STEM School Teacher Guide
for e-STEM and other online Learning Resources

Table of Content

Chapter 1: Introduction

The Purpose of this Teacher's Guide

The Teacher Guide has been developed to support teachers' use of digital learning resources.
The guide specifically focuses on the Egyptian MOETE online learning platform, e-STEM, and other recommended online, open resources such as LabXchange, Khan Academy, Quill, and ReadWorks.
The target audience of this guide is both English and STEM teachers. We envision the guide supporting teachers with varying experience, knowledge, and skill levels to work better with their students in blended and distance instruction and tools.

How to Use the Guide

When planning their own lessons, teachers should consult this guide, the instructional videos, and the included sample lesson plans for support integrating online learning platforms into their instruction. Beyond outlining e-STEM and other online learning tools, this guide explains approaches to assessment, blended learning and differentiated instruction so that teachers will have strategies for and gain comfort using digital learning resources in their classroom routines.

To benefit most from the guide, you should consider:
- Taking time to become familiar with e-STEM and other online tools/platforms. Allow time prior to the lesson (at least 15-20 minutes) for you and your students to become familiar with the tool before assigning any tasks.
- Seeking out support from colleagues that have gone through e-STEM and online learning training
- Making gradual changes as you learn to integrate online learning tools into your teaching practices.
- Making time to reflect on the effectiveness of integrated lessons after they are taught. Ask yourself, "What went well? What could be improved upon for the next lesson? How can I build upon this further?"
- Visiting teaching resources and videos referenced throughout the guide for further support and professional development.

Instructional videos

The STESSA project has developed a set of instructional videos to go along with this guide that explains the main aspects of the guide and provides illustrative examples. An overview of the videos can be found in the table on the next page.

Nr	Title
1	Digital Learning
2	How to start integrating online tools?
3	Assessments
4	Kahoot
5	EdPuzzle
6	Quizlet
7	Recommended Online learning tools
8	LabXchange
9	Khan Academy
10	Quill
11	ReadWorks (consists of 4 short videos)

The videos show how teachers can apply the pedagogy and tools described in this manual in their daily teaching. Find the videos on YouTube via this link or search for 'STESSA Online learning Egypt'.

Chapter 2: How is Online and Digital Learning Delivered?

Definitions

Across educational spaces there are many words that are used to discuss different ways that instruction is organized. Many of these words can be confusing because they are used interchangeably and sometimes mean different things in different teaching and learning contexts. In the sections that follow, concepts such as *Distance*, *Blended*, *Hybrid*, and *Supplemental* Modes of Learning are defined for the purpose of developing a shared understanding about delivery methods for digital and online learning.

Distance Education (DE)—Distance education is defined as formal learning activities where students and instructors are separated by geography, time, or both for the majority of the instructional period. Distance learning materials are delivered through a variety of media including print, audio recording, videotape, broadcasts, computer software, web-based programs and other online technology. Teachers support distance learners through communication via mail, telephone, e-mail or online technologies and software.
There are also approaches that integrate a mix of instructional modes. Murphy et al. (2017) provide definitions for these approaches based on a study of digital learning.

Remote Face-to-Face Instruction is delivered to students on the internet in real time when students and their teachers are online together. Zoom, Google Hangouts, or Skype can be used to provide real time, virtual interaction using video conferencing. Whole groups of students might choose to meet with a teacher at the same time, and if the conferencing tools allow it, might even break out into small groups during the course of the online class time interacting through video, chat, and file sharing.

Blended Models are a combination of classroom based and online instruction and student practice. Teachers may plan for classroom teaching as well as online instruction. Responsive teachers make adjustments to their face-to-face teaching based on their monitoring of student work online. Likewise, teachers alter online assignments based on what they observe during class. s Another key characteristic of blended learning is that it allows learners to control time, place/space, and pace of their learning. Using this approach, practitioners carefully design and sequence instruction to incorporate multiple options for learners' engagement by supporting students working independently with content, discussing the materials with each other, and interacting with the instructor.

Hybrid models employ the use of an online curriculum together with in-class teaching. Although the teacher reviews students' work, how they perform on their assignments may not be aligned to what happens in the classroom.

Supplemental models of instruction make use of online curricula outside of regular class meeting times, but are not required and may not even be reviewed by the teacher. This supplemental work may be somewhat aligned to the goals of a course and/or may provide extra practice or extensions to the content. In either case, the activities are completed by students without outside meetings occurring with a teacher.

Asynchronous is a word used to describe learning that happens outside of class meetings or online instruction time. **Anytime learning** is another term often used when describing asynchronous activities because learners can flexibly complete their assigned work at a time that is convenient for them.

Synchronous is a term used when learners and the teacher meet at the same time to engage in teaching and learning activities. **Real time learning** is another expression that is often used when describing synchronous activities because learners and the teachers must all synchronize their online time to meet online for discussions and other learning interactions.

The vocabulary used to describe online and digital learning is evolving as digital tools and the digital landscape in education are evolving. The many ways to deliver instruction and these descriptors are defined to provide common ground for using this Teacher's Guide.

The Triple E Framework

The Triple E framework is a model that illustrates how use of educational technology impacts learning.

Triple E Framework shows how online and digital learning makes use of many different platforms, apps, resources, or online tools, and other technology that can (a) **Engage** learning, (b) **Enhance** learning, and (c) **Extend** learning[1]. Engage is defined as "students participating in active social learning activities focused on learning goals"[2]; enhance is defined as "students learning through technology-rich activities, where technology makes learning possible in new ways"[3]; and extend is defined as "students experiencing a natural connection between school and everyday life

Triple E framework

Enhance

Instructional Strategies

Engage   Extend
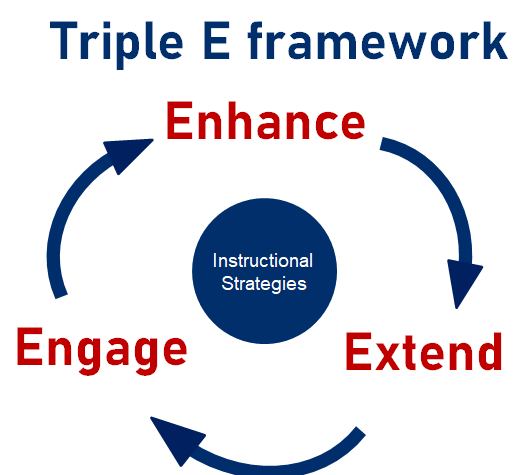
© University of Michigan

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[1] "Triple E Framework," Triple E Framework, accessed July 22, 2020. Retrieved from https://www.tripleeframework.com/.

[2] Gaer, Susan. (2019). "The Triple E Framework for More Effective Technology Integration in Adult Education,"accessed April 19, 2022. Retrieved from https://edtech.worlded.org/the-triple-e-framework-for-more-effective-technology-integration-in-adult-education/

[3] Ibid.

through technology use"[4]. There are some digital learning tools that offer *offline* functionality, and so utilizing digital learning tools does not necessarily require a strong internet connection. Although there are hundreds of online and digital learning tools available, it is important for the curriculum and pedagogy to drive the technology choice.

The Online Teaching and Learning Environment

Online teaching and learning has become an important part of the teacher and student experience outside of the classroom, however teachers must bear special considerations in mind when integrating the virtual environment with face to face learning.

During **asynchronous delivery** of many online courses, students will work at a different pace than the instructor and other students. As a result, giving and receiving timely feedback is important. Students' progress depends on how well they understand the instructors' expectations and evaluation of their responses supports concept development and may enhance learning motivation and engagement with the material.

When using digital resources, a teacher should pay close attention to:
- Evidence of students' learning;
- Evidence of students' areas of struggle;
- Evidence of students' understanding.

Students have ultimate control over their time and attention, therefore teachers should consider:
- How he/she can help students stay engaged with their learning;
- How he/she helps students become successful thinkers and learners.

Teachers must also be aware of students' progress and differentiate to meet their needs. Online students:
- Come from various academic levels;
- Come from a variety of backgrounds and have various life experiences;
- Have various levels of technological ability, and their access to technology and the internet vary[5].

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[4] *Ibid.*
[5] *"Teacher Guide to Online Learning | Michigan Virtual," accessed July 22, 2020, Retrieved from https://michiganvirtual.org/resources/guides/teacher-guide/.*

Chapter 3: What is e-STEM and How Does it Work?

The purpose of e-STEM

To support English learning for STEM school students, the Egyptian MOETE through the assistance of USAID and   its implementing partners developed an online learning platform named e-STEM (English for STEM education). The platform, currently hosted on the MOETE server, has distinct modules for grade 10 and grade 11 separated into the following categories: Core units (STEM content), Grammar, Writing and Skill Building (study skills). Some e-STEM modules were integrated into the STEM English and Leadership Summer Camp curriculum, which is presented to 10th graders during their two-week orientation into the STEM program. STEM school English teachers attend an annual professional development that coincides with summer camp preparations. Teachers are encouraged to integrate e-STEM in class and likewise encourage students to access e-STEM independently outside of class to advance their English learning. The following section builds off of the initial summer camp teacher training, further explaining how English and STEM content teachers can utilize e-STEM to support their students' academic English.

The structure of e-STEM modules

e-STEM is currently designed for **Grade 10** and **Grade 11** students.

Grade 10 consists of Core Units, Grammar, Writing and Skill Builder.

- ★ Core Units contain six components: pre-activity activation, reading, listening, synthesizing knowledge, unit review, and vocabulary.
- ★ All Core Units reference a science or English learning objective
- ★ Grammar contains four components: warm-up quiz, lesson and practice quiz 1, practice quiz 2 and a post-test.
- ★ Writing contains three components: warm-up quiz, lesson and practice quiz 1,and a post-test.
- ★ Skill Builder contains three to four components (depending on the module): warm-up quiz, lesson and practice quiz 1, quiz 2 and a post-test.

Grade 11 consists of Core Units and Grammar.

- ★ Core Units contain six components: pre-activity activation, reading, listening, synthesizing knowledge, unit review, and vocabulary.
- ★ Grammar contains three components: warm-up quiz, lesson and practice quiz, and post-test.

How teachers can use e-STEM

Independent Learning

The e-STEM platform can be an engaging platform for students to explore independently and build their background knowledge. The video resources can be viewed independently to engage interest, build curiosity and pose questions. Independent learning is encouraged as an opportunity to make connections to learners' lives, experiences, and backgrounds. Repeated viewings can support vocabulary acquisition and deep interest. When independent learning is the aim, the learning outcomes can be centered on developing a list of interesting words, questions, or bullet points. The resources can also be revisited in greater depth for meeting learning aims.

Assessing Learning

Teachers can assign e-STEM modules or individual lessons for students to complete independently. In any case, a student could use e-STEM as a key resource for self-directed learning, or to reinforce content that the teacher had taught or preview content the teacher is about to introduce.

Since the e-STEM platform does not record student progress or mastery of concepts, teachers must plan on checking-in on students' independent use of e-STEM. In the past, teachers have asked students to take screenshots of their completion of the activity or unit assigned to them.

If teachers want to use e-STEM as an assessment tool, they should choose an assessment option prior to assigning e-STEM units to students. Assessments can verify student comprehension and mastery of concepts using the online content. By having this data, teachers can more easily follow up with students and prepare individual progress plans based on their learning needs. Below is a list of potential assessment options:

- *Student Self-Assessment.* Students can use e-STEM to introduce and preview content prior to learning it in class to be better prepared to work on collaborative activities and apply what was learned. In this approach, an e-STEM unit could be assigned as a means for students to self-assess themselves on the content and come to class ready to build on that knowledge and ask any questions they may have. At the beginning of class, teachers can ask students to verbally self-report their progress, which could be verified through a screen capture of their e-stem formative assessment.

- *Student Reflections*. Teachers could also ask students to reflect on what they learned from the e-STEM module and share that reflection as evidence of learning.

- In some of the writing units within e-STEM, students are asked to write a paragraph or short answers. These could also be shared with the teacher for evaluation.

Blended learning:
Blended learning, a mix of online and face-to-face learning activities, embraces and promotes the learner-centered model for learning English. Blended learning provides flexibility and convenience to both teacher and student, while delivering learning experiences that improve language skills and self- directed learning post-course[6].

In the STEM school program, there are many opportunities to blend classroom and online e-STEM instruction. In this case, instructors consider both in-class and online instruction as part of a collective whole, making adjustments to their face-to-face teaching based on what they see as they monitor student work online and altering online assignments based on what they observe in class. Through blended learning, teachers are able to intensify learning by differentiating instruction, providing differently leveled activities to suit the knowledge and skills of different learners[7].

For example, e-STEM can help support differentiated instruction within the classroom by setting up tiered groups stations to accommodate students' individual needs:

- (1) Some students could engage in interest-driven inquiry and explore e-STEM materials to build their background knowledge and explore new concepts and vocabulary to investigate new content on their own.
- (2) Another small group of students may need more reinforcement on a given concept and so the teacher could work with them closely.
- (3) At the same time, there may be a second group of students with a basic understanding who could reinforce their skills independently using an online e-STEM video or activity.
- (4) Finally, there may be a third group of students with a deeper understanding of a concept who are ready for a challenging extension of learning; this group could collaborate in a group activity. For example, they could investigate a simulation (such as free Phet simulations https://phet.colorado.edu/) that encourages them to investigate, hypothesize, test, and discuss concepts in English alongside the content they are learning.

Blended learning strategies for STEM and English Teachers

Using e-STEM for Reading Activities

Preparation before, during, and after reading is important for all students, but especially for language learners whose cognitive load is already heavy with respect to language. Scaffolding during all stages in the reading process can take even challenging texts and put them within the grasp of language learners.

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[6] Lamees Abbas, "Applying Blended Learning to English Communication Courses 101 and 102 at Bzu / Palestine : Case Study," (January 2015): 31–64, https://doi.org/10.12816/0016358.
[7] Vanek, "Setting the Stage for Distance and Blended Learning."

a. Before students read, teachers can preview the reading passage with them to make explicit connections between the text and the firsthand science experiences students have already engaged in, and even introduce the science concepts and cognates that are part of the text.

b. During reading, give students a "graphic organizer," a tool that allows language learners to focus on and capture the most relevant information and concepts. The graphic organizer should have a limited number of questions related to key concepts that students answer as they read.

c. Activities that students complete after reading provide additional opportunities to interact with the reading passage. One strategy for facilitating extended interactions with the text is to have small groups of students read the text, then retell and discuss what they have just read in their own words. This provides a chance to acknowledge students' understanding, help them solidify their understanding, and to identify any misunderstandings.

Using e-STEM for Writing Activities

The writing component of e-STEM provides students opportunities to engage with writing prompts that could encourage their development of writing mechanics as well as content.

For writing activities in e-STEM to be effective, it's vital for teachers to review students' completed writing assignments and provide detailed feedback. When reviewing student writing, teachers are encouraged to:
- Target specific issues from language learners' short compositions;
- Provide repeated feedback on errors;
- Include follow-up assignments that require students to address the selective error correction. Additional practice that follows from a teacher's feedback encourages learners and pinpoints target areas where writing can be improved.

Using e-STEM for Conversation Activities

To support students' conversation skills, teachers can utilize **Productive Conversation Moves[8]** to assist English Learners at all levels of English proficiency express their ideas within groups. This resource provides examples of how teachers can help students discuss and develop ideas. Sample prompts are given based on students' English proficiency levels to help students and teachers extend oral and written communication.

The Productive Conversation Moves help students practice seven types of responses:

1. Tell and support one's own idea
2. Ask for clarification
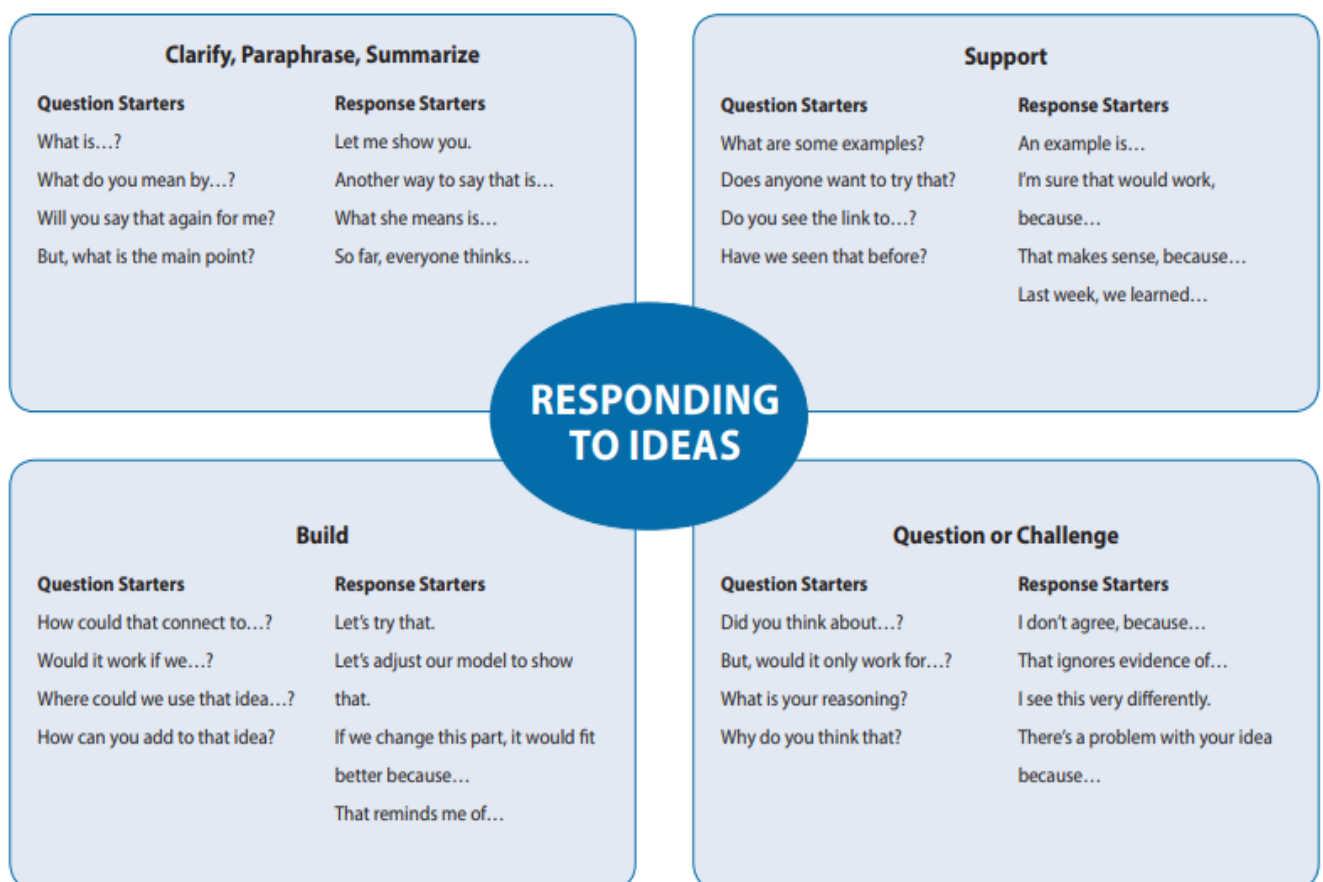3. Restate or paraphrase an idea
4. Summarize ideas

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[8] *Doing and Talking Math and Science: Resources," Accessed July 4/14/2022, http://stem4els.wceruw.org/*

5. Support someone's idea
6. Build on someone's idea
7. Challenge someone's idea

Teachers can also utilize **Conversation Support Cards** to help students model, explain and respond to questions posted in the group. The resource provides conversation prompts that are common for a variety of academic communicative functions. For example, if the purpose of a conversation is to respond to others' ideas and extend the dialogue, the prompts listed on the card can provide students with common phrases used in this type of discussion so that they can focus on getting across their understanding of the content or topic. The support cards provide a language boost for important terms that might not otherwise be taught by the content teacher.

These cards should be copied and made accessible to all students (either individual copies or group copies depending on available resources). An enlarged copy of the cards could also hang in the classroom. Please see examples of the Conversation Support Cards further in the guide.

Conversation Support Card adapted from Zwiers, O'Hara, & Pritchard (2014)

Clarify, Paraphrase, Summarize

Question Starters	Response Starters
What is...?	Let me show you.
What do you mean by...?	Another way to say that is…
Will you say that again for me?	What she means is…
But, what is the main point?	So far, everyone thinks…

Support

Question Starters	Response Starters
What are some examples?	An example is…
Does anyone want to try that?	I'm sure that would work, because…
Do you see the link to...?	
Have we seen that before?	That makes sense, because…
	Last week, we learned…

RESPONDING TO IDEAS

Build

Question Starters	Response Starters
How could that connect to...?	Let's try that.
Would it work if we...?	Let's adjust our model to show that.
Where could we use that idea...?	
How can you add to that idea?	If we change this part, it would fit better because…
	That reminds me of…

Question or Challenge

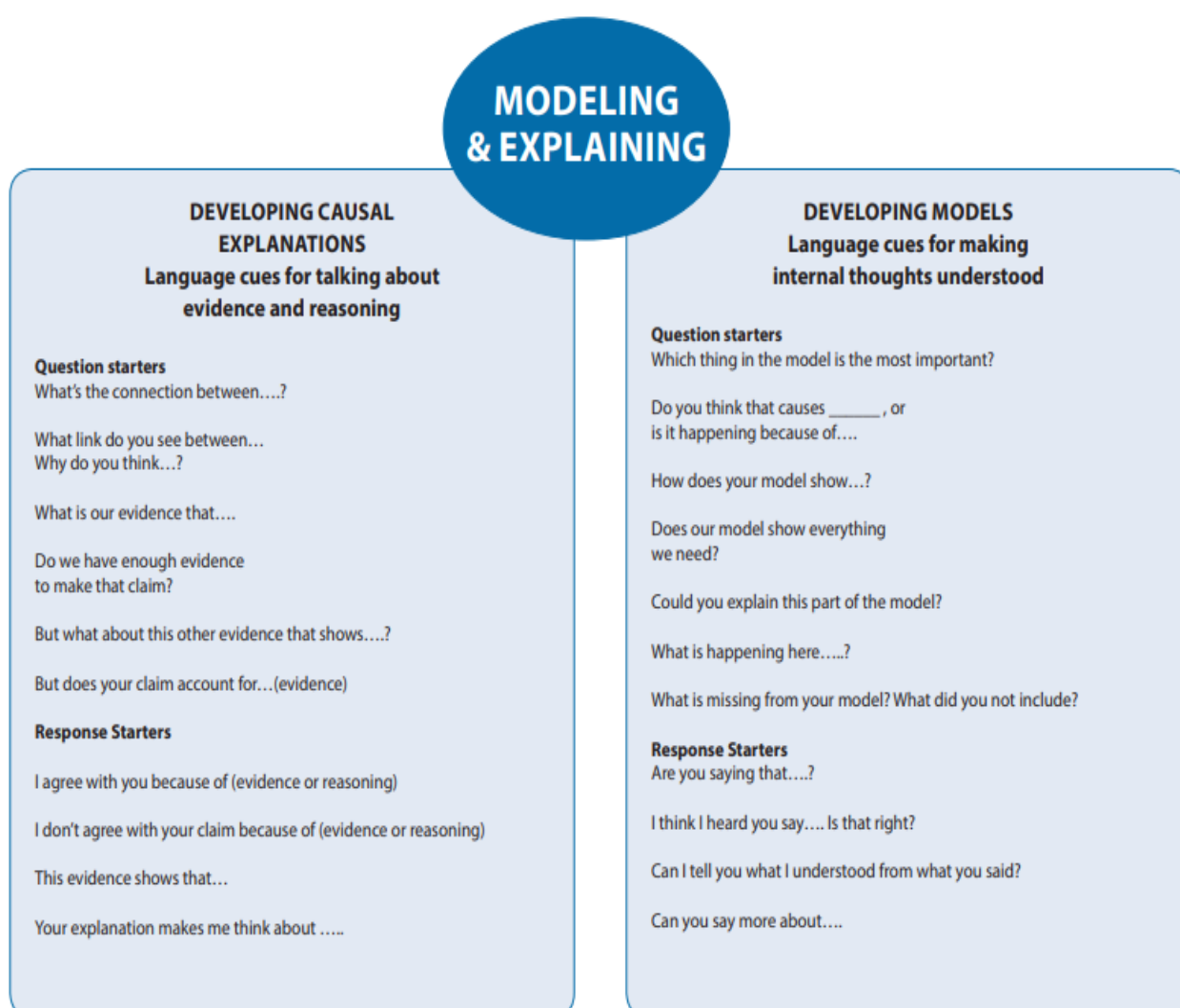| Question Starters	Response Starters
Did you think about...?	I don't agree, because…
But, would it only work for...?	That ignores evidence of…
What is your reasoning?	I see this very differently.
Why do you think that?	There's a problem with your idea because…

9

Creating a classroom where the English language is living and accessible is essential to the advancement of an ESL student's understanding of academic language. To facilitate this, teachers must support students in deepening their understanding of the academic language used to make arguments, evaluate statements made by classmates, and understand vocabulary needed to discuss scientific concepts and ideas. Snow writes that both the language structures and the way English speakers use them must both be part of any science curriculum for English language learners[10]. One way to accomplish this is for language and science teachers to collaborate in the development of curricula and classroom activities.

A realistic approach to supporting the language development of native Arabic speakers is to organize meaningful opportunities for English language teachers and STEM subject teachers to collaborate in lesson planning and instruction.

MODELING & EXPLAINING

DEVELOPING CAUSAL EXPLANATIONS
Language cues for talking about evidence and reasoning

Question starters
What's the connection between....?

What link do you see between...
Why do you think...?

What is our evidence that....

Do we have enough evidence
to make that claim?

But what about this other evidence that shows....?

But does your claim account for...(evidence)

Response Starters

I agree with you because of (evidence or reasoning)

I don't agree with your claim because of (evidence or reasoning)

This evidence shows that...

Your explanation makes me think about .....

DEVELOPING MODELS
Language cues for making internal thoughts understood

Question starters
Which thing in the model is the most important?

Do you think that causes _____ , or
is it happening because of....

How does your model show...?

Does our model show everything
we need?

Could you explain this part of the model?

What is happening here.....?

What is missing from your model? What did you not include?

Response Starters
Are you saying that....?

I think I heard you say.... Is that right?

Can I tell you what I understood from what you said?

Can you say more about....

[10] Catherine Snow, "Academic Language and the Challenge of Reading for Learning About Science," Science (New York, N.Y.) 328 (April 1, 2010): 450–52, https://doi.org/10.1126/science.1182597.

Collaboration requires both teachers to have (1) planning time together to ensure that language instruction and appropriate support are provided and given enough attention. Collaboration also requires both groups of teachers to have an (2) understanding of language development and STEM content.

To support co-teaching, English teachers should build: (a) a conceptual understanding of STEM subjects in order to learn how language is used in that context; (b) an idea of the types of activities done in STEM classes, and (c) an awareness of where and how students struggle with English during that subject. It may also be helpful for English teachers to observe STEM classes and for STEM teachers to watch recorded videos of the English classes.

Likewise, STEM teachers should develop their understanding of the Academic English needed to discuss, write and read STEM concepts. For an in-depth overview of academic English, refer to *STEM Academic English for Teachers*, a 7 week online professional development (PD) course for Egyptian STEM and English teachers that was conducted in 2020 via Google Classroom. The course consists of Powerpoint slides, activities and reflection questions to guide teachers in applying the content to their instruction.

STEM subject teachers and English teachers should also consider integrating language and STEM learning objectives in their classrooms through language-rich activities to further develop students' skills in STEM dialogue in English. Usually, when English language and STEM teachers map out the objectives and learning outcomes for classroom activities, they may have two parallel sets of objectives, but separating objectives falsely reinforces the notion that language and STEM content are taught and learned independently.

The following two bullet points are examples of integrated objectives that could be created for a STEM or English language classroom:

- Students will collaboratively develop a model that explains and predicts patterns in the changes to the land caused by wind and rain[11].
- Students will collaboratively construct an explanation of the effect of thermal energy on molecular movement[12].

As students complete the activity requiring them to develop the model, teachers can support the effort by supplying language supports such as sentence starters. Sentence starters are used as cues to elicit the use of functional language required for "explaining" and "predicting", therefore leading to an activity that supports both content and language learning.

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[11] Cathryn Manduca et al., "Improving Undergraduate STEM Education: The Efficacy of Discipline-Based Professional Development," Science Advances 3 (February 1, 2017): e1600193, https://doi.org/10.1126/sciadv.1600193.

[12] National Academies of Sciences, Engineering, and Medicine. (2018). *English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives*. Washington, DC: The National Academies Press. doi: https://doi.org/10.17226/25182.

Chapter 4: Other Useful Online Tools

Making use of other online tools and open education resources is a great way to extend learning inside and outside the classroom. Even the most robust curriculum cannot cover all of the needs of a learner or provide all of the content necessary to address required standards. As students outgrow e-STEM, supplemental resources can fill the gap.

Given that there are a number of online learning resources available, it can be overwhelming to decide what to use. There are many considerations before deciding on a resource: Does it provide instruction that will help learners achieve their goals and course objectives? Is it engaging and easy to use? Is it accessible?

Consider starting small. Pick one new tool at time, and involve your learners in the process. Your decisions about which technologies to use should begin with understanding the range of access, hardware, and skill levels of your learners. Learn about the challenges learners face when using it, and adjust use as needed to be certain that all learners can be successful with the support available. Only then should you integrate a new tool or resource.

As you identify what works and what doesn't for you and your students, acknowledge to your students that using new technology is a learning experience for everyone involved and it's okay to make mistakes.

Tips to Get Started
- Start small with bite-sized goals & introduce one new tool at a time
- Become a learner and experiment with the new resource
- Allow students to discover the website by trying a scavenger hunt
- Consider different ways to use the resource
- Try using the resource for daily practice
- Learn alongside your students

The following section highlights 5 free online learning tools and suggests how they can be integrated in an English or STEM classroom. Sample lesson plans for 2 tools are included in the Teacher Guide (Annex 1). Other online tools appropriate for supporting academic English and STEM teaching and learning have been included in the Online Tools Landscape Scan (Annex 2).

For each of the online tools, an instructional video has been developed. Each video will walk you through the various steps to setting up the tool, then provide examples of how to use them in your daily teaching.

Learning Objectives

Below is a table that outlines each online tool by subject/s, macro-skill and micro/sub skill. For the purposes of this Teacher Guide, macro skill is being defined as one of the four basic English language skills, including reading, writing, speaking and listening. Micro/sub skills are components of each macro-skill, including grammar, vocabulary, and punctuation. The purpose of this table is to help you select the tool that aligns with your content and students' language needs.

Platform	Subjects	Macro Skill(s)	Micro/Sub Skill(s)
e-STEM	English and STEM	Listening Reading Writing	● Grammar ● Vocabulary
Khan Academy	STEM[13]	Listening Reading	● Vocabulary ● Grammar ● Punctuation
LabXchange	STEM[14]	Listening Speaking Reading	● Vocabulary
Quill	English	Writing	● Grammar ● Vocabulary ● Proofreading
Readworks	English	Reading	● Vocabulary ● Grammar ● Reading Strategies

Language objectives

When English language learners participate in STEM instructional activities delivered in English, their teachers need to attend to English language objectives in addition to STEM content objectives. Below is a list of the five online tools curated to support supplemental instruction and the contextualized language objectives that are addressed in each. The English language objectives listed beneath each one are drawn from the work of World-Class Instructional Design and Assessment (WIDA) and its "WIDA English Language Development Standards Framework". "WIDA" is a US-based research and technical support organization committed to the "research, design, and implementation of a high-quality,

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[13] Algebra 1 and 2, Geometry, Trigonometry, Precalculus, Statistics, Linear Algebra, Biology, Chemistry, Physics, Environmental Science, Electrical Engineering

[14] Biology, Physics, Chemistry, Health Science, Bioethics, Young Scientist Profiles

standards-based system for K-12 multilingual learners"[15]. The WIDA English Language standards shape content-based instruction for multilingual learners in the US and 100 countries.

WIDA describes the language necessary for communicating about academic content through both interpretive and expressive modes of communication. "Interpretive" includes "listening, reading, and viewing" (p. 26). "Expressive communication" includes "speaking, writing, and representing" (p. 26). It also identifies high level key language uses common in academic settings: narrate, explain, argue, and inform (see p. 24 for more information). Each of the list of objectives below indicates both the mode of communication and the key language use as identified in the WIDA Framework (see pages 193-194 for more information).

LabXchange:
These are the language objectives that can be supported in secondary education science classes.

Explain.Interpretive: Interpret scientific expressions
● Define investigable questions or problems based on observations, information, and/or data
● Paraphrase central ideas presented in complex evidence, concepts, processes, and information
● Evaluate the extent to which reasoning, theory and/or models link evidence to claims and support conclusions

Explain. Expressive: Construct scientific explanations
● Describe reliable and valid evidence from multiple sources
● Establish a neutral or objective stance in how results are communicated
● Develop reasoning to illustrate and/ or predict the relationships between variables in a system or between components of a system
● Summarize and refine solutions referencing scientific knowledge, evidence, criteria, and/or trade-offs

Argue.Interpretive: Interpret scientific arguments
● Identify appropriate and sufficient evidence from data, models, and/ or information from investigations of a phenomenon or design solutions
● Compare reasoning and claims based on evidence from competing arguments or design solutions
● Evaluate currently accepted explanations, new evidence, limitations (trade-offs), constraints, and ethical issues

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[15]WIDA. (2020). WIDA English language development standards framework, 2020 edition: Kindergarten–grade 12. Board of Regents of the University of Wisconsin System.
https://wida.wisc.edu/sites/default/files/resource/WIDA-ELD-Standards-Framework-2020.pdf

ELD-SC.9-12.Argue.Expressive: Construct scientific arguments
● Introduce and contextualize a topic in current scientific or historical episodes in science
● Defend or refute a claim based on data and evidence
● Establish and maintain an appropriate tone and stance (neutral/objective or biased/subjective)
● Signal logical relationships among reasoning, evidence, data, and/or models when making and defending a claim, counterclaim, and/or rebuttal

Khan Academy: (same as LabXchange)

Quill:
These are the language objectives that can be supported in secondary education science classes.

Argue. Expressive: Use language to construct language arts arguments
• Introduce and develop precise claim(s) and address counterclaim(s)
• Support claims and refute counterclaims with valid reasoning and relevant and sufficient evidence
• Establish and maintain a formal style and objective tone
• Logically organize claims, counterclaims, reasons, and evidence; offer a conclusion with recommendations

Readworks:
These are the language objectives that can be supported in secondary education science classes.

Argue.Interpretive: Interpret language arts arguments
● Identify and summarizing central ideas of primary or secondary sources
● Analyze use of rhetoric and details to advance point of view or purpose
● Evaluate and corroborate relevance and sufficiency of evidence as well as validity of reasoning to support claims

Argue.Expressive: Construct language arts arguments
● Introduce and develop precise claims and address counterclaims
● Support claims and refute counterclaims with valid reasoning and relevant and sufficient evidence
● Establish and maintain a formal style and objective tone
● Logically organize claims, counterclaims, reasons, and evidence; offer a conclusion with recommendations

Inform. Interpretive: Interpret informational texts in language arts
● Identify and/or summarizing central ideas
● Analyze descriptions and inferences in textual evidence for key attributes, qualities, characteristics, activities, and conceptual relationships
● Evaluate cumulative impact and refinement of author's key word choices over the course of text
Inform. Expressive: Construct informational texts in language arts

● Introduce and define topic and/or entity for audience
● Establish an objective or neutral stance
● Add precision, details, and clarity about complex attributes, qualities, characteristics, activities, and conceptual relationships
● Develop coherence and cohesion throughout text

Narrate. Interpretive: Interpret language arts narratives
● Identify themes or central ideas that develop over the course of a text
● Analyze how author choices about characters and their actions relate to story elements (setting, event sequences, and context)
● Evaluate the impact of specific word choices on meaning, tone, and explicit vs. implicit points of view

Narrate. Expressive: Construct language arts narratives
● Orient audience to context and one or multiple point(s) of view
● Develop and describe characters and their relationships over a progression of experiences or events
● Develop story, advancing the plot and themes with complications and resolutions, time and event sequences
● Engage and adjust for audience

e-STEM:

Inform. Interpretive: Interpret informational texts in language arts
● Identify and/or summarizing central ideas
● Analyze descriptions and inferences in textual evidence for key attributes, qualities, characteristics, activities, and conceptual relationships
● Evaluate cumulative impact and refinement of author's key word choices over the course of text

Inform. Expressive: Construct informational texts in language arts
● Introduce and define topic and/or entity for audience
● Establish an objective or neutral stance
● Add precision, details, and clarity about complex attributes, qualities, characteristics, activities, and conceptual relationships
● Develop coherence and cohesion throughout text

LabXchange

What is it?
LabXchange is a free open source online platform for science education from Harvard University. LabXchange shares high-quality digital science content (virtual modeling, videos, case studies and simulations) that can be organized in different ways for use in blended learning. Content is organized by subject, content type, content sources and community favorites and is easy for teachers to look through.

The platform also provides teachers ways to design their own content to track students' progress. The content in LabXchange is fully customizable and can be organized into:

- **Assets:** high quality learning content such as videos, text, simulations and assessment questions that comes from a variety of sources
- **Clusters**: thematic groupings of related topics that center around a common content, see https://www.labxchange.org/library/items/lb:LabXchange:f81ca975:video:1
- **Pathways**: individual pieces of content called assets (e.g., videos, texts, simulations, interactives, or review materials/quizzes) that an educator can group into a sequenced and customized "pathway" to meet the needs of his or her students, see https://www.labxchange.org/library/items/lb:LabXchange:ea5eff77:video:1

How do I use it in class?

- Teachers can sign up for a free LabXchange account

- Teachers can (a) assign an existing pathway, (b) find and sequence assets that are housed on LabXchange's library, or (c) clone and customize pathways by adding in and sequencing new content to better meet the learning needs of their students;
- Teachers use the Educator Dashboard to search LabXchange content, design a pathway, assign a pathway and track student progress.
- Examples of lesson plans for LabXchange are found in Annex 1.

How do I create a class and enroll my students?

1. Make sure your account is set to the Educator role. If yes, you can navigate to your Educator Dashboard. This should take you to your Educator Dashboard.
2. To create Classes, click the Classes tab.
3. To add learners to your class, you need to share the code that is automatically generated when you create a class. (You can share this code by email, in writing, or however you normally communicate with your students.)
   Learners will enter the code on the Classes tab of the Learner Dashboard.

Khan Academy

What is it?

Khan Academy provides math, physics, chemistry, biology, and grammar practice exercises, instructional videos, and a personalized learning dashboard that empower learners to study at their own pace in and outside of the classroom. The resource also provides student data so that teachers can identify gaps in learning and provide tailored instruction.

How do I use it in class?

1. Self-paced practice
   Use the Course Mastery feature. You can get started by setting mastery goals for your students, either class-wide or individually. This is a long term goal that will likely take your students many months to complete since it is an entire course worth of concepts.
2. Lesson-aligned practice
   Assign Khan Academy problem sets (exercises) during class for practice on the topic, or standard, of the day. In this model, teachers use Khan Academy as a regular practice tool to build student's concept development.
3. Topic review
   Assign several resources for students to complete and review at the end of a unit or fill learning gaps from past material. In the Topic review model, teachers use Khan Academy to assign a bundle of review topics approximately two times per month. Students have the chance to start this assignment bundle in class, but teachers may expect students to complete the assignments partially outside of class.
4. Homework
   Assign videos, articles, and/or problem sets for your students to complete outside of class.

How do I create a class and enroll my students?

1. Create your account by navigating to khanacademy.org.
2. Select Join Khan Academy as a Teacher and follow the prompts to create your account.
3. To create a class, go to your Teacher dashboard, accessible through the username drop-down menu at the top-right of the screen.
4. Click the Add new class button. Either enter your own class name or import a class from Google Classroom.
5. Select a subject for your class. To add your students, you have three options:

   Option 1: Link to your Google Classroom account and import the class. You will need your username and password for Google.
   Option 2: Have students add themselves by class code. Each class has a unique class code. You can share a direct link with students or students can enter the class code at www.khanacademy.org/teachers to join your class.
   Option 3: Add students without email accounts by creating Khan Academy accounts for them.

Quill

What is it?
Quill is a free tool to help students become better writers. Quill focuses on grammar and proofreading. It has several tools including Quill Grammar, Quill Connect, Quill Proofreader, Quill Lessons, and Quill Diagnostic.

How do I use it in class?
1. Self-paced practice
   Use Quill's 10-15 minute independent practice activities to help students build sentence construction skills. As students work through activities, Quill provides instant feedback and hints to help students improve.
2. Lesson-aligned practice
   Use Quill activities as a quick daily warm-up lesson at the beginning of class After students complete the activities, Quill will produce Student Reports.
3. Homework
   Use Quill activities for homework.

How do I create a class and enroll my students?

If you don't have Google Classroom or Clever, create classes manually on Quill. To create your first class,
1. Navigate to "Classes > Active Classes" tab
2. Select "Create a Class."
3. To create additional classes, go to your "Classes" tab and press "Create a Class."

Then, to add students to your class, you can choose one of three options. You can find these options by:
1. Navigate to "classes,"
2. Select "create a class" and
3. Select a name and grade for your class.

Finally, to add students to your class, you have 3 options:
   Option 1: Students can create their own accounts and join your class using the class code.
   Option 2: If you have synced classes from Google, students can log in by selecting the Google on the "login" page and using the class code.
   Option 3: You can manually add students by inputting their first and last names.

How do I assign a diagnostic test?

Before using the Quill online tool, teachers have the option of assigning students a diagnostic test. This diagnostic test is used as a tool to differentiate learning on the Quill platform.

When students complete a diagnostic, Quill will create an individualized list of recommendations for each student. The five available diagnostics include the Starter, Intermediate, and Advanced ELA Diagnostic, and the Starter English Language Learner (ELL) and regular ELL Diagnostic.

1. First, select "Explore Activities", select Assess student writing with a diagnostic.
2. Then, select either the Starter, Intermediate, Advanced, ELL Starter, or ELL Diagnostic. You will have the option to preview the diagnostic.
3. Click on the diagnostic and you will be taken to a page where you can choose a name and due date for the assignment.

To assign the diagnostic to your students, select the "Continue to Assign" button.

ReadWorks

ReadWorks®

What is it?
ReadWorks is an online resource that provides reading passages, text-based question sets, paired texts related to the same topic or theme, and 10-minute "Article-A-Day" for students in grades K-12. Passages are organized by topic and grade level.
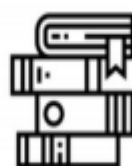
The Pillars of Reading Comprehension

ReadWorks supports the development of successful and joyful readers in 4 key ways:

Build background knowledge
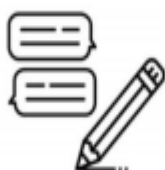
Grow vocabularies

Increase reading quantity

Develop reading comprehension strategies

How do I use it in class?
1. Assign high-quality nonfiction and fiction articles to students to practice every day with the **Article-A-Day series**.
2. Provide hesitant readers **StepRead** texts, which are less complex versions of nonfiction and literary passages.
3. Monitor student reading comprehension over time.
4. Use Paired Texts to promote higher-level thinking.
   Encourage students to access ReadWorks outside of class to work on reading independently.

How do I create a class and enroll my students?
1. Click on "Class Admin" in the upper navigation bar.
2. Click on the "+Create a Class" button.
3. Select "Create a New Class".
4. Fill out your class information in the "Create a Class" pop-up box.
5. Click on the "Invite with Roster" button.
6. Add your students to the roster class by typing out or copying and pasting in their names.

Give your student the class password.

Student Courses for Independent Learning

An evaluation was conducted on independent learning courses based on criteria including

functionality, content, cognitive engagement, collaboration, instructor engagement, accessibility and technicality. These courses will support students' academic English beyond the e-STEM platform. The following courses rated highly on the criteria and prioritize academic English and STEM teaching and learning. Although these courses are completed independently, teachers should still become familiar with them and consider formally introducing them to students during class time to give students the opportunity to ask questions and gain confidence with them before starting.

Free
- ★ University of Pennsylvania STEM Coursera: https://www.coursera.org/learn/stem
- ★ How to Write an Essay Edx course by Berkley university:
  https://www.edx.org/course/how-to-write-an-essay
- ★ Academic Writing Made Easy by Munich University:
  https://www.edx.org/course/academic-writing-made-easy-2

- ★ SAT Preparation Online Exercises and Practice Tests (multiple sites):
  - ○ Khan Academy: https://www.khanacademy.org/sat
  - ○ High School Test Prep: https://www.highschooltestprep.com/
  - ○ Kaplan: https://www.kaptest.com/sat/free/sat-practice

Not Free
- ★ Arizona State University Academic Thinking Course 1*:
  https://courses.cpe.asu.edu/browse/global-launch/courses/academic-thinking1
- ★ Arizona State University Academic Thinking Course 2*:
  https://courses.cpe.asu.edu/browse/global-launch/courses/academic-thinking2

The ASU courses cost 350 USD per student. Group discounts available.
- ★ Inspark Smart Course Coursera - https://landing.inspark.education/teach.
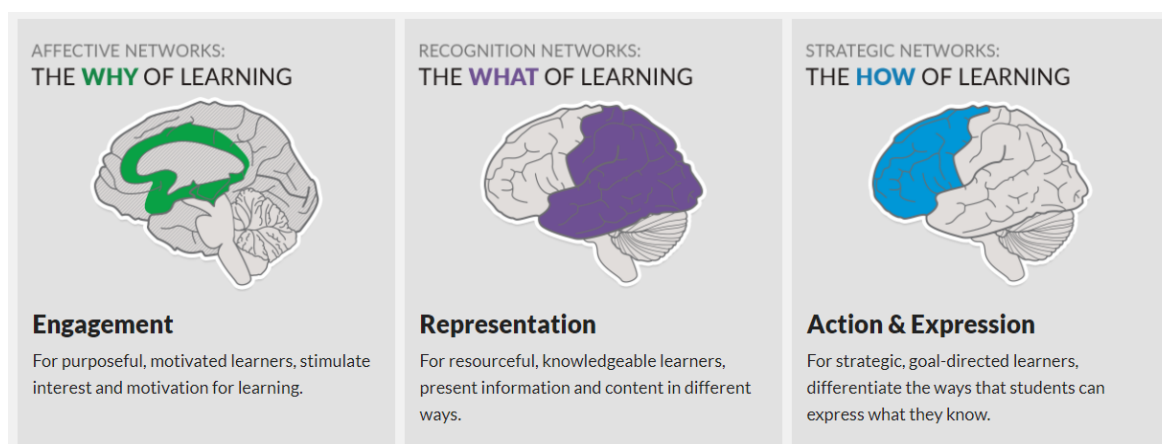 These courses cost 25 to 40 USD per student. Group discounts available.

Chapter 5: Using Online Learning to Provide Differentiated Instruction

Universal Design for Learning Framework

The Universal Design for Learning (UDL) framework (see [CAST, 2011)](#) was created to improve and optimize teaching and learning for all people based on scientific insights about how humans learn. UDL reflects specific awareness of the unique nature of each learner and the need to address learners' differences by designing differentiated instruction that offers learners:

- **Multiple means of engagement** - learners differ in what engages or motivates them to learn, so teachers should provide multiple avenues for engagement. In response, teachers can create more student choice and autonomy, clarify the relevance of the learning objectives, and promote expectations and beliefs that increase student motivation[16].
- **Multiple means of representation** - teachers can present content in different mediums (text,audio, video, case study, simulations, etc.)so that students can engage with concepts in multiple ways
- **Multiple means of action and expression** - Learners differ in the ways that they can navigate a learning environment and express what they know[17]. In response, teachers can provide multiple ways for students to express their knowledge and comprehension to enable students to more successfully take part in their learning and articulate what they know[18].

Using different modes during instruction such as audio, visual, and text (or any combination of) can be used to customize an individual student's learning experience by offering them multiple means of engagement, representation, and expression. Some students may choose to employ a text-to-speech reader to support their reading comprehension. Text-to-speech functions within many internet browsers and can support pronunciation and reading fluency. Other students may benefit from writing assignments that are designed as multimodal compositions that use images and audio narration to express ideas. By using technology and UDL principles, there are a

AFFECTIVE NETWORKS: THE **WHY** OF LEARNING	RECOGNITION NETWORKS: THE **WHAT** OF LEARNING	STRATEGIC NETWORKS: THE **HOW** OF LEARNING
Engagement For purposeful, motivated learners, stimulate interest and motivation for learning.	**Representation** For resourceful, knowledgeable learners, present information and content in different ways.	**Action & Expression** For strategic, goal-directed learners, differentiate the ways that students can express what they know.

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[16] "[UDL: Engagement](#)," accessed July 22, 2020,
[17] "[UDL: Action & Expression](#)," accessed July 22, 2020,
[18] "[UDL: Use Multiple Tools for Construction and Composition,](#)" accessed July 22, 2020,

multitude of possibilities available for teachers and students to share their thinking and express their ideas.

Creating differentiated opportunities

Differentiated activities and multiple options to illustrate learning can provide students at varying skill levels the opportunity to work through content and address their individual learning needs. Organizing instruction in this way can be facilitated in different ways.

- Some students can work independently and complete the work at their own pace, giving them control over what they spend more time on (for deeper learning of concepts) and less time on (for skills they have already mastered).
- Students that find a concept challenging can slow and take more time, perhaps repeating segments more than once for additional practice.
- Advanced students could have the opportunity to expand on what they have learned and go beyond the curriculum into independent investigation.

Teachers play a pivotal and important role during all differentiated instruction to assessing students' understanding, adjusting the groups and options based on progress made, and supporting, guiding, and encouraging student engagement. Technology can provide teachers the opportunity to provide differentiated and personalized instruction to students to support and strengthen in-class teaching and learning. While there are several technologies that can provide differentiated instruction, for the purposes of this manual, we will focus on e-STEM, LabXchange, Khan Academy, Quill and ReadWorks.

e-STEM - Because e-STEM does not have specific options for differentiation built within the content, it will be up to individual teachers to decide on options for providing scaffolding to different groups of students according to their needs. Each teacher will need to determine what each student's needs are (which change over the course of a school year) and differentiate their instruction using e-STEM modules based on that analysis. Teachers can further personalize learning by designing reflection questions that a student could respond to at the end of the unit to illustrate and share their understanding of the content and their learning process.

Reflection questions[19] include:

- What did you learn (today, this week, this year, etc.)?
- Why do you believe we're studying this objective?
- Did you give your best effort on this most recent assignment?
- Were the strategies, skills and procedures you used effective for this assignment?
- Reflect on your thinking, learning, and work today.
- What were you most proud of?

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[19] *Stephanie Hartman,* *"Student Reflection Questions," n.d.,, accessed July 22, 2020,*

- Where did you encounter struggles today, and what did you do to deal with it?

LabXchange - There are a variety of ways to create differentiated learning through LabXchange.
- Create customized learning pathways using content from the LabXchange library and assign it to specific students for additional review
- Assign interactive biology videos that break down molecular processes in English for students
- Assign virtual lab experiments to students who struggle with labs and the research methodology, particularly in English

For students looking for more advanced content, teachers should direct them to advanced media and activities from the LabXchange library. For instance, you can share case studies on specific topics such as attitudes across age groups on climate change, or phytoplankton, or the degradation of neurons. You can also assign videos and testimonials of real scientists explaining their work.

Khan Academy - Assign specific Khan Academy math, biology and physics exercises based to strengthen conceptual understanding and skills. Then, track their progress on the Khan Academy teacher dashboard and adjust your instruction in class if needed.

ReadWorks - Use this resource's Article-A-Day to fill in students' gaps in reading comprehension. It offers (a) growth in background knowledge and vocabulary and (b) effective and engaged reading practice. If you have students struggling with comprehension of nonfiction, fiction or poetry, you can assign individual students a text that comes with a set of 10 questions. Students submit their responses; you and your students can view the results. You can also comment on student results to provide feedback or hints if the student got them wrong.

Quill - For students looking for more challenging grammar skills, assign them advanced grammar exercises from the Quill activities library. Exercises can be completed as homework. There is a variety of advanced topics; a few examples include relative clauses, participial phrases, and adjectives and adverbs used in science.

Chapter 6: Assessing Students' Understanding

Capturing learning in different forms and in multiple ways can help teachers better pinpoint students' strengths and identify areas in need of additional learning. Therefore, use multiple tools to capture student learning such as rubrics, checklists, and student reflections. These tools can provide important information about the process of learning as well as learning outcomes. Note that these "snapshots" of learning are best taken frequently and should be a valued part of the learning process throughout, not just at the end of a learning experience.

The assessment process not only informs the teacher what content students have learned, but also about the process of learning as well (e.g., skills development, digital navigation). For instance, how are your students interacting with the digital tools they are using and the skills they are building?

Teachers can also assess student learning using the Teacher Portal with student data, a teacher designed assessment, or student self-reflection in order to better understand the value of the online tool and how to improve students engagement with the tool to meet learning outcomes.

Formative Assessments

Formative assessments (observing students' learning processes and capturing learning through anecdotal notes) can be a useful way to determine students' strengths and weaknesses. These observations are then used to make informed instructional decisions about what material needs to be reviewed, or what areas, skills, or foundational concepts are in need of additional support. Formative assessment takes place during a class period and can increase students' self-awareness as well as be used by the teacher. Some ways to formatively assess include:

- **Self-assessment**. Get students involved in their own learning journey. Teachers can provide a question set, a checklist, a rubric, or an exit ticket questionnaire during or after the session. Ask students to summarize or paraphrase important concepts and lessons. This can be done orally, visually, or otherwise.

- **Comprehension questions.** Use Edpuzzle to assess their comprehension of the week's learning outcomes. Edpuzzle provides interactive video lessons to students. Teachers can insert comprehension questions and narration into the video for students to answer while they're watching it. The questions are either multiple choice or open-ended; Edpuzzle indicates whether the student answered the

multiple choice questions correctly. Teachers can choose from existing Youtube videos or Edpuzzle videos.

- **Hand signals.** Hand signals can be used to rate or indicate students' understanding of content. Students can show anywhere from five fingers to signal maximum understanding to one finger to signal minimal understanding. This strategy requires engagement by all students and allows the teacher to check for understanding within a large group.

- **Think-pair-share.** Insert oral discussion prompts throughout your teaching for more interaction and opportunities to hear how students are thinking. Ask students to take a few minutes to think about the question or prompt. Next, they pair with a designated partner to compare thoughts before sharing with the whole class.

- **Response cards**. Pose a question such as "write a phrase that summarizes an important idea you just learned". Ask students to hold up their idea on index cards, whiteboards or magnetic boards. These ideas are simultaneously held up by all students. Using response devices can help the teacher easily note the responses of individual students while teaching the whole group.

- **Regular Meetings with Students**. Meet with students to discuss and review their work. Ask students to use artifacts from their learning (written essays, drawings, concept maps, reflections, and responses) to express what they have learned. You may want to ask what artifacts they are most proud of, what artifacts illustrate shifts in the way they are thinking about a concept or idea, and which assignment they would want to redo to illustrate how far they have come in their learning journey. Regular meetings can be an informative way to gain insight into students' confidence in learning and learning preferences.

Summative Assessments

Summative assessments are often used for determining the degree to which students grasped the material they were taught using a combination of multiple choice items, essay questions, matching words to definitions, or fill-in-the-blank questions. Summative assessments are used to evaluate student learning, skill acquisition, and academic achievement at the conclusion of a defined instructional period—typically at the end of a project, unit, course, semester, program, or school year. Many online platforms have built in summative assessments that can be used as is or customized by the teacher. Before beginning a unit, it is very beneficial to create a summative assessment as an end goal for instruction. The summative assessment then becomes a guide as to what concepts are

given more time and attention during instruction. Some examples of summative assessments options are:

- **Portfolios** - Students can combine a sample of their work - organized chronologically - to demonstrate their progress.

- **Culminating Activities** - Culminating activities, capstone projects or other forms of performance assessment that students work on over extended periods of time and present and defend at the conclusion of a school year. Teachers may also have students work on a culminating activity to show mastery of skills.

- **Flashcard quizzes, spelling and matching.** Quizlet is a free engaging tool that can be used to help students review vocabulary or concepts, label diagrams, spell vocabulary words, and match vocabulary or concepts to their definitions. Teachers can also project it in class by using "game mode," whereby all students work together to match vocabulary words or concepts to their definitions.

- **Quizzes embedded in online curriculum** - Teachers can identify concepts or skill sets that are important for students to understand and create questions to help determine what they have accurately understood. Students can see what items were scored correct and incorrect. Students can go back through materials to review or relearn the concepts. The results of the quizzes will enable teachers to support re-teaching and to adjust instruction.

- **Writing Assignments** - Writing solidifies thinking and promotes contextualized language use. It is helpful for students to write during different parts of the learning process because it can support the acquisition of concepts, expression of ideas, and language mechanics. Writing assignments can also serve as summary assessments as well. You can assign students daily journal prompts to help them make connections to what they are learning. Keep in mind that writing assignments do not have to be lengthy to be beneficial. You can also encourage students to brainstorm by making lists as a way to summarize what has been learned. Finally, you can ask students to explain or apply a concept through annotated drawings or concept maps as well, which offer multiple modes of expression.

- **Projects** - Designing a project for students can be an engaging way for them to illustrate what they have learned in a creative way. There are many ways to design engaging projects using free multimedia tools. Projects can take several forms and require students to plan, organize, summarize, synthesize, and present and communicate their ideas to others. They can take the form of writing an annotated glossary, designing and writing a children's book, recording a podcast, creating an

infographic that compares and contrasts information[20], interviewing an expert, creating a multimedia presentation that includes audio narration, or making a documentary film.

Digital assessment tools

- Google Quizzes: https://support.google.com/docs/answer/7032287?hl=en
- Polleverywhere: https://www.polleverywhere.com/
- EdPuzzle: https://edpuzzle.com/
- Quizlet: https://quizlet.com/
- Quizizz: https://quizizz.com/
- Mentimeter: https://www.mentimeter.com/

Annex 1: Online Tools Landscape Scan

World Education conducted a landscape scan to identify quality, relevant online resources in ESOL, STEM concepts and STEM academic language to support teaching and learning in Egyptian STEM secondary schools. Below is a summary of the landscape scan.

Our Team

The WEI team - Dana Del Vecchio, Miguel Doran, Victoria Neff, Dr. Jen Vanek, and two consultants, content experts, Dr. Karla Stone from University of Minnesota and Dr. Jill Castek from University of Arizona, worked together to conduct a comprehensive scan of online, free platforms, apps and courses related to high school ESOL and STEM. The scan is a shorter list of high quality resources. Some of the resources were personal recommendations by experts Dr. Stone and Dr. Castek, others were resources the WEI team are familiar with, and the rest were curated from the following resources:

- Spotlight: Quality Education for All During COVID-19 Crisis by OECD and HundrED[21] (report)
- UNESCO Distance Learning Solutions[22] (webpage)
- K-12 online platforms in the Middle East (desk research)

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[20] *Jillian Ruth Yarbrough, "[Infographics: In Support of Online Visual Learning]()," Academy of Educational Leadership Journal, July 23, 2019,*
[21] "Spotlight: Quality Education for All during COVID-19 Crisis | Unesco IIEP Learning Portal," accessed July 22, 2020,
https://learningportal.iiep.unesco.org/en/library/spotlight-quality-education-for-all-during-covid-19-crisis
[22] https://plus.google.com/+UNESCO, "Distance Learning Solutions," UNESCO, March 5, 2020, https://en.unesco.org/covid19/educationresponse/solutions.

- Koulu - Finnish education apps for distance learning[23]

Organizing the resources

Below, the resources have been organized into three categories: (1) STEM enrichment resources to compliment instruction, (2) STEM and ESOL content and media to support instruction in distance and/or blended learning settings, and (3) English self-paced courses. Category 1, STEM enrichment resources, supplement the lesson and could be used in STEM subject classes to introduce new STEM concepts to students or demonstrate to students how to prepare for a lab. Category 2, STEM and ESOL content and media for in class blended learning category encompasses a wider range of resources such as (a) structured K-12 online platforms, (b) platforms that allow teachers to design student learning paths and track student progress via a teacher dashboard, and (c) relevant media that teachers can draw from and incorporate into existing lesson plans. Finally, the third category, English self-paced courses are structured online classes offered through Coursera or Edx that contain readings, assignments, quizzes and a student forum.

There are other important characteristics to note about these resources. They can be classified as learning in the following areas: ESOL learning, STEM, or STEM academic English language. It should be noted that even those resources that are intended for STEM instruction can be leveraged for ESOL support (e.g., students can use the translation affordance of Khan Academy to learn content in both English and Arabic). Furthermore, some of the resources are designed specifically for students and teachers to use together, while others are only for teachers to use as instructional tools. Additionally, there are apps/tools/resources that are blank canvases - that allow teachers to author their own content.

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[23] "Koulu.Me - Free Apps to Support Distance Learning Due to the Coronavirus Outbreak," accessed July 22, 2020, https://koulu.me/.

Category 1: In-class STEM enrichment resource

	Functionality	Content	Cognitive Engagement	Collaboration	Instructor Engagement	Accessibility	Technical	URL
Phet Simulations	✓			N/A	N/A		✓	https://phet.colorado.edu/
NOVA Labs	✓	✓	✓	N/A	N/A		✓	https://www.pbs.org/wgbh/nova/labs/
Molecular Workbench	✓	✓	✓	N/A	N/A		✓	http://mw.concord.org/modeler/
Jefferson Lab (Physics)	✓	✓	✓	N/A	N/A		✓	https://www.jlab.org/physics
USDA Virtual Labs	✓	✓	✓	N/A	N/A		✓	https://virtuallabs.nmsu.edu/

Category 2: Content and media for in class in a blended-learning scenario

	Functionality	Content	Cognitive Engagement	Collaboration	Instructor Engagement	Accessibility	Technical	URL
Edraak English courses	✓	✓						https://www.edraak.org/en/course/course-v1:MoE+ENG12+T3_2017/
British Council: Learn English Teens	✓	✓		✓			✓	https://learnenglish.britishcouncil.org/

ReadWorks	✓	✓	✓	✓	✓	✓		**https://www.readworks.org/**
Quill	✓	✓	✓	✓	✓	✓	✓	**www.quill.org**
LabXchange	✓	✓	✓		✓	✓	✓	**https://www.labxchange.org/**
NASA Science	✓	✓	✓			✓	✓	**https://www.nasa.gov/stem/foreducators/k-12/index.html**
National Geographic Kids	✓					✓	✓	**https://kids.nationalgeographic.com/**
PBS Learning Media	✓	✓			✓	✓	✓	**https://mass.pbslearningmedia.org/**
Ward's Science YouTube Channel*	✓	✓					✓	**https://www.youtube.com/channel/UCa5VzBGvwJ99hrNYPXZv2Bg**
BioInteractive	✓	✓	✓		✓	✓	✓	**https://www.biointeractive.org/**
Climate.gov CLEAN Collection Resources	✓	✓	✓			✓	✓	**https://www.climate.gov/teaching/resources**

Teacher resource only

Category 3: ESOL self-paced student cours

	Functionality	Content	Cognitive Engagement	Collaboration	Instructor Engagement	Accessibility	Technical	URL
UPENN STEM Coursera	✓	✓	✓	✓	✓	✓	✓	https://www.coursera.org/learn/stem
ASU Academic Thinking Course 1*	✓	✓	✓	✓	✓	✓	✓	https://courses.cpe.asu.edu/browse/global-launch/courses/academic-thinking1
ASU Academic Thinking Course 2*	✓	✓	✓	✓	✓	✓	✓	https://courses.cpe.asu.edu/browse/global-launch/courses/academic-thinking2
Inspark Smart Course Coursera	✓	✓	✓	✓	✓		✓	https://landing.inspark.education/teach
How to Write an Essay Edx course by Berkley	✓	✓		✓	✓	✓	✓	https://www.edx.org/course/how-to-write-an-essay

Grade 10 Grammar

Unit 1 **Using Commas with Conjunctions and Subordinate Clauses**
Unit 2 **Using Colons and Semicolons**
Unit 3 **Using Capitalization**
Unit 4 **Using Contractions**
Unit 5 **Prepositions of Time and Place**
Unit 6 **Articles A, An and The**
Unit 7 **Prefixes and Suffixes**
Unit 8 **Noun, Adjectives and Verbs**
Unit 9 **Noun-Pronoun Agreement**
Unit 10 **Subject-Verb Agreement**
Unit 11 **Simple Present Tense**
Unit 12 **Simple Past vs. Present Perfect**
Unit 13 **If Conditionals and Probability**
Unit 14 **Gerunds and Infinitive**
Unit 15 **Future Tense**
Unit 16 **Using Conjunctions (FANBOYS)**
Unit 17 **Using Transition Words**
Unit 18 **Using Quantifiers**
Unit 19 **Comparing & Contrasting – Useful Language**
Unit 20 **Introduction to Relative Clauses**
Unit 21 **Using Cohesive Devices**
Unit 22 **Present Continuous Tense**

Grade 10 Writing

Unit 1 **Thesis Statements**
Unit 2 **Topic Sentences**

Unit 3 **Supporting Sentences**
Unit 4 **Run-On Sentences**
Unit 5 **Introductory Paragraphs**
Unit 6 **Explanatory Paragraphs**
Unit 7 **Informative Paragraphs**
Unit 8 **Writing Conclusions**
Unit 9 **The Five-Paragraph Essays**
Unit 10 **Descriptive Essays**
Unit 11 **Compare/Contrast Essays**
Unit 12 **Summaries**

Grade 10 Skill building

Unit 1 **Note-taking Strategies**
Unit 2 **Inferences**
Unit 3 **Skimming and Scanning**
Unit 4 **Synthesizing Information**
Unit 5 **Understanding Map Keys**
Unit 6 **Showing Agreement & Disagreement**
Unit 7 **Brainstorming Tools**
Unit 8 **Proofreadin**

Grade 11 Grammar

Unit 1 **Modal Verbs**
Unit 2 **Imperatives**
Unit 3 **Comparatives & Superlatives**
Unit 4 **Relative Pronouns**
Unit 5 **Prepositions**
Unit 6 **Passive Voice**
Unit 7 **Simple, Compound & Complex Sentences**

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