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Online Professional Learning for Science Teachers of Multilingual Learners

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The eCALLMS Team

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In its 2009 position statement *Science for English Language Learners,* the National Science Teachers Association (NSTA) recommended "that teacher preparation and professional development programs for teachers, regardless of area of certification, focus on science content and pedagogy for English language learners" (p. 2). Since that time, widespread adoption of both English language developments standards such as WIDA (https://www.wida.us) and comprehensive, rigorous science standards such as NGSS (http://www.nextgenscience.org) have provided extensive support in describing what bilingual students can and should be doing in science. While most science teachers have access to

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professional development to support the teaching practices described in either NGSS or WIDA resources, there are few opportunities to support the integration of both language and science standards.

Without specific support for integration of language and science, teachers may perceive rigorous science standards as beyond the capabilities of bilingual students with emerging English proficiency (Cho and McDonnough 2009; Lee et al. 2013; Verplaetse 1998). In crafting the Next Generation Science Standards (NGSS Lead States 2013), the National Academy of Sciences made it clear that the standards apply to all learners, including "students who have traditionally struggled to demonstrate mastery" (v 25, 25). Language and literacy instruction is embedded into the NGSS, and the shift toward greater emphasis on science and engineering practices allows for even greater opportunity for language acquisition. (Lee et al. 2013). Since 2011, the e-Learning Communities for Academic Language Learning in Mathematics and Science (eCALLMS) 1 project has been working to craft professional learning opportunities that support the integration of language instruction in science as is called for by the NGSS standards and the NSTA recommendations. By creating innovative online resources that support professional learning communities of teachers to explore various aspects of language development in relationship to content teaching, eCALLMS (see http://ecallms.ucdsehd.net/) is offering rigorous opportunities for science teachers to meaningfully integrate both language and science content development.

eCALLMS eWorkshop Format and Guiding Principles

Our approach to this professional development reflects our philosophy about the assets of multilingualism and language as a sociocultural practice. We have designed our work grounded in the linguistically responsive teaching framework (Lucas and Villegas 2010, 2011; Lucas et al. 2008) that suggests the orientations, knowledge, and skills content teachers of multilingual learners should have. We also emphasize the value of bilingualism and multilingualism by using the term "bilingual learners" or "multilingual learners" rather than "English language learners" as an effort to help teachers recognize the children they are working with for their assets and linguistic abilities rather than simply their

perceived or real deficiencies in English (Brisk 2006; García et al. 2008; Mitchell 2013). Our eWorkshops also promote critical sociocultural instructional practices as operationalized by the Standards of Effective Pedagogy (Teemant and Hausman 2013; Teemant et al. 2014) and are grounded in the WIDA standards for English language development. Increasingly, our work is also grounded in the literature focused on translanguaging and the social turn in second language acquisition (i.e., García 2009; García and Wei 2014; Valdés et al. 2015).

Informed by these guiding principles and frameworks, we have designed an eWorkshop format that assists in-service science teachers to further their professional expertise around supporting language and content development. Our eWorkshops take an asset-based approach to our audience of practicing teachers and offer differentiated activity choices that ensure the learning in the eWorkshops is applicable and relevant. They are designed for collaborative use by professional learning communities of teachers, rather than by single participants in isolation. Additionally, the eWorkshops were created so that they would not need to be moderated at the university level, rather could be used flexibly by instructional and teacher leaders within schools and districts to further local professional learning goals.

We strive to strike a balance between competing goals: (1) facilitating learning about specific aspects of linguistically responsive teaching, as informed by the literature and what we know about language acquisition, and (2) giving our professional audience control over their own learning and how they apply the learning in their specific context. To accomplish this, each of our eWorkshops has an essential question that provides an overarching framework for the learning that occurs in the eWorkshop. Then, guiding questions that lead the inquiry and learning for each unit of the eWorkshop (there are six in total) offer meaningful opportunities for in-service teachers to grow as professionals. We then offer an *Explore* section where teachers examine new ideas and content through self-selected differentiated learning. Next, there is a *Make it Work* section where we have created multiple options for teachers to apply the ideas and content from the *Explore* section to their practice. Our effort here is to ground theory and research into relevant and applied learning opportunities that are also inquiry oriented. Finally, we have a *Share* section where teachers have the opportunity to collaborate online and *Share* their ideas, successes, failures, questions, etc. after

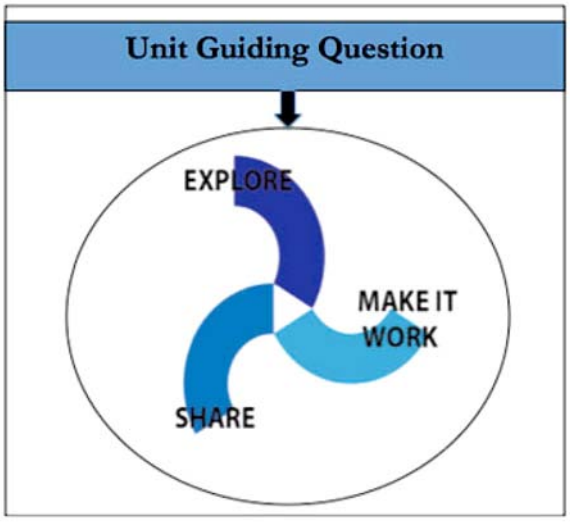

Fig. 1. Visual representation of the eCALLMS model for professional learning

having done the *Explore* and *Make it Work* sections. Each eWorkshop has been developed with this format repeating in each unit over a six-unit learning period, requiring roughly 2 h of a teacher's time per unit. A visual representation of this model of professional learning that our eWorkshops are developed around is provided in **Fig. 1.** We will briefly describe these four components below.

1. Essential/Guiding Questions: An Asset-based Perspective of our Science Teacher Audience

   Just as K-12 instruction should build on the wealth of cultural and linguistic knowledge our bilinguals bring to the classroom, professional learning opportunities for teachers of bilingual students should build on the strengths of teachers' existing practice. For example, by asking the question "How can engaging STEM activities lead to a rich writing and revising practice for bilinguals?," we ask teachers to reflect on the most meaningful learning experiences used in their existing practice. While teachers have the option of exploring example science activities that enable bilinguals to use science in highly contextual ways, we start with the assumption that teachers already do great work, and need time to explore ways to integrate language instruction into the science lesson design.

2. Explore: Differentiated Learning
   Just as bilingual learners can be supported through differentiated learning opportunities and multiple ways to show proficiency, we believe professional learning for teachers should provide freedom for teachers to be in control of their own learning. Each unit of our eWorkshops provides multiple options for teachers to explore content, research and theory related to the essential question and guiding questions. In respect for teachers' busy lives and demanding schedules, teachers are offered a path to keep their work in this section to around 30 min. Our project strives to offer manageable pieces of information that teachers will find relevant and easy to apply to their local context without feeling overburdened or overwhelmed. However, teachers are also offered extended resources to continue exploring the ideas and research that is most interesting and relevant to them as they choose.

3. Make it Work: Relevant and Applied Learning
   Both science content and language learning are facilitated when the learning is highly contextualized to the students' lived experience. We take the same approach to professional learning, by putting the application of learning at the heart of each eWorkshop. Each unit, during the *Make it Work* phase, teachers put the learning into action in a way that makes sense in their own science teaching environment. While the guiding question for the unit is the same for all learners, we provide a variety of options for how teachers may apply new knowledge or ideas garnered from the *Explore* section. Teachers may adjust an activity to intentionally plan for language acquisition, collaborate with language teachers, integrate a new practice into their teaching, or plan for future lessons.

4. Share: Collaboration
   Language learners benefit from making meaning in a collaborative space. In this same vein, we designed the eWorkshops to create an online learning community for teachers. While it is possible for a teacher to explore the resources alone, the learning experience is made more powerful through collaboration. Each unit, teachers discuss their learning online and share the result of their own attempts to apply content from *Explore* and *Make it Work* into their new learning.

The eCALLMS Model of Professional Learning: Related Literature

In developing the eCALLMS eWorkshops, we drew heavily on the findings from Desimone et al. (2002) longitudinal study suggesting the characteristics of professional development programs that were most likely to impact change in teacher practices (i.e. sustained, collaborative, active learning orientation, etc.). We also drew on the work of Cochran-Smith and Lytle (1999, 2009) and their focus on "Inquiry as Stance." They suggest that professional learning communities of teachers should evolve around "knowledge- *of* -practice" where "the knowledge teachers need to teach well is generated when teachers treat their own classrooms and schools as sites for intentional investigation at the same time that they treat the knowledge and theory produced by others as generative material for interrogation and interpretation" (1999, p. 205). The structure of eCALLMS eWorkshops described above creates meaningful learning opportunities for professional learning communities of teachers to treat their own classrooms and schools as sites of intentional investigation where "knowledge-*of*-practice" can be generated and that knowledge can thoughtfully impact the ongoing pedagogical development of science teachers working at the intersection of language and content development.

Additionally, we drew on the literature related to online professional learning that suggests online approaches can be at least as effective as face-to-face coursework (Carr 2010; Fishman et al. 2013) and that it can have positive effects on teachers' instructional practices and content knowledge (Borko 2004; Cady and Reardon 2009; Cavanaugh and Dawson 2010; O'Dwyer et al. 2010; Russell et al. 2009). Research suggests that quality online professional learning environments should offer ways for participants to get to know one another and build a sense of trust with their online peers (Carr and Chambers 2006; Carter 2004; Smith 2014; Sung 2009). The same researchers suggest that to be successful, participants need to be comfortable with the online discussion tools as well as have a strong sense of the expectations for when, where and how to respond to prompts. Further, online work can suffer from low participation and completion rates (Reeves and Pedulla 2011), but is most successful when materials are offered in a variety of multimedia formats (Carter 2004) and there is a consistency in the format and content of the online professional learning space to support

teacher success and motivation (MacKenzie and Staley 2001). We drew on all of these perspectives as we developed and continue to develop eCALLMS eWorkshops.

Finally, the content of our eWorkshops has been deeply impacted by the literature and frameworks described above (i.e. García and Wei 2014; Lucas and Villegas 2011; Teemant et al. 2014) as well as various conceptual frameworks suggesting what content teachers of multilingual learners should know and be able to do (see Viesca et al. 2016).

Implementation of the eCALLMS eWorkshops

Our first set of eWorkshops across three strands (language in science, language in mathematics and bilingual/second language development), were launched for public use in 2013. Since then we have had hundreds of teachers across Colorado, Finland and Germany participate in our eWorkshops and have continued to launch more. Currently we have 10 eWorkshops available for public use with seven more slotted for release in late spring of 2016 and approximately 15 more will be finalized by the end of the grant period (August 2016). It is simple to use our eWorkshops. With 2-week notice, we can launch any interested group into their own course shell for the eWorkshop where they can collaborate with their selected peers in a password protected learning management system environment (we use Canvas). Canvas offers a free platform that works well for our eWorkshops, so there is no cost to users for access to our content. Teacher educators are welcome to use our eWorkshops as well in their work with pre- and in-service teachers. Anyone interested in our work may get in touch with us through our website (http://ecallms.ucdsehd.net/). However, the remainder of this chapter provides content from our eWorkshops that may be used in classes or professional learning approaches with science teachers who work with multilingual students.

Samples of eCALLMS Content and Materials

Grounded in the format and guiding principles described above, we have designed multiple eWorkshops focused on supporting science teachers to expand their expertise around language and content

development for multilingual learners in their classroom. Our program promotes a comprehensive perspective of language development at the word, sentence and discourse level within science classrooms. In this section we offer examples of the work we have designed as well as teacher's work participating in it. For each sample we share two actual responses from teachers who engaged in our eWorkshops and did that particular activity. The teachers are all unique teachers across the samples we share.

Sample 1

eWorkshop Title Inquiry Science for Bilinguals

Guiding Question for the Unit How can open-ended pre-assessments inform me of my learners' assets in language and science?

Context Information During the first unit of the eWorkshop, teachers are introduced to the key concept that pre-assessments should be *biased for the best* (Swain 1984). We look for ways to connect with what students do know, rather than looking for what students do not know. In a pre-assessment with bilingual learners we collect observations in three areas: (1) language use (English and home languages); (2) collaboration, critical thinking, process skills, and; (3) science content. The vocabulary prediction activity is one of several ways to learn about how students use language and what their incoming understandings are regarding the science concepts under investigation.

Make It Work Activity

1. Select a set of key words for pre-assessment. Select words that are essential for understanding, can be used across content areas, are particularly tricky for bilingual learners (homophones, idioms, etc.), and/or lend themselves to interesting conversations about language or content. For example, (a) states of matter: solid, liquid, gas, vapor, melting, boiling, mass, volume; and (b) Weathering and erosion: weathering, erosion, deposition, glacier, abrasion, sediment, meander.

2. Put students in pairs and give them a vocabulary prediction chart (**Fig. 2**). Do a think-aloud with the first word to show how to make a vocabulary prediction. People usually say the word out loud, connect it to other words they know (these can include words from other languages than English), and look at word parts during this prediction phase. Let students complete the prediction column with their partners. Students may use English or any other language they choose. You, as a teacher, are observing the language use, the critical thinking skills, and the science content knowledge.

Vocabulary	Word Prediction	Changes to my prediction

3. Have each set of students pair-up with another set of students. Each group explains and justifies their prediction. If applicable, students can make changes to their predictions in the third column after the conversation and throughout the unit.

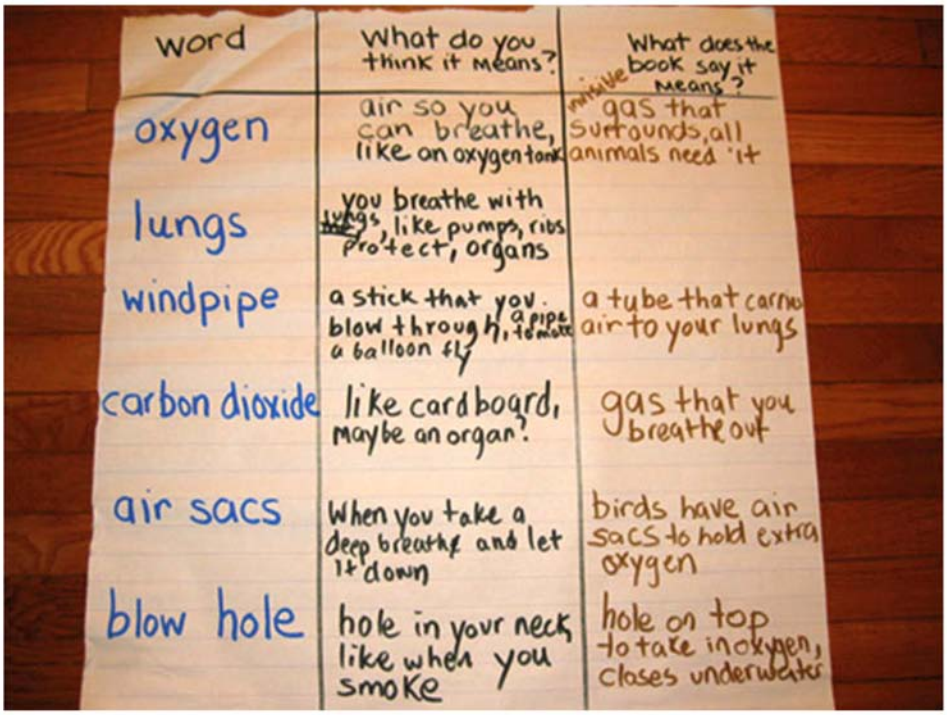

Fig. 2. Example vocabulary prediction chart

Share Actual Teacher Responses to This Activity

Sample 1 Teacher A — I really like this idea of having them predict the vocabulary words first. I had never done this before. I understand the value of not giving students vocabulary words in science until they have first had some exposure to the item or concept and then name it later. Therefore, I have never given the words upfront. However, I thought this was a great way to start to understand some of their preconceptions. I will definitely use it again! …The words that were on the list were Mixture, Property, Solution, Dissolving, Evaporation. What surprised me most is that most of the students thought dissolving meant unable to solve. DIS- Solving. Since they have no background with this word, I thought it was pretty inventive of them to think of that. I was not surprised to see that they predicted property was something they owned (although this made me sad since they have talked about properties in science since Kindergarten) and they all thought solution had to do with solving a problem. This activity that took very little time to plan for, and very little class time, told me a lot about these students' understandings! It is clear that they are not thinking about things in a scientific matter. I am guessing this is coming from the lack of consistent science education K-4. Which means (the classroom teacher) is going to have a larger hill to climb…but at least we are now armed with this information and it is something we can keep in mind while planning future lessons for them.

Sample 1 Teacher B — I really liked the conversation that went with the Vocabulary Prediction. The kids got into groups of 2–3 and talked about what they thought each word meant. Kids who were unsure were able to use the support of their group to come up with a prediction. I didn't give feedback to the kids around their predictions, but I did ask them to explain their thinking about their prediction. The kids then joined another group to make groups of 4–6. They shared their thinking again and wrote their prediction in their science journals. I felt the conversation that went along with the predictions was time well spent. This pre-assessment reminded me that I need to make sure I help my students make better connections between what they already know to scientific vocabulary.

Sample 2

eWorkshop Title Inquiry Science for Bilinguals

Guiding Question for the Unit How can we use student observation to launch the inquiry cycle?

Context Information The inquiry eWorkshop is aligned closely with the NGSS Science and Engineering Practice 1: Asking Questions and Defining Problems. In this activity, teachers use students' natural curiosity about the world around them as a launching point for deeper investigations.

Teachers are encouraged to have students observe simple, everyday phenomena, especially where students will be able to manipulate, and experience in a multisensory way. This enables students to use their existing language repertoire to generate observations and questions, which serves three purposes: (1) students can launch their inquiry in any language or register, (2) the teacher is able to get essential assessment information about the language tools available to students, and (3) the teacher is able to assess students' conceptual understanding (especially when the student is encouraged to use pictures to represent observations that are difficult to express).

This *Make It Work* activity was supported by the flexible learning that takes place during the Explore phase: teachers watched a short lecture describing the power of observing in all languages, and chose between several readings detailing possible student-centered hand-on observation experiences or describing teaching methods for improving scientific observations.

At the core of this unit's learning is the idea that expert scientific observation is not dependent on English language skills. All languages are capable of expressing specific, objective details drawing on all senses, thus learning to observe scientifically in any language is a transferrable skill that will lead to stronger bilingual language skills as well as growing scientific understandings.

Make It Work Activity

1. Work with a small group or with your whole class.
2. Pick a simple observation, which could launch an inquiry. For example:
    - A steady trickle of water meandering down a sheet of glass
    - The temperature of ice and water change as it is heated
    - A drop of food coloring mixed in water

   If you are not teaching water, choose an observation that relates to your current topic of investigation.
3. Plan to use a T-chart, I notice/I wonder.

I notice …	I wonder …

4. Model how to observe:
    - Expert – specific details, quantitative if possible, 5 senses, non-judgmental
    - Novice – non-specific, judgmental, inferences
5. Group students to conduct observations. Encourage all languages, dialects, comments, and uses of conventions on the T-chart.
6. Pair learners or group to share their T-charts.

Share Actual Teacher Responses to This Activity

Sample 2 Teacher A — We modified [an activity in which students experimented with ways to separate mixtures and solutions] and had them write an "I noticed" and "I wonder" about that. Most of their answers were fairly similar–"I noticed the water and salt went through the screen," "I noticed I can see a little bit of the salt in the water still, but not all of it." Their "I wonders" often came up with ideas about leaving the water out in the sun or near a heater and wondering if they would be able to see the salt after the water evaporated. I think this activity was another great way for students to get more practice in writing down their thinking. So often we ask them what they think, but don't have them write about it, so when it comes time for them to write a scientific explanation, it is very difficult for them. I think this is a great way for them to practice and for teachers to be able to see some of those preconceptions that still exist. (One of the students wondered if the salt would

stay melted in the water–they clearly need some more work around the difference of melting and dissolving). I noticed from the student writing that they still need a lot of practice with explaining their thinking. Most of what they wrote was pretty vague (I wonder if we put it in the sun). [eWorkshop Colleague] and I have already discussed their need for precise language so it is a focus of ours. This is just another opportunity to reiterate the importance of it.

Sample 2 Teacher B — Something that I noticed was the students' conversations with their groups were strong. They were holding each other accountable for using specific and scientific vocabulary and what they noticed and what they wondered were clear, focused and centered around scientific thinking. However… the specific vocabulary was missing and as [eWorkshop Colleague] said, what they wrote was vague. This will be part of my focus and work [with another teacher] throughout our work this year!

Sample 3

eWorkshop Title Inquiry Science for Bilinguals

Guiding Question for the Unit What strategies facilitate great discourse?

Context Information In this unit of the inquiry eWorkshop, we focus on classroom discourse specific to science. Participation in classroom discourse, either whole-class or small group, is an essential element of enacting the NGSS science and engineering practices of analyzing and interpreting data, constructing explanations, and engaging in arguments from evidence. Discourse is also an essential part of enacting the Common Core State Standards for English Language Arts (CCSS ELA), one of the top concerns for elementary generalist teachers and an area of increasing emphasis for secondary science content teachers.

For our bilingual students, this work takes on added importance. Oral language practice with discourse patterns of science facilitates both the sense-making needed for a deeper understanding of the content, but the language practice that takes place during argumentation from evidence

is thought to be a key ingredient in the development of the deeper literacy skills needed in all subjects (Lee et al. 2013).

During the *Explore* phase of this unit's learning, teachers watch a short lecture about drawing conclusions through classroom dialogue, and then chose between several options to further their learning. This work relies heavily on the work of Michaels and O'Connor (2012) in promoting active, engaged discussion. The following *Make it Work* activity, one of three options for the unit, involves practicing the talk moves described in the *Explore* resources.

Make It Work Activity Talk Moves can be helpful in all content areas, including math, literacy, social studies, and art. The purpose of this *Make it Work* activity is to plan for the intentional use of two or more talk moves.

1. Plan the setting for the productive talk

   First, you may want to review the goals of productive talk, as described by Michaels and O'Connor (2012):

   • Individual students share, expand and clarify their own thinking
   • Students listen carefully to one another
   • Students deepen their reasoning
   • Students think with others

   Next consider, how will you communicate these goals to your students and remind them (in student-friendly language) of classroom norms for discussion? Then, decide on a setting for the talk: whole class or small group discussion with the teacher.

2. Review the nine talk moves described by Michaels and O'Connor (2012):

   • Time to Think
     – Use pair/share discussion time or private reasoning time. Ensure that each question or prompt is followed by a small amount of wait time.
   • Say More…
     – "Tell me more about that…"

- So, are you saying…
  - Paraphrase the student's answer as a question: "So, are you saying…?," allowing the student to respond.
- Who can rephrase?
  - "Who can use their own words to repeat what _____ said?"
- Ask for evidence or reasoning
  - Ask questions such as "Why do you think that?" or "Can you offer some evidence to support this claim?"
  - Encourage students to ask others for evidence or reasoning.
- Challenge or counter example
  - "Does it always work this way?"
- Agree Disagree/why?
  - "Do you agree? Why?" "Are you saying the same thing as…?" "Does anyone want to respond to this idea?"
- Add-on
  - "Who can add onto this idea?"
- Explaining what someone else means
  - "Who can explain what _____ means when she says that…"

Because it may be hard to keep all of these talk moves in mind, select one or two that you would like to work on for the discussion. Consider putting these moves on note cards to help you remember the specific language you would like to use during student discussion.

3. Plan to how modify talk moves, as needed, for your emerging bilingual learners:

- Reduce linguistic complexity (not cognitive complexity)
  - "Your example provides some support of your model, but are their other cases demonstrate a need for the model to be refined?" → "Does it always work this way? Think of some other examples."
- Speak slowly and clearly. Give extended wait time after each question prompt.
- Refer to concrete items (realia) or use visual aids.
- Allow student to draw, use visuals to explain thinking.
- Give students time to process: "I'll come back in a few minutes…"
- Allow students to engage in talk moves in the language of their choice

4. Plan to gather evidence of student engagement.
   How will you reflect on the effectiveness of your talk moves in building your students' capacity to engage in productive talk? Consider asking a coach to observe you, or recording the discussion to aid in your own reflection and growth.

Share Actual Teacher Responses to This Activity

Sample 3 Teacher A — Last week and yesterday I worked on my talk moves with my class. While I'm trying to make talk moves an automatic habit, I was consciously working on it during these two sessions. Last week, I was using talk moves to help my students develop a well planned procedure to answer the question, "Do all solids have the same solubility." Yesterday, I used talk moves to help my students discuss their conclusions about that question. Without using talk moves, I would not have discovered many misunderstandings and misconceptions my students had. To begin with, I was able to clear up a few misunderstandings and misconceptions around what solubility and saturation is [sic] before the students developed a procedure. The procedure and investigation would have just been playtime for the students without a clear understanding around what they were doing and why they were doing it. As a result of the talk moves yesterday, I made adjustments to future lessons to hopefully prevent a few misunderstandings in the future.

Sample 3 Teacher B — I had never heard the phrase Talk Moves before, however they are something that I use frequently with my students. This week I focused specifically on using the silent signal, rephrasing student observations (sometimes asking students to rephrase another student), and asking students to cite specific evidence for their observations. Since we are a dual language classroom, I sometimes allow my students to respond in either language, so some of my students were answering or rephrasing in both languages. I have found that rephrasing is often very helpful to bilingual students, particularly when they can't quite think of the word they are looking for in the target language. This week we discussed and observed a distillation lab that we had created in October. Our experiment didn't work out as planned, but the student hypothesis and observations were a great opportunity to use some Talk

Moves to help them to broaden their thinking… I will definitely use Talk Moves more intentionally in the future, particularly when expecting students to clarify on their own thinking or process. This will be applicable in all subjects, not just science!

Sample 4

eWorkshop Title The 5E Science Model for Multilingual Students

Guiding Question for the Unit How can I provide comprehensible input for multilingual students in the Explain phase of a 5E Model lesson?

Context Information The 5-E Science Model for Multilingual Students proceeds unit by unit through the 5-Es: Engage, Explore, Explain, Elaborate and Evaluate (Ansberry and Morgan 2007). During this unit, teachers consider how to offer support to multilingual students during the Explain phase of instruction. During this phase, students use their own words as well as content and general academic vocabulary to explain their understanding of the science concepts that they have experienced this far. Interactive Word Walls use visuals, realia, a graphically organized structure, and a student interactive component to provide access to the needed words and phrases for bilingual students. Interactive word walls are connected to the main theme of Unit 3, which is comprehensible input (Krashen 1981). Comprehensible input is the idea that students should be able to understand the concepts and language that are being presented in a lesson. For example, the use of dictionary definitions of scientific vocabulary may offer limited comprehensible input, whereas an interactive word wall is the epitome of comprehensible input.

During the *Explore* section of the eWorkshop, teachers read two short articles (Jackson and Narvaez 2013; Jackson et al. 2011), which explain how to create interactive word walls .

Make It Work Activity Teachers create a word wall on a current science unit following the five steps explained in the articles:

Fig. 3. Example of an interactive word wall from Jackson and Narvaez (2013)

1. Plan the word wall.
   - Determine vocabulary needs.
   - Create a concept map.
2. Create a student work-sheet.
3. Place the word wall (**Fig. 3**).
4. Build the wall in class.
5. Complete student record sheet and word wall together.

Share Actual Teacher Responses to This Activity

Sample 4 Teacher A — I have a sub-par word wall going for science. I thought I was doing a great job of at least keeping up with the words. I was getting the words posted under my alphabet, have the kids use a Frayer type organizer to record the words in their notebook glossaries, and I draw "icons" or black line pictures. After reading the article,

I understand more that, "the most effective word walls include photographs or the actual item (realia)." The other part that really struck me was the interaction piece. I continually struggle with getting kids to use any resource in the room, vocab walls included. I know (but fail to apply) the idea that "student participation in creating and maintaining word walls is crucial." It can be easier and faster to just do it myself. I DO NOT let my students push the responsibility of other aspects of learning off on to me, so I'm not sure why I've taken over the classroom walls/resources. The other part of the article that struck me was how the word walls are organized. When I scanned the article, I immediately said, "that's not a word wall, that's a concept map." As I actually read the article, I began to see how the concept map is really a higher level word wall and has so many more uses. Perhaps with more purpose, kids will interact with the wall more often! This phrase was one that made [me] a believer in this style of word wall, "because they build schema for individual terms through the use of images and manipulatives while showcasing connections between terms in a unit or lesson."

Sample 4 Teacher B — Your post gave me two ideas! 1. What if we let some advanced students [lists students names] design a wall/part of a wall of the classroom. This is just a start, but it could give us some insight to what the kids could envision. We could show them some concept maps of our science topic and let them design one of their own. Then once they do the basics, we could have other kids add in the class as we go. 2. If I'm having trouble with space in the classroom, I could have each kid have a concept map for each unit that they keep and add to in their science notebook. I would have to start it with them and remember to frequently return to it. For some kids it will need to be more supported and scaffolded, but for some kids, they could really go in their own direction. We could have little vocab cards and pictures for them to cut out and glue on.

Outcomes

While research on the impacts and outcomes of eWorkshop participation is ongoing, through the annual evaluation of the eCALLMS project, we have valuable evidence of the impact of this approach to professional

learning for science teachers (and other content teachers) working with multilingual students. Overall, the eWorkshop participants have been positive about their experiences with the eWorkshops. For instance one eWorkshop tester stated that working in the eWorkshop, "Reminded me of the need to build a gradual release model of linguistic structures into every subject." Another tester stated:

> I am always looking for ways to improve. Most often when we change our thinking it is because we have been presented with new information. I am certainly thinking differently about my science instruction, but I am in a state of disequilibrium.

We think it is positive that our eWorkshop was able to help this teacher think differently about instructing multilingual learners in science classrooms, but we also hope that this teacher will continue on with more of our content to work through that state of disequilibrium.

Initial interviews with school leaders indicate that the eWorkshop model may have a powerful effect when used by professional learning communities in schools. One school leader that led an eWorkshop with four teachers in his/her school stated:

> When I went on walk-throughs, when I observed them…I noticed that they were grouping and they were providing support. So one of them had visuals and the other had different sentence strings for students and the other one was doing Total Physical Response, TPR, with students, so I was glad to see those things in their classroom.

The same group leader stated about teacher participation in an eWorkshop:

> At the beginning there was no differentiation. The supports were not evident. And now when I'm walking in the classrooms, I'm able to see supports, so groupings, visuals… vocabulary development, songs. Various supports that teachers are providing, being aware of students' language development stages.

An administrator at a school where many teachers participated in eWorkshops stated about the teachers:

> They absolutely loved the [eWorkshops]…It was something they said was one of the most valuable professional developments that they had ever done…We had a first-year teacher all the way up to someone who had I think it was 27, 28 years of experience. All of the people in the groups felt the same way… they are looking forward to the next time [they can take an eWorkshop].

Another leader overseeing the use of eWorkshops in his/her school stated:

> In particular, people were interested in the fact of the 'Make it Work' section. I think that took some of the theory we see in the 'Explore' section and it makes it concrete. And I think that was the main thing that attracted both the teachers and the school leadership because that was where there seemed to be a concrete connection to actual classroom practice that came directly out of the articles, the theory…or the PowerPoint that we saw in the 'Explore' section.

This same person also mentioned the value of the brief time commitment and accessibility of the content stating:

> I think also the brevity of it. In other words, that it's not a semester-long graduate course. It's a totally different thing. It's a much more manageable piece that is broken down into weeks so that it looks and feels like less of a commitment, I guess, than signing up for a whole class. I think also the brevity of the 'Explore' section, how there's something that's like easy to…maybe not easy to digest, but at least not so daunting in terms of the content. It's pretty accessible in terms of the content, at least in the length of time it takes to read or watch it.

These perspectives are representative of data we've collected and analyzed over the past 4 years of the project from testers and users

including teacher created digital texts in the eWorkshops, surveys, focus-groups and interviews. Based in these data, we feel strongly that the content created through the eCALLMS project for science teachers (and other content teachers) is valuable for teacher professional learning regarding working with multilingual learners. Our research is expanding and growing regarding eWorkshop content and over time we will have data from quasi-experimental studies and other studies looking at teacher motivation and engagement to further define the impacts and outcomes of this work. We will have over 30 eWorkshops publically available for teachers across the globe to use as of August 2016. Our hope is that ongoing work with eCALLMS content can have lasting, positive effects for many teachers, schools and districts.

Conclusion

In this chapter, we have introduced the eCALLMS eWorkshop approach to professional learning for science teachers of multilingual learners. Grounded in research, and designed to impact practice, the eCALLMS eWorkshops have experienced valuable success with science teachers and are worth learning from, using and/or emulating. We have also provided four samples of *Make It Work* activities from various science eWorkshops. We hope these provide valuable tools for various approaches to professional learning for science teachers of multilingual learners. In total, we hope our work offers you either an invitation to join us and use our eWorkshops or at least to benefit from what we have learned and shared with you here.

In summary, we feel that science classrooms have an excellent opportunity to promote strong language development activities, particularly when language is treated like a verb and mapped meaningfully onto the hands-on and engaging activities that can so easily take place in strong science content instruction. We strive to help teachers to create "languaging" experiences for students in science through an active inquiry approach in their own practice. We also strive to support teacher professional learning by creating flexible learning opportunities where teachers make choices and engage in work that is most relevant to them and their students. Overall, we hope that the ideas and resources provided here will help to continue to improve the quality of instructions for science teachers and their multilingual learners through the ideas and resources we have provided.

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