongoing data gathering and feedback to adjust learning practice and differentiate instruction. Summative assessments are meant to yield a report at a point about attainment against metrics or progress indicators. No distinction is made especially about the type of tool used since the application of an assessment and how the results are processed and used in instruction can make it either of these types.

Learning situation: the above listed 3 elements come together to create learning objects in particular situations. This is especially true for online and remote instruction where a learning management system like Google classroom, Canvas, or Blackboard, plays a large role in how the learner interacts with all aspects of the learning.

Links to resources concerning instruction:

- What is Explicit Instruction?
https://www.understood.org/articles/en/what-is-explicit-instruction
- Explicit vs. Direct Instruction
https://www.therecoveringtraditionalist.com/explicit-instruction-versus-direct-instruction/
- Five Phases for Instruction
https://education.ky.gov/school/stratclsgap/instruction/Documents/Direct%20Explicit%20Instruction%20Model.pdf
- Types of Assessments
https://www.queensu.ca/teachingandlearning/modules/assessments/09_s2_01_intro_section.html
- Effective STEM Methods of instructi
https://www.futurelearn.com/info/blog/effectively-teach-stem-subjects

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- Assessment A Primer: Diagnostic, Formative, & Summative Assessment http://www.ewcupdate.com/userfiles/assessmentnetwork_net/file/A%20Primer_%20Diagnostic,%20Formative,%20&%20Summative%20Assessment.pdf

4.3 How video is used

The use of video to create and save your direct instruction is a revolutionary part of online instruction. How video is used is also important. Good practices in curriculum and instructional design emphasize constructive alignment. This idea, first published by Biggs, (Biggs, 1996). states that the tasks laid out must be aligned to standards or the goals of instruction. In turn, resources and instructional practices must connect to these goals as student learning objectives, as well as specified and used to plan and implement learning activities. Finally, all of this must be aligned with formative and summative assessments to reinforce the interconnections. This 'constructive' alignment, like the constructive interference of waves, allows the curriculum and instruction to build upon one another, allowing students to gain far more from the educational experience, and allowing educators to have a clear path to plan, teach, and assess, as well as differentiate and support all learners. In a synergistic way, video can be used at all stages of the educational process. In addition, educators must have continuing professional development which can be aided by the use of video. Educators are able to gain a greater depth and breadth of content knowledge while seeing alternatives and engaging with their professional learning communities both in the school and in their respective disciplines.

Videos play a vital part in the enhancement of education. They can explain content in a wide variety of ways for different learning styles and be accessed at any time and in any place with an ability to stream or play digital media. Video allows students to review content as many times as needed, stop to take notes, or see material for the first time if they missed class. Video allows educators access to demonstrations and explanations that might not be available otherwise due to limits on time, resources, access, or even safety issues.

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Finally, video gives educators a way to capture student work to be assessed in a formative and summative way. This can be both as formal presentations of work and explanations of knowledge as well as making possible an authentic view of project completion. Extending this assessment tool, video as a summative assessment allows for a creative outlet for students and provides an alternate avenue of expression that can increase interest and persistence on task. Rather than being asked to listen to a lecture, go home and read a book, and then return to take a written exam, students can stream video to learn basic principles, be shown the content in action, see real world examples and applications, and then produce some final project that demonstrates they have mastered the knowledge and can apply it in a practical way.

Moreover, these ways of using videos allow teachers to both expand the classroom outside of the direct contact hours through blended learning as well as to maximize the effort and cross-cutting skills and learning that goes on in the class as students work with technology as a means of learning, and demonstrating mastery, and not for the sake of just using technology.

4.4 Types of video uses

In this new world of digital learning, the old videotape and long clips of materials have been replaced with short videos posted on YouTube. As digital cameras have become ubiquitous and the cost of memory has become a nonissue, video recording and sharing has become omnipresent. However, in the realm of education, there are still some challenges to overcome. Though so much more material is available, much of it is poorly done, inaccurate or incomplete. Moreover, though student tolerance of poor quality has grown, the length of time students will watch and concentrate on a video has shrunk, especially among adult learners. The key is for the content to be meaningful and the delivery efficient and engaging in some way.

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Video has many different uses and is often presented in several different ways. Most videos used in education can be separated into categories based on the production value, style of presenter, and what is shown.

1. Video with soundtrack but no audio content
2. Lecture capture
3. Voice-over- Slide Deck, Screen capture
4. Animation with audio or voice over
5. Newscasters' intercuts with on location reporters
6. Staged Reality
7. Authentic capture—candid camera

Though it would be wonderful to have a studio and a budget to produce videos for education, that is not always feasible or even possible. Consumer technology has made it possible to do much of the same things commercial groups do and allow, with some planning, knowledge, and practice, to produce a good quality finished product.

1. Video with soundtrack but no audio content
In this type of video, the viewer is expected to read information or absorb the message from images presented, often with an audio track playing music or ambient sound behind it. This can range from a simple PowerPoint transformed into a Flash video to a moving slideshow of images and video with poignant text or labels often with shocking cuts or controversial scenes.

2. Lecture capture
This is typically a single person presenting content to the camera or in front of a live audience. These can be short introductory talking-head style videos or much longer monologues or delivered direct instruction. Some excellent speakers use this in a highly effective way as shown in some of the most viewed TED talks on YouTube. However, many more times, these are little more than a camera placed in the corner of a lecture hall with poor audio quality and bad lighting that go on for an hour or more.

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3. Voice-over-Slide Deck, Screen capture
In this style of video, a program is used to capture whatever is displayed on a computer screen and any accompanying audio that is laid in with it. Often, the capture is just of a slide presentation while the presented content is spoken aloud. Many webinars are captured in this way and include a live window-boxed image of the presenter. This style of video is also used for tutorials and walk-throughs of programs and other materials. Though with some preplanning, this type of video can be highly effective and allow for high audio and visual quality, it can also lead to a presenter just taking a poor slide deck and recording what is written out on the screen and reading it with no value added or concern for the viewers' perspective and needs concerning recorded presentations.

4. Animation with audio or voice over
This is similar to the voice over slide deck but marries an audio track with animation or planned slideshow to attain a movie short style presentation. This type of video often uses specialized programs or needs post-production editing of the pieces to make an effective end product.

5. Newscasters' intercuts with real world or planned content
As the sophistication of the production increases, it is possible to merge some of the basic forms above and create a viewing experience that provides multiple voices and types of shots and locations in a single finished video. Though it is possible for this to be done in a single take, pre-production, planning, scripting, talent management and post-production editing greatly improve the quality of finished products

6. Staged Reality
In this type of video, the interactions and the players are prepared prior to shooting and the area staged to optimize content capture. This can range from complete scripting and production to something much less controlled in which a situation is outlined, the players given a prompt and the resulting conversations filmed. Often, in the less scripted environment, longer runs of video are shot and then cut and edited to produce the desired finished product. Here a narrator or outside voice can be used to provide context, ask the leading questions for viewer knowledge, or drive home points that are to be made.

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7. Authentic capture—candid camera
This is authentic since the video simply gives an accurate account of what transpired. Many times, this is used to capture a demonstration, lesson, project, interaction, or activity. It is like a lecture capture but often without any scripting or pre planning since it is meant to provide a view of the real world unfolding of a situation or interaction.

There may be a number of presenters when using video. For example, a lecture can be expanded to a panel while a staged reality can be a single person simulating a conversation or a group in a roundtable. In either case, the style of video is similar, only the specific elements are adjusted. In all cases, these categories are not meant to be distinct, but characterize major distinctions in style and elements.

4.5 Concluding Remarks
All of the ideas discussed in this document come together as educators collaborate to share best practices and high-quality video content and demonstrations. Our STEM for Success role models at NJIT have created many videos posted on our YouTube channel along with activity plans, all of which are available at www.STEMforSuccessorg. We hope that this guide provides a useful, basic introduction and support for STEM teaching and learning as online instruction and engagement becomes universal. The remainder of the guide shares the resources generated and gathered during the focus groups and interactions with our many collaborators and partners. We hope these will help you foster STEM experiences for all.

Chapter 5

Tools, resources, and next steps

5.1 List of resources for virtual education

The following is a list of resources for virtual education and STEM evaluation collected from our discussions with participants of the Howmet Aerospace grant.

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- Padlet. (2021). *Padlet: You are beautiful*. Padlet. https://padlet.com/
- Poll Everywhere. (2021). *Poll Everywhere: Host interactive online meetings*. Poll Everywhere. https://www.polleverywhere.com
- Quizizz. (2021). Quizizz: The world's most engaging learning platform. https://quizizz.com/
- Quizlet. (2021). Quizlet. Quizlet. https://quizlet.com/en-gb
- STEMscopes. (2021). STEMscopes. https://www.stemscopes.com/
- TED-Ed. (2021). Bring TED-Ed Student Talks to Your School. TED-Ed. https://ed.ted.com/educator
- UCB. (2021). PhET Interactive Simulations | University of Colorado Boulder. PhET. https://phet.colorado.edu/
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5.2 Blog posts and articles

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- Birmingham Zoo. (2019, August 28). Virtual Classroom Resources. https://www.birminghamzoo.com/education/teachers-resources/classroom-field-trip-resources/
- Hudek, R. (2021). Google Meet Breakout Rooms by Robert Hudek (0.0.17.4) [Google drive]. https://chrome.google.com/webstore/detail/google-meet-breakout-room/kogfdlbehkaeoafmgaecphlnhohpabig/related?hl=en

5.3 STEM evaluation tools & instruments

- Activation Lab Tools: Measures and Data Collection Instruments / Website (University of California, 2021)
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- ATIS. (2020). Assessment Tools in Informal STEM (ATIS). http://www.pearweb.org/atis/tools/browse?assessment=true
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Authors

Author introductions and brief biographies

Dr. James Lipuma is a faculty member in the Humanities and Social Sciences Department at NJIT and director of the Collaborative for Leadership Education, and Assessment Research (CLEAR).

About:
Legally blind since nine, Dr. Lipuma appreciates the need for positive change and works to promote broader participation for women and underrepresented minorities in Science, Technology, Engineering, and Mathematics (STEM) as part of STEMforsuccess.org and other STEM Literacy projects he leads.

Professional experience:
In his role as director, Dr. Lipuma has completed curriculum development, assessment design, program evaluation, and program design and development projects for public schools, universities, the NJ Department of Education, US Department of Education, and the National Science Foundation. He has also taught more than 5,000 students in more than 200 courses in his 25 years at NJIT. He has completed work on nearly $6M worth of grants including over $2.5M as lead PI or CoPI as well as received over $250K worth of donations.

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Cristo Leon, MBA. Director of Research, College of Science and Liberal Arts at New Jersey Institute of Technology.

About:
Cristo received his naturalization as a U.S. citizen in 2016, a process that made him aware of the need to promote broader impacts, participation, and inclusion of under-represented minorities.
His Latin American roots and professional development had taught him the importance of corporate social responsibility, innovation, and collaboration. He has focused his efforts on promoting the benefits of these topics for organizations and society at large.

Professional experience:
In his role as director of research, Cristo manages the logistics of research programs as well as pre and post-award actions for +86 active grants, overseeing the submission process of over 150 proposals per year, serving as a liaison with the Office of Research, the College Dean, 6 departments and over 100 PIs.
Cristo's experiences have included over 10 years in directive positions, managing logistics, facilitating organizational development training, designing business innovation plans, and implementing innovation projects for organizations including NJIT, Northern Ocean Habitat for Humanity, Ocean County College, Monterrey Institute of Technology & Higher Education, and the University of Veracruz. Cristo also develops and facilitates courses for the Monterrey Institute of Technology & Higher Education "ITESM" in Latin America for C-Level executives of corporations including; KPMG, Chedraui Inc., Coca-Cola Femsa, PEMEX, Continental, Adelca, SemMaterials, and Adecco among others.
Most recently, Cristo served as the Interim Associate Director of e-Learning for OCC, Managing logistics of over 600 online courses, while improving Web Content Management and Digital Asset Management processes. In addition, Cristo was the Resident Director for the International Studies Abroad office in Xalapa, México. He was responsible for coordinating intercultural immersion programs for international students.

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Dr. Bruce Bukiet is Professor of Mathematical Sciences and Associate Dean of the College of Science and Liberal Arts at New Jersey Institute of Technology (NJIT).

About:
Bruce earned his PhD in Mathematical Sciences from NYU performing research in the area of Detonation Theory. After working in the Applied and Theoretical Detonation group at Los Alamos National Laboratory in New Mexico, he moved to New Jersey Institute of Technology. Throughout his career he has worked to apply mathematical modeling to real world topics (mostly related to baseball, biology, bombs and bugs) and to promote math appreciation and awareness.

Professional experience:
In recent years, Bruce has concentrated his efforts on STEM education, serving as PI on NSF sponsored and other projects. TECHS-NJ a project funded through the Robert Noyce Scholarship program worked to train STEM teachers for high need districts. C2PRISM, an NSF-GK12 project, brought a diverse group of NJIT PhD STEM students into local high schools to infuse computation and serve as role models. LiFE, a project under the NSF INCLUDES umbrella, worked to support elementary school STEM clubs for girls to increase the persistence of girls' interest in STEM. The LiFE project has transitioned into the STEM for Success initiative that works to broaden participation in STEM among K-12 students, especially those in traditionally underrepresented groups, by fostering collaborative change. Prof. Bukiet has earned several teaching awards at NJIT and from the Mathematical Association of America, is a Master Teacher and has served as chair of the Excellence in Teaching Committee. He also has served in recruitment, advisement and in numerous other service capacities over his three decades at NJIT.