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SMEC 17

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SMEC 17 MISSION STATEMENT

The SMEC Conference is an annual event designed to promote the continued development of a professional community of mathematics and science educators across Lebanon and throughout the region. Specifically, the conference aims to:

- Provide an intellectual and professional forum for teachers to exchange theoretical and practical ideas regarding the teaching and learning of mathematics and science at the elementary, intermediate, and secondary levels

- Provide a forum for teacher educators and researchers to share their findings with science and mathematics teachers with a special emphasis on the practical classroom implications of their findings

- Provide an opportunity for science and mathematics teachers to interact with high-caliber science and mathematics education professionals from abroad

- Contribute to the ongoing development of a professional culture of science and mathematics teaching at the school level in Lebanon and in the region

- Raise awareness of science and mathematics teachers about the array of curriculum and supplemental classroom materials available to them through publishers and local distributors

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Plenary Session 1

Mathematics and Science Education in the Context of Language Diversity: From Language-as-Problem to Language-as-Resource
(Only abstract included for the following session)

Professor Mamokgethi Phakeng, PhD (Wits), University of South Africa

What does it mean to learn and teach mathematics or science in a classroom where students speak a variety of languages but none has the language of learning and teaching (LOLT) as their main or home language? Such is the situation in a majority of urban classrooms all over the world. How is mathematical learning enabled and/or constrained in such complex linguistic sites? What strategies are appropriate for use in these classrooms? Embedded in these questions are theoretical and pedagogical questions about language and learning, and language and mathematics/science and political questions about language-in-education policy. In this presentation I will draw on my research experience in multilingual mathematics classrooms in South African to explore these broader questions. I will begin the presentation with a brief review of research in this area of study. Through this I will show how research in this area has moved from a conception of language-as-problem to language-as-resource. These discussions will provide a theoretical context for a description and analysis of a strategy that I have developed for multilingual mathematics classrooms in South Africa to ensure that learners are given the language support they need in order to succeed. From these empirical and theoretical bases I will draw out my argument for the deliberate, proactive and strategic use of the learners' main languages as a transparent resource in the teaching and learning of mathematics and science in contexts of language diversity.

Mini Plenary Session

What Do School Leaders Have to do with Math and Science Teaching and Learning in The 21st Century?
Marjorie Henningsen, Grey Matters Education, Lebanon
(Only abstract included for the following session)

Although they are not often directly involved in day to day classroom life, school leaders play a crucial role in supporting math and science teaching and learning in the 21st Century through 1) establishing and maintaining a supportive, innovative school ethos and learning community; 2) being learners themselves and inquiring into their own practice; 3) having a well thought-out professional development plan for teachers and coordinators; and 4) creating opportunities for transformative discussions among teachers, administrators, students and parents.

Investigating the Science Process Skills in Cycle 3 National Science Textbooks in Lebanon
Samar Zeitoun & Zeina Hajo, Lebanese University of Beirut, Faculty of Education, Beirut, Lebanon

The purpose of this study is to examine the level of inclusion of basic and integrated science process skills in Lebanese national science text books for cycle 3 and to compare the basic and integrated process skills across subjects and within the same subject across the 3 years. For instance, the study focused on the science process skills (SPS), that have been neglected in some textbooks as well as the maximum percentage of each science process skills, for the three subjects (physics, chemistry and biology) across the three years in cycle 3: grades 7, 8 and 9.To that end, the researchers use the analytical descriptive method, and content analysis. The study revealed that the percentage of basic skills in the textbooks analyzed for all grades was higher than that of the integrated skills. The study revealed also that there is emphasis on some skills at the expense of the others and there is no consistency in the total number of skills across skills or subjects. Furthermore the study revealed that within the same subject some skills disappear from one grade to another. The study ends by recommendations regarding reviewing textbooks regarding the inclusion of science process skills in a way to ensure coherence between the content of the textbooks and the new evaluation system.

The session is organized as follows:

A PowerPoint presentation divided into three parts:

Part I (9 min) Introduction and Research Questions

Lebanese students lag behind in math and science – study. The national and international assessment results indicated that Lebanese students' conceptual understanding in science and basic inquiry skills are far behind the expected levels. Eighth-grade school children in Lebanon perform below the international average in mathematics and science (HSRC, 2012; MEHE, 2010). According to Boujaoude (2007), curricula in twenty-first century effort-based schools cannot continue to focus on old basics. Critical thinking and problem-solving should be the new basics in the new millennium. It is impossible to teach content without teaching thinking skills and thinking skills without content.

Science process skills have been described as mental and physical abilities and competencies which serve as tools needed for improvements in problem solving, technology as well as individual and societal development (Ozgelen, 2012). These skills also great influence on e ducation because they help students develop mental processes such as problem solving, critical thinking and making decisions (Cheng, 2004). This is perceived by Lebanese stakeholders as an essential in succeeding at international tests such as TIMSS where Lebanese students had poor achievements.
The purpose of this study is to determine the science process skills included in the science textbooks issued by the NCERD for cycle 3 in Lebanon; that is, the 9 science textbooks for the 3 subjects: biology, chemistry and physics. The study is important as it is perceived that the benefits of school textbooks as classroom resources are seldom queried. Textbooks are often described as the tools of the teachers' trade and as a means for spreading knowledge (Kamm & Taylor, 1966) and acting as the primary source of knowledge for most students (Gottfried & Kyle, 1992). "Teaching, assessment, and the quality of

textbooks used are also important factors that need to be considered if students' experience with science is to be complete and fulfilling" (BouJaoude, 2002, p. 154).

The research questions are:

What are the percentages of basic and integrated science process skills in the Lebanese national science textbooks for cycle 3?

Are these skills distributed equally in the 9 books or vary depending on discipline and grade level?

Part II (5 min) Method

To achieve the goals of the study, a measuring instrument was developed, based on content analysis framework, to analyze the content of nine science textbooks (grades 7, 8 and 9) according to science process skills (SPS). The two researchers examined the various national and international benchmarks to establish definitions for each skill. The measuring instrument is a form that includes definitions for each element of the SPS supported by examples relevant to the textbooks' content and on which the 3 coders agreed. This instrument was prepared based on a system of categories covering all aspects relevant to answer the research questions. Different meaning units (propositions) are then assigned to different categories already identified theoretically on basic and integrated skills (Chiapetta & Koballa, 2010, Abruscato, 2004; Martin et al., 2009).

The two researchers with the assistant who developed the coding instrument (meter) worked closely on the project to establish common meanings and hidden coding. They analyzed the same book simultaneously. They started by grade 7 manuals. Each researcher individually classified the different themes of the first unit of the manual. Researchers then met after the analysis of each chapter to reconcile difference in categorization and consistency. For the grades 8 and 9, the analysis of each subject was carried out by 2 coders and Intercoder reliability was calculated to measure the congruence between coders. The percentage of agreement among coders ranged from 0.85 to 0.89 which showed a high degree of agreement among raters.

Once all the issues are sorted, the statistical analysis of the identified skills was carried out using computer wizard to extract their frequencies and percentages (Krippendorff, 2004).

Part III (8 min) Results, Discussion and Implications for Practice

Comparison of skills across subjects and grades

There is inconsistency in the total number of skills across the 3 grade levels for the same subject or across the same grade level for the 3 subjects. Chemistry has the least total number of skills for the 3 grades as compared to biology and physics whereas the highest total number of skills was for physics. In chemistry the total number of skills was the lowest for grade 9 (97) whereas in physics it was in grade 7 (333) and in biology in grade 8 (195).

The total number of skills decreased in chemistry from grade 7 to grade 9 whereas it has increased in physics. In biology the number dropped in grade 8 to rise again in grade 9 but remained less than that of grade 7.

While "observe", "infer" and "experiment" are the most prominent skills in chemistry, "observe", "infer", "predict" and "experiment" are the most prominent in physics and "predict", "infer" and "communicate" are the most prominent in biology.

The skills “measure”, “design experiment”, “formulate hypothesis” and “classify” are almost null in chemistry, “classify”, “design experiment”, “formulate hypothesis” and “interpret” almost null in physics, “classify”, “measure”, “design experiment”, and “formulate model”.
The analysis showed that, for all subjects and across the 3 grades, the basic skills are more frequent than the integrated skills. However, there is departure from a general pattern as the percentage of basic skills in chemistry decreased from grade 7 to grade 9 while that of integrated skills increased whereas for biology and physics the percentage of integrated skills remained almost the same.
The above analysis indicated that the new science curriculum lacked a coherent and well thought-out framework regarding science process skills. The Lebanese government set, in 1999, a new evaluation system based on evaluation of competencies and the NCERD published evaluation guides for all subjects and cycles. For example, one general objective of the new NCERD (1997) curriculum is to “develop learners’ intellectual and practical scientific skills”. This new evaluation system was considered as a significant step forward in the development of new curricula (NCERD, 1999). The “applying knowledge” domain included skills such as analyzing data, observing documents, applying appropriate knowledge and evaluating the validity of results. In the “communication” domain, the students are expected to draw out appropriate information from diagrams. Added to this are the domains of “conducting an experiment, explaining phenomena by observation and hypothesizing, and drawing charts or graphs”. These competencies as defined by the NCERD were supposed to cover what is known as science process skills.

Concerning the implications of this study for action, the new national science curricula must consider science process skills as the building blocks from which suitable science tasks are being constructed. Teachers also are supposed to inculcate these science process skills to the learners and hence teachers’ conceptual understanding of these skills is critical. Science content taught in science classrooms should be used as a mean to develop science process skills (Nyakiti et al, 2010).

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Science Teachers' Views of an Instructional Resource for Guiding Students to Explore a Controversial Issue through Reading

Hagop A. Yacoubian, Haigazian University, Beirut, Lebanon

This study examined experienced secondary science teachers' views of the feasibility of an instructional resource that can be used to guide secondary students explore a controversial issue through reading. Guiding students explore controversial issues in science classrooms is significant for preparing future citizens who can make informed decisions on science-based social issues (Kolstø, 2001a, 2001b). Fang et al. (2008) and Morrison and Young (2008) have highlighted the importance of reading as an essential tool in doing science, and Ford (2004a, 2004b) has argued that reading text ought to have a conspicuous place in the science classroom. Tenopir and King (2004) have shown that reading (and writing) text occupies much of the working time of scientists. Thus, in addition to prominent manipulative and hands-on components, science has prominent reading and writing components. Norris and Phillips (2003) called attention to the role of language as being integral to both science and scientific literacy.

Preparation of the Resource

The resource included two pieces of adapted primary literature (APL) and a unit based on the APLs. The researcher developed and used APLs in this study - adapted version of primary research articles for science learning at the secondary level (Falk, Brill, & Yarden, 2008). Research shows that secondary students tend to pose questions that reveal a higher level of critical thinking when they learn science through APL (Norris, Stelnicki, & de Vries, 2011). Baram-Tsabari and Yarden (2005) showed that secondary students who read an APL text better understood the nature of scientific inquiry and raised more scientific criticism of the researchers' work than did students who read a popular scientific text.

The researcher chose a health-related topic, namely the health effects of low-intensity electromagnetic radiation from cell phones, for secondary students to engage in exploration of a controversial issue. The students would be guided to explore the extent to which cell phone usage should be regulated by law. Two articles were chosen that were published in the same year in peer-reviewed epidemiological periodicals (Ahlbom et al., 2009; Khurana et al., 2009). These two groups of researchers have performed meta-analyses of studies published to that date. Despite the fact that they had access to the same data sets, they have arrived at somewhat contradictory conclusions. The researcher adapted these two articles following Yarden, Brill and Falk's (2001) approach. The APLs were read by an epidemiologist to make sure that the substantive content was kept intact and accurate. After adapting the primary literature, the researcher used the APLs as bases to develop a unit that focused on guiding learners to engage in reading while exploring the controversial issue in question.

Procedure

A framework proposed by Nistor, Dehne, and Drews (2010) was used to study the experienced science teachers' views of the resource. The teachers were regarded as partners in the production of the resource in question. Nonetheless, the present study diverged from Nistor et al.'s in that not all of the feedback received from the participating teachers led into product modularity, or changes in the resource as product. Some of the feedback received was used to generate recommendations for in-service science teacher education.

Seventeen experienced secondary science teachers from three schools in Lebanon were enrolled in this study. The teachers participated in a 4-hour-workshop, led by the researcher, the purpose of which was to get introduced to the draft resource. The researcher utilized a learning cycle to introduce the draft resource to the teachers. After the completion of the workshop the teachers were asked to complete a questionnaire which contained a list of open-ended questions that aimed at collecting qualitative data to elicit (a) feasible features of the resource, (b) non-feasible features of the resource, and (c) recommendations for improvement. Semi-structured in-depth interviews were also conducted with 16 of the 17 participants. Interviews were audio recorded and transcribed. The questionnaires and the interview questions were pilot tested before being used. Data from the questionnaires and transcribed interviews were analyzed qualitatively using Miles and Huberman's (1994) approach.

Results

Fifteen out of the 17 participants found the resource to be somewhat feasible for inclusion in a secondary level science course. One teacher found it to be very feasible and one teacher found it non-feasible. Table 1 shows the features of the resource that the participants thought made the resource feasible and those that made it non-feasible.

Table 1

The Feasibility and Non-Feasibility of Features of the Resource as Identified by the Participants

	Features																
Part.	rel	ali	nos	cri	eng	int	lan	dif	res	str	tim	pre	siz	con	ass	lev	rea
1	+	+							-		-					-	
2				-			+			+						-	
3		+							+		-						
4	+			-							-					-	-
5							+	+			-	-					
6	+			-			-	-			-					-	
7			+								-						
8	+					+								-			
9	+	-		+							-						
10		+	-			+					-			-			
11					+						-				-		
12				+							-			-	-		
13	-													-			
14			+	+										-			
15											-			-			
16		+									-	-	-				
17	+	-															

Note. rel = relevant to student’s lives; ali = alignment (or its lack of) between curriculum and the resource; nos = ‘nature of science’-related content; cri = critical thinking; eng = engaging; int = interesting; lan = language; dif = difficulty level; res = resources; str = structure & organization of the unit; tim = time; pre = preparation for teaching; siz = class size; con = controversial elements involved in the resource; ass = assessment does not target NOS; lev = learning levels &/or various needs of students in the same class; rea = reading; + denotes a feature that makes the resource feasible; - denotes feature that makes the resource non-feasible.

Controversial elements. Six teachers thought that the controversial elements decreased the feasibility of the lesson itself (Table 1). The interviews showed that three teachers considered them to be non-useful in the unit and three considered them to be non-interesting. There were two lines of arguments made by these teachers.

The first line of argument is that the controversial elements of the resource will confuse students:

I think it is a problem when students will not be able to come up with one simplified conclusion, especially they are not up to the level when they can manipulate different criteria. They need to memorize something. That's why I don't like quantum physics. I find it confusing even to myself. (I8)

The second argument is related to the controversial elements of the resource making students lose their trust in science:

Students are already very much politicized in our country and tend to drag everything to politics. Many of them have already lost trust in politics and politicians. When you get them to discuss nature of science and how science can have different point of views… some of the students will actually be more skeptical about science and will refuse some of the facts that we consider something trivial. We have to play safe. (I10)

Participant 7's feedback is worth highlighting in this section. This participant found the controversial elements involved in the unit useful for students, yet she believed that her students would not find the controversial elements to be useful. She writes:

It [the lesson] is presenting two different research on the same topic with different conclusions. So it is a good model to represent science or NOS… [but] they [students] might think that they didn't come up with a conclusion and that it is hard to understand. (Q7)

Nonetheless, this participant was ready to compromise to ensure that her students would find the unit useful. She recommended: "find less contradictions to point out and focus on the facts more" (Q7).

Reading. Three participants found reading to be a challenge for their students. They suggested reducing the amount of reading required as part of the background context of the unit:

Researcher: I notice that you mention reading would make the unit less interesting. Why do you say so?
Participant 6: Students nowadays do not like reading. They find it a boring activity.
Researcher: Why do you think so?
Participant 6: It's a general culture thing. Kids are more interested in video games, Internet and chat than in reading.
Researcher: How do you address this issue in your science classrooms? Do you assign reading for your students?
Participant 6: I feel I'm giving less reading nowadays because the students would not read. I sometimes try to find other ways that can engage the students more in the lesson like hands-on activities.
Researcher: Do you think that replacing reading by hands-on activities would work?
Participant 6: I think students have different learning styles. A few of them would enjoy reading but others would prefer doing things. As long as my students are achieving the objectives I do not mind changing the means. (I6)

Discussion and Implications for Practice

The majority of the participants found the resource to be somewhat feasible for inclusion in a secondary level science course. There were a number of features identified in this study that the teachers claimed would make the resource more feasible. Some of these features need to be taken into consideration in attempting to improve the resource or to prepare similar resources. The participants' recommendations can be grouped under fourteen features. These are (1) the relevance of the unit to the lives of students; (2) the alignment of the unit with the science curriculum being used; (3) the adaptation of the unit, in general, and the background context, in particular, to the learning levels and/or the learning needs of various students in the same class; (4) the extent to which the unit is engaging in nature; (5) the involvement of scientific content knowledge; (6) the involvement of NOS-related content; (7) the involvement of elements that engage students in decision making; (8) discussions; (9) critical thinking; (10) the organization of the unit; (11) the details of the background context; (12) time limitations; (13) reading required from students; and (14) controversial elements involved in the unit. It is important to note that not all features identified by the participants need to be given equal weight while producing new resources or reviewing the resource package that was prepared. While adapting the background context to the learning levels and/or the needs of various students might be a plausible path to follow, removing controversial elements from the unit might not be so.

Controversial elements in the unit make it authentic and establish a context for students to engage in critical thinking. Nonetheless, many teachers considered the presence of controversial elements to be problematic. The view that students might lose trust in science as a result of being exposed to controversial issues is raised by science educators (e.g., Driver et al., 1996; Kolstø, 2001).

Reading in the context of science was chosen to be the focus of scientific inquiry in the unit. Norris and Phillips (2003) differentiated between the *fundamental* and *derived* senses of scientific literacy. They highlighted the centrality of text in Western Science and argued that reading (and writing) are constitutive of science and are not merely tools for doing science. From this perspective, reading was viewed in the present study not only as being a tool to facilitate thinking among learners, but as inherent to the thinking process itself. Some participants found reading to be a challenge for their students. Instead of thinking about ways to encourage their students to read more, they suggested reducing the amount of reading required as part of the background context of the lesson. They viewed reading as a tool or a means that one could use in order to engage in science learning. Such a position assumes that reading is merely a tool and is situated outside science.

The results reported in this study are of interest to researchers, teachers, curriculum designers, resource developers and teacher educators. In addition to the two pieces of APL that can be directly used in secondary science classrooms, the study made possible a list of teacher-generated features that can be helpful in designing similar instructional resources and in developing effective in-service teacher education modules.

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Earthquake Preparedness Initiative: Spreading Awareness in Schools
Dr. Hoda Baytieh, American University of Beirut, Beirut, Lebanon
(Only abstract included for the following session)

Lebanon is one of the most urbanized countries in the East Mediterranean region and is highly vulnerable to earthquakes. There is no question or doubt regarding future earthquake threats in Lebanon**;** a country that has insufficient infrastructure to respond to such a threat with poor disaster planning and practices at both the government and local community levels. Previous earthquakes have shown that students and teachers are among the most affected populations by such disasters. Thus, the Lebanese school system has a substantial responsibility to increase earthquake awareness while strengthening community resilience against disasters. Schools should seriously consider earthquake threats and should advocate and campaign to promote awareness, preparedness and schools safety regulations. There is a lack of awareness regarding earthquake threats among the majority of school administrators and teachers in Lebanon that must be urgently addressed, and this workshop is a part of an effort aiming at reducing the vulnerability of Lebanese students and schools to earthquake threats. The purpose of this workshop is to shed light on the existing seismic risks in Lebanon, to show preparedness strategies and mainly to motivate teachers to integrate this knowledge into their own communities and school's activities.

All Teachers are language Teachers: What Does That Mean for School Leaders?
Ghinwa Itani Malas, Grey Matters Education, Beirut, Lebanon

One of the major complaints from teachers in both private and public schools in Lebanon is that a lot of students are failing to develop language proficiency in any language of instruction, whether mother tongue or additional language, and across all grade levels and subjects. Consequently, students are not only unable to engage meaningfully in learning activities, oral discussions and written assignments, but also fall behind in developing deep conceptual understandings in any subject. This is not a surprise, when in an environment that aims to develop multilingualism, language is still thought of and taught as a separate subject that some students do better at than others. However, if language, any language, is considered a tool to communicate information, thoughts and ideas as well as to make sense of what's happening around us, there must be a paradigm shift to support how this is translated into the classroom. School leaders, administrators, pedagogical coordinators and teachers need to change their perception of the role of language and view it as a tool for communicating and making sense, and think of the implications of such a mind shift on the policies and practices at school, including changes in the curriculum and assessment procedures.

All teachers are language teachers, regardless of what language, subject, grade level they teach, and if the language they teach in is the students' first, second or third. This means that it is the responsibility of all the leaders and teachers at school to support students' language learning, since language is the most prominent vehicle to communicate ideas and make sense of them in all aspects of life and in all subjects, including math and science. However, in most schools in Lebanon, although the aim is to develop bilingual or multilingual learners, language is still viewed and taught as a separate subject, which puts all the responsibility to develop it with students on the shoulders of the language teachers solely. Consequently, students do not get the needed support to develop their language skills in various contexts, find major difficulties in engaging meaningfully in learning activities that require a higher level of language proficiency, especially in scientific subjects, and struggle and frequently fall behind in developing deep conceptual understandings in many subjects.

In order to change this situation, administrative and pedagogical leaders and teachers need to change their perception of the role of language and view it as a tool for communicating and making sense, and ponder on the implications of such a mind shift on practice. School leaders must understand that a paradigm shift is needed with all the stakeholders at school in order to support this idea and put it in practice. Therefore, they have an important role to play in influencing how language is viewed, taught and assessed at their schools. They also have the responsibility to initiate and support changes in the curriculum, school policies, classroom practices and assessment procedures that will help the school community to move toward achieving this shift in the mindset.

The session will be divided as such:

a. Introduction of the topic in a Power Point presentation
b. Participants share in small groups what they have done at their schools to improve language acquisition, what worked and what didn't
c. The main ideas discussed will be shared with the whole group
d. In their small groups, participants discuss and come up with the steps they need to take in order to help the stakeholders in their school communities move toward a mind shift about language as a tool and not as a subject
e. Participants will then individually develop an action plan that will help them reach their goal
f. Some examples of action plans will be shared and feedback given

In conclusion, it is hoped that as participants engage in developing an action plan, they take ownership of following up on it after the session, elaborating on it with their teams at school, and seeing how it can be put into action in their own context. It takes time to change one's mindset, but when school leaders realize that in order to enhance student performance, improve results, and engage children in tasks that require higher order thinking and develop deep conceptual understanding, they have to seriously reconsider how language is being approached. This will not only improve language acquisition, but will directly influence students' deeper understanding in all subjects and therefore their interest in learning as well. Considering language as a tool for learning, making sense and communication instead of a subject will impact the whole curriculum and pedagogy at school.

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Reaching and Teaching Google Generation

Amira Saoud & Marwa Najia, Makassed, Aicha Om El Mo'minin School, Saida, Lebanon

So far, it seems that our students are no longer the people our educational system was designed to teach. Today's students have spent their entire lives surrounded by and using computer, online web pages , video cams, and all the other tools of the digital age. Web tools are actually very beneficial to today's "Digital Native" kids since they are learning through these tools important "future" skills such as collaboration, problem solving, strategy formulation and execution. Padlets, Blogs, class dojo, and hot potatoes will be explained and showcased as communication, instructional and performance tools in the classroom. Participants will be introduced to the main features and techniques of web tools to help them speak the language, use these tools in their math classrooms, and make learning relevant to the 21st Century. Participants will work on several web pages and apply plenty of online activities on computers. Meanwhile they will be provided with handouts and useful websites to help them locate and create ready-to-use Web lessons, assessments, and more open atmosphere where students are expected to stay engaged and participate in class.

This workshop aims to help teachers step into the world of the digital native learners. This session highlights 21st century technology skills since we are teaching today students who have never known a world without technology. Through this session, participants will learn more about 21st century technologies. They will interact using a wall and learn how to publish it. Also they will set-up a blog for their math classes. Since technology can be an awesome tool in the classroom, the presenters will show participants useful and fun online application that engages students in learning and can be used to daily record students' behavior and achievements "class dojo". By the end of the session, participants will apply and use an online assessment "hot potatoes" in order to apply it in their classes.

The session is planned as follows: (a) Introduction of presenters and participants and expectations of workshop (5 minutes); (b) Presenting an inspirational video and having participants comment on it using padlet (10 minutes); (c) Discussing the beneficial uses of a padlet in a math class and giving participants the opportunity to create their own walls on the padlet (15 minutes); (d) Presenters will show participants how blogs can be used in math classes. Participants will then be given the opportunity to use the internet and create their own blog (20 minutes); (e) Introducing the idea of using online assessment through "hot potatoes". In this part, participants will be answering multiple choice questions prepared on hot potatoes to find out how this online assessment can be useful in classrooms and how it engages digital natives in learning process (15 minutes); (f) Discussion and sharing examples of what has worked and not worked in the workshop including handouts clarifying the benefits and steps of preparing: padlet, blog, hot potatoes, class dojo. (10 minutes)

Our digital native students learn differently, and they prefer visual information over text. Thus the manner in which students are taught will not truly change until the manner in which we teach and evaluate students change.

Learning Through the Real World: Math and Language Skills Through Inquiry
Reem Maktabi & Nisreen Ibrahim, Grey Matters Education, Beirut, Lebanon

Introduction

Research has shown that children learn better by using an inquiry-based approach to teaching and learning in order to meaningfully make sense of the world around them. Inquiry is defined as a learner-centered approach to teaching and learning where students use their own questions and interests to drive their learning. They ask questions, collect data, analyze, reflect, conclude, and ask more questions in order to develop enduring understandings. This approach lends itself to using real-life experiences as contexts for learning. As a result, skills from different academic disciplines (subject-areas) are integrated, learned, developed and used as tools to inquire into real-life authentic situations. This approach to teaching and learning answers questions students usually ask such as "Why am I learning this?" which allows them to give meaning and purpose to their learning. Participants in this workshop will engage in activities that require identifying possible real-life situations that can serve as opportunities for developing math and literacy skills. The workshop will also give participants the chance to plan for the integration of math and language skills by designing inquiry activities, identifying disciplinary objectives, and specifying assessment tools. By analyzing real student work, participants will understand that all teachers, no matter what subjects they teach, are language teachers in the real world

This session will help participants develop an understanding of the importance of viewing language as a fundamental aspect of learning, communicating and thinking regardless of which subject they teach. Language is a connecting element across subjects and the focus in the classroom should not be on language for its own sake but also on its use in other subject areas. Research shows that children learn when they are engaged in authentic situations that reflect real-world phenomenon. Therefore, learning is more meaningful when students have a chance to make connections across and beyond subject-areas. "To be truly educated, a student must also make connections across the disciplines, discover ways to integrate the separate subjects, and ultimately relate what they learn to life" (Boyer, 1995). Exploring connections between and beyond subjects is made possible when using the inquiry approach to teaching and learning. Inquiry is a dynamic process of learning where learners have the opportunity to construct their own learning by asking questions about real-world, significant and engaging problems. Learners engage in a process of investigation that comprises collecting data and information, representing data and creating models, constant reflection on new understandings and making connections between ideas being explored. This process also includes asking more questions after a lengthy investigation that might or might not be answered, which leads to a deeper understanding of the nature of knowledge (Goldman, Radinsky, Tozer, & Wink, 2010). One way to integrating subjects is by using real-life situations as contexts in order to develop mathematical and literacy skills. One of the goals of this session is to help participants in identifying authentic learning experiences that can be used to fulfill curricular requirements across the disciplines using the inquiry approach. Mathison & Freeman (1997) state that "interdisciplinary/integrated/integrative approaches are not simply attempts to combine two or more knowledge cases, but also to do so in ways that are more inquiry oriented, hands-on and connected to the real world" (p. 14). Accordingly, another goal is to practice planning using an inquiry-based approach to teaching and learning math and language. Presenters will provide samples of student work for participants to analyze and use as an inspiration to plan inquiry-based activities.

1. **Strategy:**

Presenters will use a hands-on and minds-on approach to leading this session. Participants will have time to work in groups, share ideas, engage in discussions, and ask questions. Teaching strategies used by the presenters of this session could easily be transferred to the classroom. This would be made explicit during the session. Work produced by the participants will be displayed and used as a reference for discussion.

2. **Description of session:**

The session is planned as follows: (a) Brief introduction and share agenda of session (3 minutes). (b) Introduction to inquiry: define inquiry and share different inquiry cycles and examples from the classroom (10 minutes) (c) Discuss different types of integration with examples (10 minutes) (d) As a whole group, participants will sort different examples of integration into authentic vs. superficial (5 minutes) (e) Presenters will provide sample student work. Participants will use them to identify 1. Possible disciplinary skills and objectives 2. Inquiry indicators 3. Forms of assessment (25-30 minutes) (f) Groups share their findings and discuss (15 minutes) (g) Presenters will have a question and answer session about topics/ideas discussed in the workshop (5 minutes).

3. **Conclusion & Suggestions:**

It is highly recommended that artifacts from the classroom and student work are used during workshops. This will help participants to take away practical strategies to apply in their own classrooms.

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Theatrical Math

Dalia Sous, Israa Fawaz & Abed Al Wahab Kassir, Houssam Hariri High School, Saida, Lebanon

In our multi-dimensional society, divergent thinking is vital for success and innovation in every field and aspect of life. Whether in school, businesses, or the society at large, thinking out of the box and reaching out for a multiple-perspective analysis are at the core of our society. This workshop tackles the topic of how teachers can implement the idea of "multi-dimensional analysis" in their classrooms to maintain the cognitive growth of their students and to encourage students' deep-level analysis and acquisition. The workshop is going to utilize Mathematical concepts with the integration of theatrical performances, innovative and creative activities as well as a gallery walk to show how math can be vital in developing student cognition.

This workshop aims at providing teachers and educators with innovative and creative ideas on implementing the strategies of open-ended questioning, Mathematical mind-games, innovational activities, and theatrical performances and demonstrations to encourage cognitive development and multi-perspectival analysis. In the 21st Century, the world is more than in need of such concepts which are essential for sustainable development and creative thinking. In this session, participants will encounter a variety of activities aimed at enriching their understanding and expanding their current knowledge on how simple and complex Math equations can be treated in different angles or perspectives in a classroom and why such analysis is vital for students' profile. Participants will be encouraged to think creatively and diversely to come up with solutions to situations which seem at first hand to have one solution only. They will be enticed to push themselves to the limits, thinking of alternatives to what they currently believe in and utilizing theatrical demonstrations throughout the process.

The session is planned as follows:

a) Inspirational video that highlights on divergent thinking. (5 minutes)
b) Brief introduction on divergent thinking and its importance as a skill of the 21st Century social being. (5 minutes)
c) "Ice breaking" activity to get acquainted and introduced to each other. (5 minutes)
d) Presentation on why, how, and when multi-dimensional analysis should be implemented in the Math classroom. (10 minutes)
e) Participating in theatrical activities that encourage thinking out of the box and formulating different solutions for problems that are related to Math. (15 minutes)
f) Math show prepared by students of HHHS which shows implementation of multi-dimensional thinking throughout theatrical performances at school and dealing with the concepts of order of operations and geometrical shapes. (10 minutes)
g) Gallery walk and reflections on workshop ideas and topics presented. (15 minutes)

h) Concluding that thinking in different perspectives is vital for success in the work field, for cooperative learning and working, for problem-solving strategies, for tolerance of people and na tions, and for leadership skills. (10 minutes)

Creativity and Innovation Through Science
Sabine El Kahi, Wellspring Learning Community, Lebanon

Several researches explored the importance and effectiveness of hands-on activities in education. It has a major role in understanding concepts instead of memorizing statements. What if, in science, these hands-on activities where developed not only to understand scientific concepts but also see their application in our daily life? In this session, hands-on applications will be presented, helping in making clear for students that science is about understanding how things work around us and how we can improve our environment and living through science. Finally, a presentation about makerspaces and open source technology in schools, their importance and impact on skills development for students as well as results of a makerspace implementation in Wellspring Learning Community will be shared with the audience. Science should be for students a fun session to understand what is happening around us and a tool to start innovation and contribution in improving our environment.

1. Introduction:

Science is a tool that help us developing new ideas and projects. In the session "Creativity and Innovation through Science", new ideas of how students can be engaged in science classes through videos and simple experiments as well as examples of some hands-on projects that can help students understand scientific concepts are presented. That way, the science class becomes the session where they understand in a fun manner how things work and how can they make use of what they learned to develop their projects.

2. Strategy:

- Introduction and presentation about the importance of hands-on science activities in the learning process (15 mins)
- Videos and examples of hands-on activities showing the approach in class with students (20 mins)
- Makerspace in schools: importance, implementation and opportunities for new ideas to be born (20 mins)
- Activity on small machines (we will install a small makerspace), feedback and conclusion (30 mins)

3. Description of session:

The session will start with a presentation during which we will highlight the importance of hands-on activities for science classes and show some hands-on applications and photos of science classes and students interaction in Lebanese schools. At the end of the presentation, the role and advantages of makerspaces in schools will be highlighted as being the place where the acquired knowledge in science and math is not only to be tested through quizzes but also used to make things, innovative ideas and finally maybe new products and where students are introduced to the open source technology. Such a space at school, give the students the chance to develop decision making skills, analytical, practical and long-life learning skills. Finally, some pictures for the makerspace project that was started at Wellspring Learning Community are shown.
We will set a small makerspace with small machines and invite participants to make a small project of air propelled wooden car and compete in a small race. Finally we will ask about their experience and what

would be, in their opinion, the impact on kids if they were given the chance and space to innovate using acquired science knowledge.

4. Conclusion:

- Search on the internet especially educational videos, there are plenty on youtube
- Try to show a video of the concept for students then prepare the hands-on application and let then make the connection between what they watch in the video and what they have seen in the experiment.
-Be open to having unexpected problems during the experiment, try to solve it class with student and think all together, analyze, troubleshoot. This will engage more the students because they want to prove that they can do it to.
- A proposition for universities to launch an elective course where future educators get introduced to the open source community and break the barriers between the theory and practical work so that they are more prepared when they go in schools to transmit the tinkering spirit to their students and start innovating through science.

الدراما الابداعية في تعليم العلوم

سارة قصير، الجامعة اللبنانية، معهد الفنون الجميلة، بيروت لبنان

(Only abstract included for the following session)

الدراما الابداعية هي مجموعة من اللعب الدرامي من العاب ارتجال و لعب الأدوار، والتخييل الإيهامي، والعاب جسدية وذهنية . ومن خلال هذه التمارين والالعاب نقوم بتقديم العلوم وشرحها . فيتحول الصف التقليدي الى صف من اللعب والحماسة فيصبح المتعلم متعلما متفاعلا ومشاركا .

العنوان العريض للعمل هو مسرحة المناهج والدراما الابداعية هي أحد تقنيات مسرحة المناهج التي تساهم في :

1- تطوير شخصية المتعلم من النواحي الاجتماعية والجسدية والذهنية
2- ايصال العلوم والمعلومات بطريقة جذابة لا يمكن للمتعلم نسيانها او تجاهلها

وهذه التقنيات اصبحت طرقا عالمية للتعليم وتطال كافة المواد التعليمية من علوم ولغات وجغرافيا وتاريخ واقتصاد وغيرها .

في الجلسة سيكون هناك ثلاث عناوين سيتم شرحها ونستطيع استبدال احد العناوين بعنوان مقترح من قبلكم وهي :

خصائص الذرّة (سائل – جامد – غاز) وكيفية تفاعلها فيما بينها

انتقال الكهرباء (موجب وسالب) وموانع الانتقال

انتقال الصوت والذبذبات الصوتية

مدة كل لعبة هي 15 دقيقة وبعدها سيكون هناك مشاركة للاستاذة في النقاش وسيتم اخذ فكرة من الاساتذة الحضور

وتحويلها مباشرة الى لعبة من خلال مشاركة الاستاذة الحضور انفسهم

ان طرح مثل هذه التقنية يفتح الافاق امام المدارس لتطوير منهجية التدريس ويحفذ على العمل الابتكاري والجذاب سواء للاستاذ او للتلميذ ومن الممكن تدريب الاساتذة المدرسين على تقنيات هذا العمل بسهولة .

بعض المراجع :

THE INTEGRATION OF CREATIVE DRAMA INTO SCIENCE TEACHING
BRACHA (BARI) ARIELI
http://diwanalarab.com/spip.php?article19118

All A-Board: A Science Cruise

Farah Hankir & Roweida Bawab, Beirut, Lebanon

Let’s convert our classroom into a playground, and make every student’s dream come true!

It is the ultimate dream of everyone to play in class, and you can simply do that to serve your lesson. Nothing should be uttered against that! This workshop intends to help us think of methods to implement our favorite games to serve science objectives and to transform students’ phone applications into beneficial educational tools. We will be popping up various ideas, playing some games, and sharing some experiences that will definitely keep your students captivated and in love with your session.

One of the most important strategies that ensures any successful pedagogy is student engagement. However, students are constantly being distracted by their smart electronic devices. A good way to overcome this is to keep class exercises as diverse as possible. Some appealing additions to lectures can be group work, computer activities, inspiring videos and interactive games. In fact, interactive games are attractive since they can be easily tailored to meet the learning process. Games make learning more fun and contribute to better peer relationships and a positive classroom atmosphere that make it impossible for students to lose interest in class.

This workshop combines traditional games, board games and some interactive games to serve the same objective.

The Procedures of the Session:

Participants are expected to enter the hall holding playing cards, each with a different pattern and number. a) Start with an icebreaking activity (the storm blows) that introduces us to each other and get the attendees into the gaming mood, brainstorm the game that the audience used to play in their childhood. Tell them that we can be using these games that we are familiar with to have fun with our students, especially that they are highly attached to games on their phones and pads; we want them to jump around for a change. b) Start with the science challenge track: make the participants (A group of four) play or pose questions according to random choice of their playing cards. Later quickly reflect on how you imagine each attendee’s students interacting with this. c) Play Hangman (involves all the audience as a group): ask someone from a specific playing card group to be in charge, tell the audience of the theme we are explaining (the title can also be suggested by this same leader) and then check for who wins d) Pectionaries (Pair Work): Get students into pairs. One draws something that has been studied and the other one guesses what it is; later they swap in this game as well and choose participants according to their cards. e) Give selected people domino rocks that will complement each other; a possible scenario is having reactants and products of some chemical reactions on different cards. f) Place four counters on starting circles. Aim at move all your counters clockwise around the circuit, ending on each of your four “home” squares. You can only move a counter from a starting circle into the circuit if you roll a six. If you toll a six, you get another roll. If you land on another player’s counter, you send it back to their starting circle to start the circuit again. If you land on a question square (Q), you must answer a science question before you can move that counter on. The winner is the first to have all four of their counters on their four home squares. g) End the session by asking whether we are able to assess students based on such games, and suggest rubrics/criteria to base the assessment on.

In all of the activities we are presenting, simple materials that can be handmade are used so that they could fit almost every class and every level.

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Introducing the Tabshoura Multilingual E-Learning Platform

Nayla Fahed, Universite Saint-Joseph & Nagi Ghorra, Lebanese Alternative Learning, Beirut, Lebanon

(Only abstract included for the following session)

Tabshoura is a project of the Lebanese Alternative Learning (LAL) NGO. It is an eLearning platform accessible to anyone who wishes to learn in a fun an innovative way, in three languages, based on the Lebanese curriculum (including science and mathematics). The Tabshoura supports user-friendly informal, multilingual and accelerated learning. The project aims to support international, regional and local organizations active in Lebanon in order to develop their work in education. It provides these organizations with an efficient, user-friendly and attractive tool that will help them enhance and upgrade their educational approach. In this session, the project will be introduced, a trial of the Tabshoura platform presented and a discussion of the future of this project, how science and mathematics teachers can benefit from it, and the challenges faced by the project more generally.

Plenary Session 2

Students' Linguistic Diversity as a Vehicle for Scientific Inquiry in the Classroom

Professor Aurolyn luykx, University of Texas, El Paso, USA

(Only abstract included for the following session)

Like most countries in the world, Lebanon is linguistically diverse, and that diversity brings numerous challenges to the realm of science education. Two principal challenges are 1) the intelligible presentation of science content to students who are not fully fluent in the language of instruction, and 2) the social marginalization of students who are perceived as linguistically "different" from their more mainstream peers.

These two issues are usually addressed separately, if at all. However, there is a way to engage both of in an integrated manner: make students' own linguistic diversity the focus of scientific inquiry in the classroom. While STEM education is not generally thought to include the social sciences, socially-patterned variation in natural spoken language is a perfectly suitable object for scientific description and analysis, similar to that employed in the natural sciences. An approach that guides students through the systematic collection and analysis of linguistic data, thus leading them to understand language variation as a natural process, has a number of advantages. First, it offers

students a scientific framework that challenges common misperceptions and prejudices about language variation—prejudices that have undeniably pernicious effects on students' education and development. Second, it allows children the opportunity to collect first-hand empirical data from their immediate environment, without the need for expensive materials or technology. Third, it requires students to engage with each other across social boundaries in order to carry out the data collection and analysis. Fourth, it positions all students as potential sources of data, with native expertise in one or more language varieties. Fifth, the required analysis uses deductive reasoning to infer principles and relationships from a set of concrete examples, thus instilling scientific "habits of mind" through direct experience.

A well-grounded curriculum based in the local linguistic ecology of each classroom can foster a child-centered, cooperative, inquiry-based pedagogy that is both scientifically rigorous and socially empowering. This approach holds the potential for educators as well as students to view linguistic diversity not simply as an obstacle to be overcome, but as a resource to be utilized in science instruction.

Developmental Workshop

Accountable Talk™ as a Tool for Orchestrating Mathematics Classroom Discussions

Dr. Marjorie Henningsen, Grey Matters Education, Lebanon

One of the greatest challenges in modern mathematics classroom teaching at all levels is creating opportunities for and supporting fruitful academic discussions around substantive mathematical ideas. The traditional emphasis on rote memorization and procedures often leaves little space for authentic discussion. But as mathematics teachers engage their students more and more in problem-based and project-based approaches, new opportunities arise for students to engage in deeper discussions of ideas. Accountable Talk™, a tool for meeting this challenge, refers to three areas of accountability in classroom discussions: to the community of learners, to knowledge and accuracy, and to rigorous thinking. There are deliberate moves teachers (and students) can make to propel discussions forward and to provide all three types of accountability. Participants in the session were introduced to the areas of accountability and the talk moves and used these tools to analyze cases of real classroom discussions in order to see how all the elements fit together in supporting a fruitful mathematical discourse with students aged 3-11.

Since the 1990s, design of mathematics education settings has increasingly emphasized the importance of engaging student actively in problem solving and reasoning and communication and that these processes are as important as the content of the mathematics curriculum. When these processes become more prominent in the classroom, the opportunities for students to discuss and make sense of mathematical ideas increases dramatically. However, teachers often find managing such discussions to be challenging and despite the best of intentions, teachers can limit discussion in order to retain control of the ideas or where the discussion goes or because they are not confident that students (especially younger children) will be able to "get there" without a lot of leading and coaxing by the teacher.

Also, curriculum does not always keep up with pedagogy in the sense that in many countries, including Lebanon, the content of the elementary math curriculum has not changed much over the past 100 years. So another challenge in having great discussions in the math classroom often is that there is nothing interesting to talk about because everything is highly structured and the outcomes predictable. However as teachers take risks and engage more in problem-based and project-based approaches, more space is opened up for discussion and those discussions need to be managed!

The strategy/tool in focus in the session was the use of Accountable Talk. Accountable Talk is a discourse management tool for classroom teachers in any subject. It was developed in the 90s and refined over the past 15 years and is now owned by the University of Pittsburgh, Institute for Learning. The tool has been shown to be useful in all sorts of classroom settings, including ESL settings. The basic tool consists of three *areas of accountability*: to the Learning Community, to Knowledge and Accuracy, and to Rigorous Thinking. In addition a set of common *talk moves* are defined that can be used deliberately by teachers and students to steer discussion toward one or more of the areas of accountability. The tool is elaborated below:

A. Accountability to the Learning Community

- Participate actively in classroom talk.
- Listen attentively.
- Elaborate and build on each other's ideas.
- Work to clarify or expand a proposition.

B. Accountability to Knowledge

- Share specific and accurate knowledge.
- Require appropriate evidence to support claims and arguments.
- Commit to getting it right.

C. Accountability to Rigorous Thinking

- Synthesize several sources of information.
- Construct explanations and test understanding of concepts.
- Formulate conjectures and hypotheses.
- Challenge the quality of evidence and reasoning.

Talk Moves and Functions

1. Marking	… direct attention to the value and importance of a student's contribution
2. Challenging students	… redirect a question back to the students, or use students' contributions as a source for further challenge or query.

3. Modeling	… make one's thinking public and demonstrate expert forms of reasoning through talk.
4. Recapping	… make public in a concise, coherent form, the group's achievement at creating a shared understanding of the phenomenon under discussion.
5. Keeping the channels open	… ensure that students can hear each other, and remind them that they must hear what others have said.
6. Keeping everyone together	… ensure that everyone not only heard, but also understood, what a speaker said.
7. Linking contributions	… make explicit the relationship between a new contribution and what has gone before.
8. Verifying and clarifying	… revoice a student's contribution, thereby helping both speakers and listeners to engage more profitably in the conversation.
9. Pressing for accuracy	… hold students accountable for the accuracy, credibility, and clarity of their contributions.
10. Building on prior knowledge	… tie a current contribution back to knowledge accumulated by the class as a previous time.
11. Pressing for reasoning	… elicit evidence to establish what contribution a student's utterance is intended to make within the group's larger enterprise.
12. Expanding reasoning	… open up extra time and space in the conversation for student reasoning.

The tool is useful when discussion is happening; therefore, having accountable discussions in the classroom requires that there is time and space for discussion as well as something worth discussing! So it also important for teachers to consider all the various opportunities that might arise for discussion in the typical math classroom, possibly creating routine opportunities for discussion to happen, but also considering the quality of the mathematical thinking required of students in the tasks they are given.

Flow of the session: In the first 30 minutes of the session participants will be introduced to the importance of classroom discussion for students' language development as well as their mathematical learning. They will also be introduced to the concept of accountability in discussion and then to the tool itself. The tool will be explored in small group or pair work to analyze the relationships between the talk moves and the three areas of accountability. In the next 30 minutes participants will use the tool to analyze two short transcripts, one from 3rd Grade and one from Preschool (the 3rd Grade one also has a video that we can show along with the transcript). They will asked to identify talk moves in each transcript but also how the moves helped steer discussion toward which area(s) of accountability. We will wrap up with open discussion and questions, and a whole group reflection on why it's important for class discussions to have a deliberate purpose and how a tool like this can help.

(I prefer to write a conclusion after giving the session.)

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Addressing the Language Problems in Teaching/Learning Mathematics in Our Arabic Speaking Society

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(Only abstract included for the following session)

In Lebanon, mathematics is mostly taught in a foreign language. Cognitive theories emphasize the intimate relationships between language and thought. Piaget relates the emergence of concepts to the development of language, and Vygotsky views language as a main mediating tool for the development of higher-order thinking. More recently, the relationships between the language of instruction and the quality of mathematics learning are being discussed in the literature and issues related to the language of instruction are being highlighted.

We can safely assume that learning mathematics in a non-native language in our schools may account for some of the obstacles that our students face, as well as for low mathematical achievement. Students are required to "do mathematics" in order to learn it, which includes constructing mathematical arguments and communicating mathematically. Such a requirement makes the use of language central to learning mathematics. Difficulties in language use will thus generate difficulties in learning and doing mathematics. Another layer of difficulty is added, considering that mathematics is itself a language, which has its own vocabulary and grammatical (symbolic) structure.

The aim of the proposed workshop is to open a discussion about the above problems, overview solutions mostly proposed in the literature, brainstorm solutions suitable for our Lebanese context, and apply those ideas through actually working on selected chapters from the mathematics textbooks and class scenarios at different levels.

Engaging in Science and Mathematics Practices: Argumentation and Debating

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Argumentation has been identified with the language people should use while reasoning. Argumentation is a collective cognitive development process which involves using evidence to support or refute a particular claim, coordinating the claims with evidence to make an argument, forming a judgment of scientific knowledge claims, and identifying reliable and consensual scientific knowledge (Chen & She, 2012). The terms argument and argumentation reflect the two senses in which the term argument is used, as both product and process. An individual constructs an argument to support a claim. The dialogic process in which two or more people engage in debate of opposing claims can be referred to as argumentation or argumentative discourse to distinguish it from argument as product (Kuhn & Udell, 2003). Research findings showed that classroom argumentations improved students' rational informal reasoning and conceptual understanding (Venville & Dawson, 2010). As well, the progressive adoption of argumentative practices in education seems to increase students' motivation and beliefs towards their democratic citizenship roles in their society (Mirza & Clerment, 2009).

It was evident that insufficient teaching and learning of argumentation in science and math education lead to inability of students and even graduates to provide evidence and justification to some of their claims to natural and real world (Durant, Evans & Thomas, 1989).

Considering Mathematics education, it is essential to consider the nature of the interactions that occur in the mathematics classroom (Yackel,2000). Research found that explicit attention to classroom social and sociomathematical norms and to classroom discourse can result in advancing children's development of mathematical argumentation (Cobb, Wood, Yackel, & McNeal, 1992). As children learn to explain and justify their thinking to others, they develop intellectual autonomy, and in the process, mathematical power.

For a long time, argumentation has been regarded as one of the key components of contemporary science education (AAAS, 1993; National Research Council (NRC), 1996). In recent years, Toulmin's definition of argument has been widely applied as a methodological tool in characterization of teaching and learning process in the science classroom as well as pedagogical and learning tool (Osborne, Eduran, Simon, 2004)

The twentieth-century British philosopher Stephen Toulmin noticed that good, realistic arguments typically will consist of six parts (Toulmin, 1969). He used these terms to describe the items. 1) Data: The facts or evidence used to prove the argument. 2) Claim: The statement being argued (a thesis). 3) Warrants: The general, hypothetical (and often implicit) logical statements that serve as bridges between the claim and the data. 4) Qualifiers: Statements that limit the strength of the argument or statements that propose the conditions under which the argument is true. 5) Rebuttals: Counter-arguments or statements indicating circumstances when the general argument does not hold true. 6) Backing: Statements that serve to support the warrants (i.e., arguments that don't necessarily prove the main point being argued, but which do prove the warrants are true.) In the Mind The Gap Project, Toulmin's frame has been used to support teachers in introducing argumentation in the classroom (Jimenez- Aleixandre et al, 2009). To reinforce argumentation practices, teachers must be engaged in the use of the following writing frames: Claims, Data, Warrants, Qualifiers, Backings, and Rebuttals (Jorde & Dillon, 2012).

Based on what has been mentioned, the goals of this workshop will be introducing science and math teachers and coordinators to importance and use of argumentation and Debate in classroom. At the end of this workshop, participants will be able to plan and evaluate student argumentations and debates.

The session will start with an icebreaker activity through which participants will share “the best of their class” supporting their claims with evidences through group work discussions using token chips strategy (5 min). Then the definition and significance of argumentation will be presented focusing on writing frames of argumentation (15 min). The participants will then apply their acquired knowledge by identifying the various writing frames in prepared student argumentations samples (10 min). Presenters will explain how to evaluate students’ argumentation by using rubrics (10 min), the participants will use the rubrics to evaluate the student samples handouts (10 min). The participants will then enjoy watching a video modeling students’ Debate in science class (6 min). Tips for lesson planning using argumentation in science and math classroom will be demonstrated by presenters (20 min) The participants will then apply these tips by planning and presenting different science and math lesson plans for different levels (30 min). The rest of the time will be spared for participants’ questions, suggestions, and evaluation (10 min).

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Language Support in Mathematics and Science Classes to Enhance Students Learning

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Even students who are native speakers of the language of instruction used in Math and Science classes need language support so that language does not become a barrier to the learning of the content. During this workshop the audience will be given an idea about the nature and types of languages that are used in a content subject such as Math and Science as well as how to plan for language support in order to enhance students learning of the subject matter. Providing language support by Math and Science teachers does not mean that these teachers are going to become language teachers and since finding the time for language support is always a challenge, teachers need to carefully plan their lessons. The audience will be given many strategies to be able to achieve this goal and at the same time teach the subject matter. The audience will be involved in many hands-on activities to apply the strategies that will be introduced in this workshop.

In any content subject class, as compared to any language class, such as Math and Science classes, the students experience three types of languages. The first type is called the *Basic Interpersonal Communication Skills*, which is the social language that the students use to communicate in any class and they learn this language first since they get a great deal of exposure to it. The second type is called the *Classroom Language*, which is used by the teacher to frame the lesson. The students learn this language since the teacher uses it most of the time to give instructions, assign roles for group work and so on. The third type of language is called the *Cognitive Academic Language Proficiency*, which is also referred to as the academic language and which is the language needed to understand and apply the new ideas that are taught and also it is the language that supports creative thinking skills. The academic language includes content *vocabulary* and *functional language*. The content vocabulary is of two types, the *general academic vocabulary* that could be used in any class and *domain-specific vocabulary*, which is used in a particular subject. Providing language support by Math and Science teachers does not mean that these teachers are going to become language teachers and since finding the time for language support is always a challenge, teachers need to carefully plan their lessons.

After planning the lesson to be taught in Math or Science classes and identifying the content lesson objectives and the assessment tasks and learning activities to be used, the teacher needs to plan for the needed language support by identifying the content vocabulary, the functional language and the language skills that the students need to learn the lesson. Then they need to decide how and when they will give the needed language support. This can be done in coordination with language teachers if possible, before teaching the lesson or with the use of many strategies and tools so that time is not wasted and so that it is done efficiently. There are many tools and strategies that can used by the teacher to teach the academic vocabulary such as word walls, flow charts, concept maps, word games or any other graphic organizer or tool. Students can be given lists that include verbs that are used to ask questions or in performance tasks, or the meaning of word roots, suffixes or prefixes, or the meaning of the lesson key words that can be displayed in the classroom. Teachers can prepare guidelines for writing lab reports and for the steps of the scientific method or for any other tasks that the students perform in class and have them put in the students' subject folders or displayed in class. Teachers can also provide the students with word or phrase prompts to help the student in using the needed functional language and to be able to think, write and speak properly in Math and Science classes. Students in general face difficulties when solving word problems, so they need to learn the steps needed to solve the problem. Students need to learn how to take notes which is a very essential skill that the students will use to study and learning the material.

During this workshop the audience is given many strategies and tools that can be used to give the students the language support that is needed to enhance their learning of the subject matter and then they are involved in hands-on activities to apply these strategies and tools. The first activity involves the audience in identifying the types of languages used in a particular lesson such as the domain-specific vocabulary, functional language and the other language skills that are needed to learn a particular lesson. Then they will be asked to plan for how they are going to teach the students the needed vocabulary and other language skills. They will have then to plan one assessment task or learning activity and identify any language support that the students need to successfully complete it. They will work in groups of 4 to 6 members who teach the same grade level and subject or in groups made of same subject teachers who teach elementary students, middle school students or high school students depending on the number and what the participants teach. Each group will present their work after doing each of the three tasks described above. The audience will be given the chance to discuss any issue related to the topic of this workshop, share their ideas about tools or strategies that they have successfully used to support language in their classes and to ask any questions that they might have.

Even students who are native speakers of the language of instruction used in Math and Science classes need language support so that language does not become a barrier to the learning of the content. It is time consuming to give the students the needed language support but it is very essential for enhancing the students learning of subject matter and if we want the students to think, write and speak like the mathematicians and scientists.

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To Lead or Not to Lead

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Most educators, whether principals, coordinators or even teachers, forget that they are the leaders of young minds, who are able to empower them to find their own way and be leaders themselves. Being followers rather than leaders, most students graduate from schools not knowing the fact that they could be leaders themselves! In this session, several activities, inspirational videos and various discussions concerning leadership and its effect on the lives of our students are going to be presented. Based on information from books for *Warren Bennis* and *Gary Hamel*, participants will discover the different skills of being leaders; they will come out with a conclusion that leadership is a decision that they should make in order to create more leaders for a better future. Moreover, the difference between a manager and a leader will be clarified by various examples. The session will end up having each participant discover his/her ability of being a leader after applying the last activity which puts each in a situation where he/she has to be a good decision maker. Educators who are good leaders can expect to make a change in their school and the people in it by understanding and communicating vision, clarifying purposes, making behavior congruent to belief and aligning procedures with principles, roles and goals.

1) Introduction:

This workshop aims to raise a generation of leaders at our schools, not only as science and math teachers, but as educators as well. It targets, through inspirational videos and motivating group-work activities, the minds of participants to have them recognize how to direct their students and enable them discover the leadership skills in themselves. The information presented is in reference to books for Warren Bennis and Gary Hamel.

2) Strategy:

The workshop includes several topics concerning the title, which will be presented to participants through 120 min. Four activities that help participants discover their leadership skills will be applied in addition to five short videos that assist the understanding of the key terms in this topic. Each time, participants are asked to feel free comment on any activity as "Like" or "Dislike" on charts hanged in the room, so that we'll be able, at the end of the workshop, to evaluate our strategy.

3) Description of Session:

The session starts by an ice-breaking activity under the title of **"Hosting the Guests".** In this activity, each participant is asked to know the main information (Name of the participant, school's name and the cycle he/she teaches) of five other participants in the room within 5 minutes. This activity helps participants in evaluating themselves on how they would behave on in a relationship:

• they are active people who would take the initiative, or

• passive and wait for people to get to know them.

As an introduction to the session, a 5-minutes video under the title of **"Leaders Care"** is presented to define what leadership is. This is followed by a discussion of the definition and the components of leadership.

To stress on the importance of team-work, a 2-minutes video under the title of **"What is your profession?"** is presented followed by a discussion of the properties of great leaders and another 2-minutes video **"The Leaders"** that summarizes the properties of leaders. This part precedes our second activity which is **"Leading The Group/ Chocolate time"**, during which participants are asked to sit in groups (number of individuals per group will be according to the number of participants) and choose one of them to be the leader. Each leader will be provided with drawings from the presenter, and he/she has to give correct instructions to the group in order to have all members of their team draw the same drawings only by instructions (members of the 2 team must not see the drawings). The team that succeeds in doing the activity correctly will be given chocolate bars.

"What it takes to be Number One" is a 3-minutes video during which quotes about Leadership are presented. This is followed by an important topic about Leadership and Empowerment; during this part, participants are motivated to be leaders who empower their group (their students) by knowing the difference between a manager and a leader.

“Raising from a Cocoon” is another activity during which participants are asked in pairs to use one paper and try to fold it around their partners in 5 minutes. This activity helps participants recognize how creative they are since creativity is an important factor of leadership.
“Win-Win” is the last activity in the workshop. This activity assists the participants to discover the leader inside them. They are asked to sit in groups (according to the number of participants), given a case to study and come out with the best result. After that, each group will present its result. The activity stresses on the fact that a leader is a good listener who is able to communicate with all people.
A summary that stresses on the main ideas discussed in the workshop is presented after which participants watch the last video (6 minutes) under the title of **“The Dream”**. This video is an inspirational motivating one that makes participants feel the spirit of being leaders and have them take a decision of making a change not only in their lives, but in the lives of all people in their circle of life, most importantly, the lives of their students.
Finally, before leaving the room, participants are asked to write one of the leadership quotes that they like the most from the workshop and they feel they will apply it in the future and stick it on a chart hanged together with the “Like” and “Dislike” charts.

4) Conclusion:

Educators who are good leaders can expect to make a change in their school and the people in it by understanding and communicating vision, clarifying purposes, making behavior congruent to belief and aligning procedures with principles, roles and goals.

5) References:

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Talking Climate Change Education and Education for Sustainable Development in Intermediate and Secondary Classrooms

Dr. Sulieman Sulieman, Programme Specialist: STV, Unesco, Beirut, Lebanon & Mona Betour El Zoghbi, Environmental Consultant/ Expert, Lebanon

1. Introduction:

The aim of the workshop is to enhance the knowledge and skills of science and math teachers, as well as students at the Intermediate and Secondary levels on Climate Change Education (CCE) and Education for Sustainable Development (ESD) through interactive teaching and learning experiences using both Arabic and English language strategies. The workshop is based on regional and national achievements of the UN Decade on Education for Sustainable Development (DESD, 2005-2014) presented during the World Conference on ESD held in Aichi-Nagoya, Japan (November 2014) and included in both the Global Action Programme on Education for Sustainable Development (GAP- ESD) and the Final Assessment Report on ESD/DESD prepared by UNESCO and presented during the World Conference on ESD. The GAP-ESD seeks to advance policy and mobilize resources for re-orienting education towards a pathway that would accelerate progress towards sustainable development.

2. Strategy:

The workshop strategy integrates aspects of thematic concept-based learning with practice-based learning and group interaction. This strategy encourages participants to critically reflect on the connections of climate change themes to their teaching experiences and promotes dynamic dialogue and group interaction amongst diverse participants.

The strategy consists of three key aspects:

- In-depth exploration of key themes within climate change and their connection to science and math education topics by linking them to real-life situations;
- Practical application of diverse tools and techniques that can be used by teachers in science and math classrooms to teach students about climate change; and
- Interactive group activity in which participants develop a template of key language/terminology problem-solving questions and student activities relating to a specific climate change topic relevant to science or math lessons.
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3. Description of the Session:
The Session will include two presentations on UNESCO's Global Action Programme on Education for Sustainable Development (GAP-ESD) and a set of practical and interactive teaching and learning activities on Climate Change Education (CCE), with group discussion on language-terminology used in both Intermediate and Secondary classrooms (Science and Math).
The session coordinators include STV Programme Specialist at UNESCO-Beirut, CCE experts from the Hashemite University (Jordan) and from the American University in Cairo (Egypt), and UNESCO environmental consultant (Lebanon).

The Group Work activities are:

ACTIVITY 1: Identification of Priority Areas of GAP-ESD (30 minutes) Order of Activity: Facilitators to introduce UNESCO's GAP-ESD priority areas and Climate Change Education language-terminology; based on country, regional, and international perspectives (ESD/DESD). Participant Involvement: Interaction on two power-point presentations and group discussion-questions on the two main topics of the workshop.

ACTIVITY 2: Tools, Techniques, and Language-Terminology of Climate Change Education in the Classroom (Science & Math)-50 minutes Order of Activity: -Facilitators group participants into teams; -Facilitators demonstrate diverse tools and techniques for discussing climate change topics in the science and math classroom; -Participants interactively test and apply these tools and techniques with each other; -Facilitator explains the usefulness of these techniques and ways to determine optimal methods and opportunities for applying them in class. Participant Involvement: Group discussions and activities.

ACTIVITY 3: Developing a Template for Teaching CCE in Classroom- 40 minutes Order of Activity: -Facilitators group participants into 3-4 teams based on teaching topics in the classroom (i.e. Chemistry, Physics, Biology, and Math); -Participants select a specific theme on climate change and math/science education and identify key student learning outcomes on this theme;

-Participants develop their own guide template with key questions, resources, and activities for applying this teaching method in class with students;
-Team representatives share main discussion points and their design template;
-Facilitators wrap-up the discussion and provide participants with documents containing references and links to handbooks, tools, web-links and activities on ESD and climate change education.

Participant Involvement: Group discussions and activities; participant attainment of further learning resources (CD).

4. Conclusion:
This workshop helps math and science educators in Intermediate and Secondary classrooms to discuss with their students the local and global impacts and response strategies of climate change and to develop their own teaching tools and strategies on specific themes within climate change and sustainable development. The workshop strategy can also be useful for ESD trainers who wish to apply a similar strategy for educators in different academic levels or topics. It is important to note that any similar workshops based on this strategy need to consider the learning needs and profile of participants such as their level of understanding of climate change and sustainability issues, their specific teaching styles, and whether their teaching topic is scientific, literature, or arts-based, and at school or university level.

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Guided Inquiry in Chemistry Laboratory
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Guided inquiry laboratory experiments promote students' learning, expand students' critical thinking, encourage teamwork, develop students' leadership skills, and present apparent advantages over traditional "cookbook" experiments where students simply follow a lab manual. Most of the Lab manuals used in teaching chemistry provide procedures for students to apply directly. This method emphasizes limited numbers of skills; but does not give the opportunity for students to design their own procedures, test and retest them in order to reach a valid conclusion that will assure their understanding of a scientific concept. Guided inquiry in chemistry laboratory can create a suitable context for students to test their understanding of chemistry concepts or introduce them to new ones that lead to a meaningful learning. In this workshop, we will present how some traditional chemistry experiments can be transformed into guided inquiry laboratory work. Students, by designing their own procedures, they model the work of scientists or chemists in the industrial sector. Thus, they recognize the personal relevance of their study; which increases their interest in the subject matter.

In science, if you let your students experience scientific processes and to deal with measuring devices, materials, and laboratory equipment, then laboratory experiences will promote a direct experience with science phenomena. Students benefit from lab experiences, although research indicates the amount of learning between traditional and inquiry labs varies. The traditional approach to laboratory activities has been to provide an opportunity for students to confirm a concept, identify an unknown chemical compound, or to verify a fact previously presented in a lecture. Lab manuals using this method are generally written in "cookbook" style, and students are expected to follow explicit, step-by-step directions. All students in the laboratory do the same procedure and only look for "the answer." This structure has led to traditional labs being referred to as verification labs.

By doing an experiment in a traditional manner, students may become proficient in basic manipulative skills, and they may have some insights that bolster their conceptual understanding. Educational research, however, tends to indicate the vast majority of students doing traditional laboratory experiments will often miss basic concepts. Traditional labs offer little hope that they develop any sense of the scientific process and the nature of science. Students in traditional labs miss the opportunity to develop the skill of designing an experiment to answer a research question. Finally, the prescriptive nature of the traditional lab often means students will be unable to apply what they have learned to slightly different situations.

A substantial body of chemical education research on students who have done inquiry labs indicates that students learn and retain more knowledge and skills using this approach than they do through comparable traditional labs. Research also shows increased levels of student engagement during laboratory.

Strategy

Inquiry labs take a different instructional approach than the traditional labs discussed above, though they cover the same core chemistry concepts. Instead of seeking confirmation of concepts, inquiry-based labs allow students, with guidance, to observe phenomena, explore ideas, and find patterns allowing students to answer questions they have developed themselves. Several descriptions of inquiry exist.

One example was defined by Marshall D. Herron in 1971, which characterizes inquiry as structured, guided, or open.

- Structured inquiry involves answering a given question with a set procedure, but the answer is unknown and the students must analyze the data.

■ Guided inquiry has a teacher-presented question, but the students must design their own procedures, compare data, and look for trends to answer the question.

■ Open inquiry involves the students deciding on their own question in a topic area and designing their own experiment to answer that question.

Level of Inquiry	Question	Procedure	Solution
Confirmation (verification)	Teacher-presented	Teacher-presented	Teacher-presented
Structured inquiry	Teacher-presented	Teacher-presented	Student-generated
Guided inquiry	*Teacher-presented*	*Student-generated*	*Student-generated*
Open inquiry	Student-generated	Student-generated	Student-generated

Chart adapted from R. Bell, L. Smetana, and I. Binns, "Simplifying Inquiry Instruction" (The Science Teacher, October 2005)

In Inquiry and National Science Education Standards: A Guide for Teaching and Learning, the National Research Council (NRC) identified five essential components or elements of inquiry investigations:

1. Learners are engaged with scientifically relevant questions
2. Learners give priority to evidence
3. Learner explanations are based on the evidence they have generated
4. Learners make connections to prior scientific knowledge
5. Students communicate and justify their explanations

Description of session

	Activity	Description	Time min.	Nature of involvement
1	Introduction	Objective, track of the workshop, different types of inquiry, benefits of GICL	15	Power points, discussion
2	Discuss the learning cycle of guided inquiry	- Exploration phase - Concept invention phase - Application phase	15	Group discussion
3	Instructional models for chemistry Inquiry Lab Investigations	Applying the learning cycle using the experiments at different Levels Grade 10: solubility of polar and non-polar compounds Grade 11: classification of metals based on their standard reduction power Grade 12: Identification of weak, strong acids and weak and strong bases	40	Teachers are involved in doing actual experiments
4	Converting Traditional	Provide a list of traditional	15	Group work

	Laboratory Experiments to inquiry experiments	experiments and ask participants to transform them into guided inquiry experiments		
5	Practical criteria for implementing Inquiry laboratory experiments	List of criteria used in an Inquiry Laboratory work	10	Group discussion
6	Teachers' role	Participants describe the role of the teacher based on the different steps already discussed in the workshop	10	Brainstorming
7	Safety and Technique	Students should be taught a set of techniques and safety considerations prior to the guided inquiry experiment	10	Power point presentation
8	Conclusion	Summarize the advantages and disadvantages of the GICL and emphasize the advantages	5	Discussion

Conclusion

Through guided inquiry laboratories students design and conduct their own experiments, discover what works and what doesn't, make adjustments based on those discoveries, and try again. It is hoped that these guided-inquiry laboratories will help students think critically about what they are doing and why. Applying this strategy in chemistry laboratory is not a complicated issue; however teachers should change perspective and get accustomed to the different phases of the strategy in order to extend it to different context and to apply it for different taught concepts.

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Effective Use of Science Models in Chemical Pedagogy

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Models have two interconnected functions in science. On the one hand, they are used to think about phenomena and generate new research questions for significant explorations. On the other hand, science models, as products of empirical research, are meant to explain specific aspects of the world elegantly and systematically. A number of researchers contend that the complete solution to every science problem is a model. Seemingly, science and its explanatory models are inextricable because models are science’s products, methods and its major pedagogical tools. Unfortunately, the way models are addressed in science (chemical) education is not commensurate with the value of their function in science (chemistry). The 'confusing diversity' of models in educational resources along with the noticeable scarcity of initiatives to teach explicitly and purposely about the epistemology of models make students more vulnerable to developing misconceptions. Commonly, students erroneously envision models as copies of reality, lack the critical perspective to interpret different forms of models, and fail to appreciate the contributions of models to science inquiry. The purpose of this session is essentially twofold: (a) Discussing science models in chemistry in relation to instructional practices and students’ learning and (b) Proposing a preliminary framework and some academic tasks to integrate ‘science models’ in the teaching and learning of chemistry.

1. Introduction:

Scientific modeling is the creation of physical, conceptual, or mathematical representations of natural phenomena (Rogers, n.d.). Models can be expressed in several forms (i.e. words, pictures, graphs, symbols or diagrams), but they all tend to have two interconnected functions in science. On the one hand, they are used to think about phenomena and generate new research questions for significant explorations. On the other hand, science models, as products of empirical research, are meant to explain specific aspects of the world elegantly and systematically. A number of researchers contend that the complete solution to every science problem is a model rather than a number (Wells, Hestenes & Swackhammer, 1995). Seemingly, science and its explanatory models are inextricable, because models are science’s products, methods and its major pedagogical tools (Gilbert, 1993).

“Chemistry as a discipline is dominated by the use of models” (Levy Nahum et al., 2004, p.302). Fundamentally, this 'dominance' manifests itself in the nature of chemistry that needs to be perceived via multileveled thinking model integrating macro, micro, and symbolic levels of understanding (Johnstone, 1982). Another materialization of models' 'strong presence' in chemistry comes from the chemical educational resources (electronic, books, science kits) that are 'packed' with different versions and forms of models (Shehab, 2012). Reasonably, it may be argued that models are basically the building blocks of chemical language and communication. This association between 'models' and 'language' is an attribute that 'excites models to a higher level of importance'. According to the Theory of Knowledge (TOK) course in the International Baccalaureate Diploma Program (IBDP), language is a 'way of knowing' rather than a tool of communication; thus "language is part and parcel of the knowledge claim itself and not merely a description of something that exists independently of language" (IBO, 2015, p. 29). Possibly, this view is debatable, yet it may at least insinuate how crucial the role of science models could be in structuring scientific knowledge.

Unfortunately, the way models are addressed in science (chemical) education is not commensurate with their value in science (chemistry). The 'confusing diversity' of models in educational resources along with the noticeable scarcity of initiatives to teach explicitly and purposely about the epistemology of models make students more vulnerable to developing misconceptions. Commonly, students erroneously envision models as copies of reality, lack the critical perspective to interpret different forms of models, and fail to appreciate the contributions of models to science inquiry (Jaber, 2009).

To anchor school science in authentic science practices, the use of science models ought to be wisely incorporated into classroom instruction. This means that teachers must explicitly and purposely design and implement a variety of learning experiences, where students can (a) understand the nature, rationale, and function of models (b) Interpret and critically use different forms of models and (c) coordinate the use of evidence with the development of plausible models for natural phenomena (Windschitl & Thompson, n.d.)

2. <u>Pedagogical approach</u>

In this session, the participants will be guided to appreciate the need for a research-based approach to integrate science models in the 'mainstream' of chemical pedagogy. The presenter will propose an 'integration framework' and illustrate how chemistry learning activities may be developed to - explicitly and purposely- teach with and about science models. The activities will be based on students' engagement in (a) developing and refining models based on evidence (b) discussing and critiquing different models (c) addressing models in traditional and conceptual problem-solving and (d) expressing models in different forms.

3. <u>Description of the session</u>

After briefing the participants about the general and specific objectives of the session [**5 min**], a number of activities will be performed according to the following scheme:

Activity's title	Activity's dynamics	Activity's outcome(s)
Introduction to science models: Definition, forms, and attributes [20 min]	• Nature of activity: whole-group discussion • Brief description: A slideshow (PowerPoint) of familiar chemical models (e.g. chemical equations, collision theory graphics, molecules ball- and stick models, equilibrium microscopic views, scientific method, Aufbau principle, Bohr's model…etc.) will be presented. Participants will be guided to respond to the following prompts: Which of the figures that appeared in the slideshow may be regarded as science models? What are the distinctive properties	Expectedly, with the presenter's assistance, participants will be able to : • recognize a model as a representation of how an aspect of the natural world is structured or how it works • realize that a science

	of these models? How do you assess the value of these models?	model may be classified into 'physical', 'conceptual', or 'mathematical' and expressed in terms of words, pictures, graphs, and symbols (with different explanatory purposes) • appreciate that a science model is an approximation of reality, end product of research, dynamic & evolving, parsimonious, and limited (models are never meant to be perfect)
Self-reflection on instructional practice [15 min]	• Nature of activity: whole-group discussion • Brief description: The presenter will facilitate a short discussion where he invites participants to respond to a number of prompts such as: How do you commonly use different forms of models in your chemistry classes? Have you ever purposely tried to teach your students about the forms and attributes of models? /Is that important? How do you assess your students' understanding of models' significances and implications?	Expectedly, participants will be able to develop an awareness of their (probably inadequate) ways of addressing science models in their instructional practices.
Research-based recommend-ations for teaching with science models [35 min]	• Nature of activity: Reading assignment (individual work) followed by whole-group 'reflective debriefing' • Brief description : Participants will read a brief literature review (2-3 pages) outlining (i) some ineffective uses of models in science pedagogy, (ii) a number of students' misconceptions about science models and chemical concepts , and (iii) some essential suggestions for advantageous use of science models to teach chemistry and about chemistry. After the reading assignment, the presenter will facilitate a reflective debriefing phase about the main ideas in the literature review. Participants will be asked to reflect on their teaching practices in light of what they have read in the review	Expectedly, participants will be able to realize the importance of explicit and purposeful instruction with models as cognitive tools to enhance students' understanding of chemical knowledge (concepts, principles, topics) and nature (language, structure, inquiry)

Chemistry learning activities to teach with and about science models [45 min]	• Nature of activity: small-group discussions followed by a whole-group exchange of ideas and reflections • Brief description: In small groups participants will engage in examining and reflecting on: (i) A framework for effective integration of science models in chemical pedagogy (prepared by the presenter in advance and based on 'scientific communication', ' critical thinking & problem-solving', and 'Nature of scientific knowledge') (ii) Different learning activities (compiled/prepared by the presenter in advance) for illustrating the effective use of science models in chemical pedagogy. The learning activities (addressing a variety of topics) will be grouped under the following titles: 'Models in classroom discussions', 'Models in problem- solving', 'Model development during practical work', and 'Models in association with concept mapping'. All reflections will be focused on responding to the following prompts: How do these activities pertain to the literature recommendations? How and when can such activities be used? What are the challenges and how can they be faced? What kind of learning gains students could achieve from these activities? What assessment measures are suitable for such activities? How can these activities be chunked, modified or extended to serve students' needs? Following the intra-group discussions, the presenter will facilitate an inter-group exchange of ideas and reflections. The presenter will interfere when necessary to clarify, reinforce, and suggest. Additionally, the presenter will provide the participants with helpful relevant resources.	Expectedly, participants will be able to realize how the literature recommendations about effective teaching with models can be explicitly and purposely manifested in: (a) classroom discussions, (b) problem-solving tasks (c) practical learning experiences and (d) concept mapping.

4. <u>Conclusion</u>

Chemistry teachers who want to teach effectively with and about science models are recommended to:

- Empower themselves with sufficient knowledge and profound understanding. Self-empowerment entails adequate review of relevant literature/resources to seek credible information and suggestions regarding the teaching -learning mechanisms associated with science models
- Plan for explicit and purposeful instruction in accordance with the research-based recommendations. Unlike what many teachers might think, these recommendations could be feasible even under restricted professional and organizational conditions. Quite often, rather manageable modifications or initiatives are needed to advance the learning yield of a traditional pedagogical practice

- Implement their instruction wisely, gradually, and selectively. Teachers need time to develop the confidence and competency to teach effectively with and about models in a way that serves their students' learning development. Self-reflection as well as peer and student feedback are always recommended to improve professional performance.

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Circulatory System for Digital Natives

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Science is the most subject related to real life, where most scientific topics can be easily modeled, instructed or explained through analogy for elementary students. Although, the circulatory system is a topic that cycle two students find difficulties in understanding how it functions, it is interesting and very important to learn about. To motivate digital native students and hold their attention, new interactive strategies should be used to create an effective learning environment. Using Smart Board techniques in science will facilitate and enhance teaching and learning in explaining circulatory system. In this workshop, participants will be introduced to the main features of Smart Board skills and techniques to make the concepts of this topic more accessible. They will apply many activities and games through their laptops, and they will be provided with useful and educational websites that help them learn and improve their teaching skills.

Science and technology education have enjoyed a meaningful partnership across most of this century. They are of increasing importance and integral to our rapidly changing world. A student's sense of wonder and curiosity about the natural and made world is fostered through actively engaging in the processes of working scientifically and technologically.

The primary purpose of this session is to teach participants special techniques and skills that can be used on Smart Board technology that facilitates science teaching and learning. Smart Board technology is changing the ways teachers interact with students in the classrooms. It facilitates and supports conceptual development, understanding, process skills, habits, and makes scientific concepts more accessible especially for the circulatory system.

The session is planned as follows:

a- Introduction of presenters and participants and expectations of workshop (4min)
b- Explain the objectives of workshop. (4min)
c- Video to shed light on the importance of technology in teaching and learning (4min)
d- Participants will discuss technological strategies used in their classrooms. (4min)
e- Presenters will show participants many projects about circulatory system using ActivInspire program on Smart board.(5min)
f- Participants will be taught some techniques and skills that help them to prepare an interactive lesson on circulatory system using Smart Board. (60min)
g- They will be learned how to link videos especially for the circulatory system: heart and blood vessels, blood songs, pulse video, and power point to their interactive lesson. (10min)
h- They will learn how to draw a graph and interpret it using Smart Board. (10min)
i- At the end of the session, they will learn how to prepare a competition game, using Smart Board. (15min)
j- Last, participants will be provided with some websites to help them more in improving their learning and teaching skills. (4min)

Today, technology has become part of the educational process in which appropriate educational technologies have the potential to make scientific concepts more accessible through visualization, modeling, and multiple representations. Using technology to perform tasks that are just as easily or even more effectively carried out without technology may actually be a hindrance to learning.

أثر تدريس العلوم الطبيعية باستخدام استراتيجيات الخطاب الصفي

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(Only abstract included for the following session)

تهدف هذه الورشة إلى استقصاء أثر تدريس العلوم الطبيعية باستخدام استراتيجيات المناقشة والحوار في تنمية مستوى التواصل مع المادة العلمية واكتساب مفاهيمها.

تعد استراتيجية المناقشة والحوار الصفي، صورة مصغرة للحياة الواقعية (الاجتماعية) التي بدأت تشكل اهتماماً لدى التربويين للتدريس الصفي؛ ذلك لأن هذه الاستراتيجيات تساعد على التواصل وتبادل الاراء ونقل الأفكار بين الطلبة أنفسهم، مما يسهم في بناء التفكير الناقد مع مرحلة نموهم.

وتجدر الاشارة إلى أن تحليل مضمون المناقشة والحوار بين المعلمين والتلامذة في الغرفة الصفية هي إحدى الطرق المهمة في عملية التعليم وفي زيادة فعالية الطالب في الموقف التعليمي؛ ويمكن الاستفادة من هذه الاستراتيجيات في دروس العلوم للمرحلة الأساسية التي هي محور هذه الدراسة حيث أنها ليست مجرد مفردات أو قائمة من المصطلحات الفنية المتخصصة، أو أنها سرد لتعريفات علمية.

حيث أن التلاميذ بحاجة للتحدث في دروس العلوم باستخدام اللغة العلمية السليمة التي تتكون من: أشباه جمل وجمل وفقرات أو عبارات. وتعلم العلوم يعني تعلم "كلام وسلوك العلوم". وهذا يعني استخدام لغة المفاهيم في القراءة والكتابة وفي التفسير وحل المشكلات وفي الاجراءات العملية داخل المختبر وكذلك توظيفها في الحياة اليومية.

كما يعني تعلم العلوم أيضاً الملاحظة، والوصف، والمقارنة، والتصنيف، والتحليل، والمناقشة، وتوليد النظريات Theorizing، وبناء الفرضيات، والتساؤل وتحدي الأفكار والمواقف، والجدل المنطقي الهادف، وتصميم التجارب، ومتابعة الاجراءات، والحكم، والتعميم وتقديم التقارير، والكتابة الصحيحة لغةً وتخصصاً، والمحاضرة... على أن تتم جميع الفعاليات باستخدام اللغة العلمية السليمة أثناء الخطاب الصفي.

بناء عليه فإن الورشة تحاكي العديد من الاستراتيجيات التي ذكرت أعلاه بشكل تطبيقي عملي للاستفادة منها وتوظيفها داخل الصفوف.

Steps Beyond Meeting the Language Challenge – 4 Practices

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Introduction:

The session will highlight four educational practices implemented at our schools to overcome the challenge of communication. The presenters will share and discuss these practices through demonstrations and activities. The educational practices are:

5. Teaching and assessing competencies and abilities regarding scientific communication.
6. Implementing integration projects across subjects
7. Inclusion of learners with special needs into regular classes.
8. Authors and teachers from our schools write, design and animate E-books of science for our learners.

Strategy:

The presenters will introduce four educational aspects related to communication that our schools implement. These are examples of how we overcome the language challenge in science education and not "just simply meeting the language challenge".

1. Teachers include in the unit plans and assess competencies and abilities related to scientific communication. Teachers teach and assess these in addition to the scientific knowledge required by the curriculum. An example of such competencies is: *Communicate using scientific data in accordance with the rules and conventions of science by utilizing various methods to present information and by using accurate and appropriate scientific terminologies related to*…)

2. Teachers meet to agree on projects that integrate competencies and abilities from different subjects. These integration projects help the learner understand how knowledge from one domain can be transferred into another. These projects tackle problems faced by educators where learners "learn" a skill in one subject but cannot use the skill in another subject or in real life.

3. Inclusion of learners with special needs into regular classes is possible through modification of instructions and assessments, thus overcoming the language challenges that arise due to the special needs.

4. E-books of science and other subjects are written, designed and animated by authors and teachers from our schools. They include actual life situations, topics and themes that our learners live and experience every day. This makes their studying experience tangible and easy to achieve without the troubles that may arise from understanding references in foreign books.

Description of session:

Activity 1: *Introducing the challenge of communication:*
Participants will watch a short science video explaining a concept in a way that is open to multiple interpretations (may involve misconceptions). Then they will answer questions about the video using the technique of "wall newspapers". A discussion will be held about the answers, which are expected to be diverse because of communication problems. An alternate explanation will be suggested and shown using another video.

Activity 2: S*cientific communication competencies and abilities*
Participants will be given the competencies of scientific communication and asked to include them in the plan to teach and to assess an ability in G8 chemistry. A discussion will be held in which the presenters will share how they implement including such competencies in teaching and assessing.

Activity 3: *Integration projects.*
Participant will be given a chart with a list of concepts that are taught in intermediate science and asked to fill the chart with where these concepts are useful in situations other than the subject in which they are taught. Then a discussion will be followed in which the process of implementing integration is shared. the discussion and sharing will include how the results of the integration are assessed.

Activity 4: *Inclusion of learners with special needs*
A presenter will introduce a learning difficulty, through an activity, and then give the participants a sample concept to be taught and assessed. The presenter will ask the teachers to give their ideas on how to modify teaching and assessment in order to meet this special need. The presenter will then share how this challenge is met and overcome at our schools.

Activity 5: *E-books of science*
Participants will be shown samples of how the science concepts are taught, using our E-Books, in which the concepts are explained using real life situation familiar to our learners.

Conclusion:
The session will introduce the participant's actual practices in education that are currently used to overcome the "language challenge". It will be an opportunity to share and develop our experiences leading to the best interest of the learners.

Geometrical Language: Codes that Need to be Cracked

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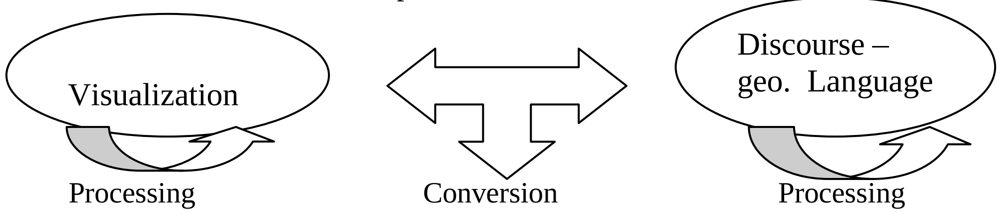
Introduction

Language is always thought of as a mean for communication, in which people in certain community share the same codes, and associates them with certain meanings. But the role of language does not stop at this point. Vygotsky (1997) identified a direct connection between language on one side, and thinking and mental development on the other side. He also considered language as an indicator of cognitive activity that facilitates the movement between every day concepts and scientific concepts. The relation between language and mathematics was always underestimated due to the fact that mathematics and language were considered of different nature. The primary purpose of this session is to help participant recognize the special role that language plays in mathematics teaching in general and in geometry teaching in particular.

Language is inevitably available in all mathematics classes; consequently, it was given some attention in mathematics education research. This paper will highlight on the role that language play in the study of geometry. The interest in geometry stems from the fact that of all areas of knowledge, it requires the most comprehensive cognitive activities and it is the most difficult to teach (Duval, 2005). In this field of research, Robitti (2012) studied the role that verbalization can play on the ability of students to solve plane geometry problems. She emphasized that the role of language goes beyond mere communication tool, and also showed that language can be used as a researcher tool in which students can make explicit, study, and describe the development of their own cognitive processes.

To explain the relation between geometry and language from a cognitive point of view, Duval (2006) tried to analyze what constitute mathematical comprehension and to explain students' difficulties in understanding. He emphasized that the development of semiotic representation (set of signs and symbols) is an essential condition for mathematical thoughts, and that in mathematics there are vast amount of semiotic representations used. In his theory, he specified the conditions in which the semiotic representations can be considered as registers of representations, and clarified the kind of transformations that can occur among different registers. In geometry, students are required to coordinate among at least two kinds of registers; one that requires visualization, and one that requires discourse (geometrical language) for the verbal expression of properties. Duval (2005) mentioned that visualization and language are two kinds of cognitive functions that often oppose each others, but in geometry their articulation is crucial. Moreover, geometrical work is based on the synergy of both registers of representation, and one of the main difficulties in geometry stems from the fact that these registers are used in a way contrary to their normal cognitive function outside geometry. Duval (1999) explained the two kinds of transformations among registers: "processing" and "conversion". Processing or treatment includes transformations that happen within the same register, whereas, conversion includes transformations between different registers. According to him, the coordination among registers, in its two kinds is considered as an essential condition for comprehension.



Few points have to be mentioned here:

- In geometry, “processing” in which transformations are done within one register is not enough.
- “Conversion” between different registers is a crucial condition for learning geometry.
- “Conversion” is more complex, and it includes the transformations that allow the representation of an object to be translated among different registers. It is considered as encoding.
- The coordination among different registers is difficult and not spontaneous.
- Students need long training in order to be able to move back and forth between different registers easily and flexibly.

Robotti (2012) agreed with Duval on the need to use many registers of representations in mathematics, and confirmed that in geometry three registers are always involved: the figural register, the natural language register, and symbolic language. It is important for mathematics teachers to understand the concept of registers of representations and how they operate. This can help in analyzing the difficulties that students might face, and in designing some classroom activities that can facilitate the coordination among different registers, in order to help students become flexible in coding or un-coding verbal data and in relating it to visual data.

Strategy

Participants in this workshop performed some hand-on activities and participated in interactive discussions. The aim of this session was to help participants:

- Identify the vast amount of terms that are specific for geometry.
- Recognize that some terms in geometry are not formally defined although they are used in most of the geometric definitions.
- Be aware of the fact that many of the terms are used in geometry in a way that is different than their use in natural language.
- Be acquainted with the registers of representations and how they operate.
- Recognize the difficulty in coordination among the visual and verbal registers.
- Communicate some of the difficulties they experience in their classes.
- Relate these difficulties to the theory of registers of representations.
- Come up with practical recommendations that can help teachers in their classrooms.

Description

In what follows the flow of the session will be described:

(a) A brief introduction and warm up to discuss the importance of the topic, and the meaning of the term “geometry”. The presenter and the participants agreed on the following definitions: The Greek definition of the word geometry; **Geo**: related to earth land, like geology and geography, **Metry**: related to measurement, like metric units, **Geometry**: The branch of mathematics that deals with measurement and relationship of points, lines, angles, and figures in space from the defining conditions by mean of certain assumed properties. **Geometry discourse**: The language that is used in geometry and it is accepted and understood by the members of the mathematical community (10 min).

(b) Participants were involved in solving a cross word puzzle that uses geometrical terms, and providing more terms that are specific for geometry. They concluded that in language there are vast amount of terms that are specific for geometry (10 min).

(c) Participants were asked to give definitions for the geometrical basic terms: point, line, and plane. They reached a conclusion that there is no formal definition for these terms although they are used in most geometrical definitions (10 min).

(d) Participants were given a worksheet that included twelve sentences that needs to be filled in with six given geometrical terms. Each term was supposed to be used in two sentences, once in a geometrical context, and once in an everyday language. When they finished working with the worksheet, they discussed the paradox in the meaning of the terms. This activity helped them to realize that some words are used in geometry in a different way that they are used in everyday life (15 min).
(e) The presenter introduced Duval's theory of registers of representation, explained its importance in geometry due to the fact that there is a need for at least two registers of representations (visualization and discourse), and discussed the difference among "processing" and "conversion" and how they operate. (15 min)
(f) Participants were encouraged to relate this theory to geometry comprehension and provide examples. They were able to pinpoint on one of the difficulties related to geometrical figures and language; In geometry one statement might lead to many figures, and one figure might lead to many statements (10 min),
(g) Participants were involved practically in an activity given by Blanco (2001), trying to construct the orthocenter of an obtuse triangle and to analyze interactively the difficulties associated with finding this point. They were encouraged to relate it to the theory of coordination among registers (15 min),
(h) Participants worked in groups and discussed some geometric difficulties that they faced with their students and tried to relate it to language and the theory of coordination of registers. They presented briefly their difficulties to others (20min).
(i) Summing up, providing practical recommendations, and asking questions (15 min).

Conclusion

Teachers must be aware of the role that language can play in geometry comprehension, and to understand that linguistic difficulties might hinder students' abilities to solve geometrical problems. Follows are some practical recommendations that are expected to facilitate students' ability to move between the two main registers that we are concerned about in this paper; verbal and visual: (Most of these recommendations were taken from Duval (2005), Robitti (2012), and Blanco (2001))

- Encourage students to verbalize their thoughts (think aloud).
- Explain the meaning of everything you name.
- Relate the names to other forms like figures or symbols.
- Supplement, explain, and justify verbally the purpose of all the steps you take.
- Emphasis on understanding rather than rote learning of the geometrical terms and concepts.
- Encourage students to work in groups.
- Allow students to reflect on their learning process.
- Leave space for communication in the classroom in which students can use the language to discuss or explain.
- Correct students' language.
- Give lots of examples to show students that for one statement there might be many visual representations, and for one visual representation there can be many related statements.
- Allow students to construct geometrical figures given verbal instructions.
- Allow students to interpret and analyze verbally provided figures.
- Encourage teachers not to just rely on the book as the ultimate resource; instead guide the students to other resources that can present the same information in different forms.

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Problem Posing: A Teaching Strategy to Enhance problem Solving

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The presentation will highlight the common problems that teachers and learners face while teaching/learning to solve real life mathematical word problems. It will also define and identify problem posing as a strategy to enhance problem solving abilities. The presenters will explain the advantages of using problem posing activities in the Math classroom, as well as identify different types of problem posing activities with examples.

The presenters will also conduct several problem-posing activities as an application on various problem-posing activities for different grade levels. For example:

a- Participants will be given a problem situation and they will be asked to pose as many questions as possible related to the given situation.

b- Participants will be asked to pose a whole problem that targets a specific given situation.

c- Participants will be asked to vary conditions of a given word problem (such as given data, the question, etc…)

The presentation will introduce a practical teaching method that may help learners in problem solving difficulties as well as develop their problem solving skills, through deep reflection on real life aspects of Math word problems. It will be an opportunity to share experiences with other teachers who are attending.

I- Introduction:

A general definition of problem posing according to Silver is "both the generation of new problems and the re-formulation of given problems" (Silver, 1994, p.19). Research reveals that problem posing has positive effects on learners' problem solving abilities. It fosters creativity and flexibility and enhances critical thinking.

The significance of using problem posing involves learners in higher-order and active learning assignments which is important for the development of their problem solving abilities. It provides a link between problem-based learning and some sort of scientific inquiry as it involves learners in higher-order questioning skills. Problem posing targets learners' conceptual understanding and involves students in critical reflection as they shift away from only acquiring knowledge and work more on applying it. This strategy fosters the learning of Mathematics with understanding rather than by mechanical procedures and memorized and drilled algorithms, which raises the expectations that students will retain life-long knowledge and understanding of mathematical concepts.

II- Strategy

During this session, problem posing will be introduced as a teaching strategy that enhances mathematical abilities in general, and problem solving skills in specific.

III- Description of session:

The session will be divided into two main parts: 1- theory & 2- application.

1- Theory:

a- Point out the common problems both teachers and learners face while teaching/learning to solve real life mathematical word problems.

b- Identify and define problem posing as a strategy to enhance problem solving abilities.

c- Explain the advantages of using problem posing activities in the Math classroom.

d- Identify different types of problem posing activities with examples.

2- Application:

Conducting several problem-posing activities as an application on various problem-posing activities for different grade levels. For example:

d- Participants will be given a problem situation and they will be asked to pose as many questions as possible related to the given situation.

e- Participants will be asked to pose a whole problem that targets a specific given situation.

f- Participants will be asked to vary conditions of a given word problem (such as given data, the question, etc…)

IV- Conclusion:

This strategy can be used while teaching problem solving in a Grade 8 classroom. The learners will face some difficulties at first because upon using problem posing as a strategy in class, the responsibility of learning/teaching will be shared by the teacher and the learners. Thus, students may be overwhelmed at start, but later on will find this experience interesting and beneficial.

V- References:

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