-Explore, Research, Collaborate and Innovate- The Academies of Loudoun Mission

EL and STEM Best Practices using the 5E Method and NASA Resources

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I blended a STEM and English Learners (EL) pedagogy method to combine and enhance language development for my students. When taking my first Endeavor course, the 5E method intrigued me because of it's features that allowed for introducing phenomena, curiosity, engagement and allowance for time to process student thought, (BSCS 5E method, 2021). It also has options to accommodate extensions at the end for further study or promote enlightenment. All of those are critical areas that are needed to develop and support academic language for bilingual students. I teach at The Academies of Loudoun, a Governor's school in Virginia. It is not the regular core curriculum of a common high school but is the English language I teach for highly specific technical vocabulary and skills from 27 different STEM and vocational pathways. Typical high school courses through EL support does not meet the unique EL objectives needed for STEM lessons, only language, hence the blend and following harmony by implementing the 5E method.

I presented a virtual, synchronous, EL professional development during our County Wide staff development day designed specifically for STEM content with a "spotlight" on using NASA resources and in addition, leaned into one district element of our Culturally Responsive Teaching Framework. It is rigorous converging 3 different elements, but it is easily integrated, symbiotic, and a just addition. The time element is *vital* here for my EL population because typical lesson plans are not constructed for it regarding EL students.

Seventy-four Loudoun county Public School educators attended this 45-minute session, representing all grade levels and heavily attended by EL and science teachers, (Pierscinski, 2021).

I opened my presentation sharing good news, that they did not have to learn a new learning lessons for our EL students, who are also immensely underrepresented in STEM courses.

I loaded all the resources I had created in our Schoology based platform that we use for PD platform! I explained that the 5E method is just a new way to approach how to present Language beforehand for easy reference. My PD included a PowerPoint (Pierscinski, T., EL & STEM Best Practices., 2021) and my lesson format was a Google Hyperdoc, which is ideal, for it allows for any mixed media phenomena throughout the document. Another EL teacher preference, to allow for multi-lingual and multi-cognitive thought. The Hyperdoc included the following segments; Engage (I often alternate with the word Phenomena here), Explore, Explain, Elaborate and Evaluate. Sometimes, I will add a 6thE (Extend), if a student wants to dive deeper into the content with research with the provided resources. The project assimilated a non-verbal Parker Probe video for phenomena, (Garner, R. 2018, July 11). I do use non-verbal realia often, it reduces the pressure of reading closed captions or the need to read another language. I filled the remaining Hyperdoc with the rest of the E's and listed some teaching activities that would fit for EL's and STEM content.

I did have an opening activity for the audience, a Padlet asking what they were excited to learn about this topic and why they chose it, (Pierscinski, T., EL & STEM Best Practices, 2021, Padlet). I often asked for questions or check for additional queries. Teacher's were hungry for this who had EL students in science classes and ecstatic about using NASA resources,

(Pierscinski, T. NASA Resources, 2021). They had a small 7-minute break to go to the NASA website and look for phenomena that interested them. The feedback on this (Pierscinski, T, Google form Feedback, 2021.) was predictable, not enough time allotted for that activity. I should have increased that to 10 minutes. They shared out verbally about their choices with everyone. I welcomed all the feedback due to this was only my second time presenting and the first time for such a large audience. Please find below the names and contact information for two attendees of the project PD.:

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I am currently a lead English Learner (EL) teacher at the Academies of Loudoun in Leesburg, Virginia (ACL, 2020). This is a unique high school, built in 2018, that houses the following academic divisions: The Academy of Sciences (AOS), The Academy of Engineering (AET), and The Monroe Advanced Technical Academy (MATA) a Virginia Governor's career & technical (CTE) STEM Academy, that alone includes 27 vocational and career studies. Our school's mission is to Explore, Research, Collaborate and Innovate, which is the driver for instructional practices.

I teach 9-12 grades in all divisions of the school but specifically the MATA division in the areas of HVAC, Health Informatics, Cisco, and many others. I specialize in teaching language development through content. Since my students are so diverse and spread out in select pathways that are in highly specific and technical academic areas, it can be challenging for them. Students are on an A and B day schedule and alternate between their home school and the Academies. The language development levels of my students range from L2 to L5 (beginner English proficiency to fluency) and above. I practice scaffolding by pre-teaching vocabulary and

discussing or investigating background knowledge also. These learning experiences are usually conducted in small groups or peer to peer, except for our TED-Ed group that meets which includes all EL students and even some who are just interested in public speaking, we are all inclusive.

I have a strong passion for science and have taught STEM prior to 2018 in our county's Charter schools and have had many opportunities to teach STEAM related subjects and activities. Some examples of recent activities/sessions I have taught included coding for the Mars Rover for elementary students, presenting the MOSAiC expedition mission overview, presenting and teaching at our school booth at the STEM Expo in DC.

I also became certified in NASA's meteorite and lunar materials program that allows me to have these artifacts once a year for 2 weeks to share with all the divisions and courses, combined with presentations, NASA incorporated lessons, digital animation for calculating meteorite impact distances, range and speeds, and of course the realia is out of this world!

Studying Marine Science is an interesting area that I have not incorporated into my STEM lessons yet since I did not feel literate enough in the subject matter and it is not usually taught above the standard earth science courses. I have learned through the Ocean Literacy living Project that life in the ocean is very non-linear and interdisciplinary, much like language development is for students learning English. Since my EL students did TED-Ed talks about their personal experiences this school year, Ocean Literacy will be an excellent avenue to share and join in this project for the next academic year.

EL students represent many countries and other nations, and we focus on English literacy skills for mastery. Ocean literacy is relevant to our existence and survival and it can increase

awareness of something they may have never been exposed to before. Similarly, ocean literacy will also engage metalingual skills of our dynamic and diverse ocean and will be an excellent resource and topic to dive deeper into. Being able to teach and increase their knowledge of the Ocean by participating in this living Project, will circumstantiate how it influences their daily life.

With the 7 Essential Principles of the Ocean Literacy Project, and 45 fundamental concepts, there are an abundant amount of engaging and educational science concepts to explore, collaborate, and investigate what background knowledge they have and then begin introducing new content, while also developing academic language through writing, reading, speaking and listening.

The following essential Ocean Literacy keynotes I would like to teach and explore with my students are: The Earth, the ocean's impact on weather and climate, and how the ocean and humans are interconnected, all encompassed in a vital and often delicately balanced environment. These are the essential topics as a teacher I would initiate with students and they would learn about all 3, but only choose one for an in-depth TED-Ed talk.

For Ocean Literacy (Ocean Literacy, 2013) essentials number one, The Earth has one big ocean with many features, I would introduce fundamental concepts that would not necessarily be covered I,n Earth Sciences at the same academic level of the Ocean Literacy Project does. It has the potential to deepen their level of comprehension of how the ocean's topography is comparable to our dry land, how important the sun is to living organisms and their liquid ecosystem globally, and what the Coriolis effect is and how it is globally influenced in ways, including but not limited to, measured by movement, distance, climate differentiation and density comparisons.

The Ocean is a major influence on our global weather and climate change and is an important concept to explore and connect these links. Currently, my students and I, often discuss how to distinguish between real and fake news and this topic has endured both. I would focus on the fundamentals and concepts of the heat exchange that occurs between the ocean and the layers of the atmosphere in refined detail. Some of my students come from poorer countries where their families are directly impacted and more vulnerable to even the slightest climate changes regarding farming, fishing, home structures and schools. Using authentic data and showing its relevancy to their own lives and of others increases their awareness and could potentially produce more knowledgeable, academically social citizen scientists.

The Ocean and humans are inextricably interconnected fundamental would also be culturally relatable to my students. By incorporating the concepts of what a healthy ocean is, how debris and human trash effects our oceans, how changes in recycling at their own school could affect future generations to foster better practices would be taught. I would use peer groups to survey and gather data for 3 days of trash amounts of plastic that was not recycled. We provide plastic utensils for students and they end up in the paper bin most of the time. I would introduce a brainstorming activity followed by research of Ocean Literacy on how to possibly reduce the data trends and how they would implement a program to inform other students on how wasteful and harming this is to our environment, focusing on our oceans and polar regions.

I think the greatest obstacles in teaching these essential and fundamental concepts of Ocean Literacy would be that it generates more questions than answers. I believe this a vital, and authentic academic opportunity for our students to learn exactly how scientists navigate real time obstacles in gathering data (some of it without large enough sample sizes or geographically non-specific locations) to support that much more research is needed to influence trending policies on

how the human environment impacts our oceans. I also believe that as questions are generated, it will likely prompt more answers actively pursued and create more accessible information moving forward and teaches students to think in other ways besides just having one answer to the issue of removing or rearranging obstacles. When this is practiced, we do create more non-linear thinkers, which our bi-lingual students are already practicing every day through learning another language.

Incorporating ocean animal tracking would be rich in the intricate details of research with layers upon layers of non-linear data. This is an excellent STEM pathway opportunity I now have some literacy in, to share with students. Teaching objectives of compare, data assessment of living organisms' differences on land and by sea, using inquiry. Just by using the ACES site (ACES of Spring, 2018), I became acutely aware of how impactful all the essential elements are intricately connected by every energy source created on earth and in our solar system.

Animals are very engaging phenomena when presented to anyone who likes them. I would introduce tracking animals by flipping the lesson and showing infographics as in the following. (Translating Marine Animal Tracking Data into Conservation ... (2019). An example would be to study marine animal tracking strengths and weaknesses, including but not limited to, compatibility, size, obstacles of use, and design. These engineering analyses could be explored by using methods for designing their own device and what they would include in it to choose what data they would choose to prioritize. I would also incorporate articles similar to those we have read in the course, (A 'FitBit for squid', 2019). We have a Maker Space lab where they can use the raw materials needed for a device. I would use different sized water balloons for attachment possibilities and assessing device strengths and weaknesses. Utilizing the background knowledge of the survival needs for specific animals that live in the ocean vary in

non-absolute and absolute conditions, which could also be used to exemplify the oceans habitants in their ecosystem in the ocean. This topic seems to have endless endeavors, such as varying conditions of devices for salinity of water, Ph, temperature, and more. This lesson could also be tailored for researching the coastal area of their native country (relevance) and using a podcast or scientist interview videos for assessment, (Culture Grams, 2020).

Creating a global awareness in students of how we and other variables impact our food, habitats and weather are enormous issues facing us, even now as we navigate a current COVID-19 pandemic. Using the principles and implementing the fundamental concepts of The Ocean Literacy Project is an exciting academic endeavor I can't wait to begin with my students. As I like to say, the EL curriculum is not for just EL students, it applies to strategies that can be used by any teacher! I also look forward to linking The Ocean Literacy Project with the current MOSAiC expedition (MOSAiC, 2020), findings and lessons to incorporate with students.

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