THE TWENTY-SECOND ANNUAL SCIENCE AND MATHEMATICS EDUCATORS CONFERENCE (SMEC 22)

SMEC 22

CONFERENCE PROCEEDINGS

March 6 AND 7, 2021

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	SMEC 22 CONFERENCE PROGRAM AT-A-GLANCE	
	SATURDAY MARCH 6, 2021	
9:00 - 9:15 am	**OPENING CEREMONY**	
	PLENARY SESSIONS	
9:15 - 10:30 am	**SCIENCE** **Moderator: Rola Khishfe** Generic competences in science teaching: A challenge for practice and a topic for research *Jan Alexis Nielsen,* *Department of Science Education* *University of Copenhagen,* *Denmark*	**MATHEMATICS** **Moderator: Murad Jurdak** Mathematics Education in a time of Fake News and Pandemics *Renuka Vithal,* *University of Fort Hare, Alice, Eastern Cape, South Africa*
10:30 - 11:00 am	**BREAK**	
	RESEARCH SESSIONS **MODERATOR: RABIH EL MOUHAYAR**	
	11:00 – 11:30 am La Schématisation des Circuits Electriques selon le Curriculum Libanais: Ses Difficultés Didactiques et les Enjeux de son Apprentissage a Distance *Georges El Ahl and Naim Rouadi* **11:30 am – 12:00 pm** Investigating the Role of False Diagrams in Facilitating Grade Seven Students' Deductive Argumentations in Geometry *Badera Nakouzi*	

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Carol Shehaimi and Fatima Koubaissi

12:30 – 1:00 pm
A Community of Mathematicians
Nadine Daya</td></tr>
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(DEVELOPMENTAL WORKSHOPS, INNOVATIVE IDEAS, REPORTS OF SCHOOL RESEARCH AND DEVELOPMENT PROJECTS)</td></tr>
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Innovative Idea Sessions **11:30 am – 12:45 pm**	History and Storytelling in Mathematics Classrooms	*Heba Khanafer*	*Razan Kachmar*	Math Intermediate and Secondary
	Analogy in Chemistry Teaching	*Fatima Al Zahraa*	*Tamer Amin*	Science Secondary
Reports of School Research and Development Projects **11:30 am – 12:45 pm**	Conceptions and Misconceptions of Infinity in the Light of the Lebanese Curriculum	*Layla Nasr*	*Rana Bassaj*	Math Secondary
	Flipped Classrooms: Benefits and Challenges	*Zeina Jaffal*	*Rola Khishfe*	Math and Science Elementary and Secondary
	SUNDAY MARCH 7, 2021			
	PLENARY SESSIONS			
9:15 - 10:30 am	**SCIENCE** **Moderator: Saouma BouJaoude** Preparing Scientifically Literate Citizens in Times of Crises *Hagop A. Yacoubian,* *Education Department* *Lebanese American University, Lebanon*	**MATHEMATICS** **Moderator: Rabih El Mouhayar** Assisting and Limiting Factors in Integrating Technology in Mathematics Education *Houssam Kasti* Hariri High School II; Lebanese International University; Haigazian University, *Lebanon*		
10:30 – 11:00 am	**BREAK**			
	CONCURRENT INTERACTIVE SESSIONS **(DEVELOPMENTAL WORKSHOPS, INNOVATIVE IDEA SESSIONS** and **REPORTS OF SCHOOL RESEARCH AND DEVELOPMENT PROJECTS)**			

	Title	Presenter(s)	Moderators	Audience
Developmental Workshops **11:00 am – 1:00 pm**	Embrace the Change and Let's Dive in the World of E-Learning!	*Nour El Akhdar and Fawzieh Hnaini*	*Murad Jurdak*	Math Elementary and Intermediate
	Experience-Based Learning and The Lebanese Curriculum	*Nasser Barakat*	*Rana Bassaj*	Math and Science All levels
	Go Online, Go Inventive	*Hanadi Hammoud*	*Rola Khishfe*	Science Intermediate and Secondary
	Title	**Presenter(s)**	**Moderators**	**Audience**
Innovative Idea Sessions **11:30 am – 12:45 pm**	Teaching Mathematics from the Lens of 21st Century Educators: A Practical and Authentic Implementation!	*Israa Fawaz*	*Rabih El Mouhayar*	Math Elementary, Intermediate and Secondary
	Escaping Educational Stereotypes	*Roweida Bawab and Dalia Sous*	*Tamer Amin*	Science Elementary and Intermediate
Reports of School Research and Development Projects **11:30 am – 12:45 pm**	The Effect of Problem Based Learning on High School Students' Achievement and Conceptual Understanding in the topics "Solution Preparation and Titration" and on their Attitudes toward Chemistry in Secondary School in Beirut District	*Fatima Al Zahraa*	*Saouma BouJaoude*	Science Secondary

Plenary Session Science

Generic Competences in Science Teaching: A challenge for practice and a topic for research

Jan Alexis Nielsen
Department of Science Education, University of Copenhagen, Denmark

In this presentation, we will together explore a particular type of learning goal: namely, generic, or cross-cutting, competences (such as inquiry, argumentation, modelling, innovation/creativity and so on). Such competences are generic in the sense that they are the target of teaching in multiple disciplines or subjects. Science curricula in many countries abound with learning goals of this type. But research shows that generic learning goals, and generic competence goals, in particular, can pose challenges for teaching practice. Some of the challenges relate directly to the fact that these leaning goals are goals across disciplines – as opposed to being goals that have an established "home" in a discipline. In the presentation, we will discuss the challenges and begin to form hypotheses about why the challenges arise. Finally, we will collaboratively sketch research approaches to investigate more closely how generic competences, as learning goals, can be made operational for teaching and assessment.

Plenary Session Mathematics

Mathematics Education in a Time of Fake News and Pandemics

Renuka Vithal
University of Fort Hare, Alice, Eastern Cape, South Africa

The question that may be put to mathematics and science educators the world over today is: what role could or should mathematics and science education play in an era in which citizens are overwhelmed with information including that which is variously described as anti-science, anti-intellectual, conspiracies and against reason and logic. The last few decades has seen the rise of the social, cultural and political dimensions of mathematics education that have attempted to address some of these broader questions of the relations between mathematics education and society. Related to these dimensions, there have emerged a broad range of theories, research and practices, which are becoming mainstreamed in mathematics curricula. However, this work, it may be argued, has been overtaken by the current context of the Covid-19 pandemic across the world. This presentation engages rethinking some of these practices related to what may be described as part of a social, cultural, and political approach to mathematics teaching and learning and to teacher education for the current context. And it makes a case for a more sustained and

deeper consideration of developing a more critical perspective in mathematics classrooms, notwithstanding consequencesthat may extend beyond the classroom.

Research Sessions

La Schématisation des Circuits Electriques selon le Curriculum Libanais: SesDifficultés Didactiques et les Enjeux de son Apprentissage à Distance

Georges El Ahl and Naim Rouadi
University of Saint Joseph (USJ), Lebanon

Mots clés:
Schématisation ; circuit électrique ; montage réel ; conversion schéma électrique-montage réel.

Notre étude s'intéresse à la schématisation des circuits électriques ainsi qu'à leur représentation sous forme de montages réels. Nous voulons, par cette étude, mettre en évidence l'importance des conversions réciproques: « schéma symbolisé-montage réel » d'un circuit électrique dans l'acquisition des concepts de l'électricité élémentaire. Nous avons eu alors recours à un dispositif sous forme de simulations formatives et d'exercices en ligne avec leurs corrigés. Un des objectifs de ce dispositif est de faire apprendre aux apprenants des processus permettant de distinguer les circuits série des circuits en dérivation. Un autre objectif est de tracer les boucles possibles d'un circuit schématisé. Le troisième et le plus intéressant est de convertir un circuit symbolisé en un montage réel et la réciproque. Pour tester l'efficacité de cette démarche, nous avons administré à une centaine de lycéens libanais un pré-test avant de participer à une série de séances explicatives qui, à leur tour, sont suivies d'un post test. Un T-test va être effectué ensuite afin de comparer les notes des échantillons appariés. Une analyse épistémique et didactique des tests devra mettre devra mettre en évidence l'efficience de la schématisation des circuits électriques sur l'apprentissage des concepts de l'électricité.

Investigating the Role ofFalse Diagrams in Facilitating Grade Seven Students'Deductive Argumentations in Geometry

Badera Nakouzi
University of Saint Joseph (USJ), Lebanon

Geometric diagrams play an essential role in geometry, and they are regarded as key resources in students' geometric reasoning (Chen & Herbst, 2013). There is a near consensus among mathematicians and mathematics educators that "diagrams are important in doing, learning and teaching mathematics and in visualization, mathematical thinking and problem solving" (Alshwaikh, 2011, p. 50). Polya (1973) emphasized on the heuristic role that diagrams play in solving problems since they allow the students to grasp the different relations and to

anticipate the results. Diagrams can also provide clues for the solution, facilitate conjectures, and assist in communicating and interpreting results.

Despite the importance of geometric diagrams, their use in problem solving is considered problematic. Diagrams can mislead students, especially when they are used with proof tasks (Inglis & Mejía-Ramos, 2009). This was attributed by some researchers to the dual nature of diagrams since they possess two different kinds of properties: the *visuospatial* and the *theoretical* properties (Dimmel & Herbst, 2015; Gobert, 2007; Laborde, 2005). The visuospatial properties can be accessed by merely looking at the diagram, and they offer lots of information some of which are relevant and useful and others that can just be regarded as interesting (Laborde, 2005). Whereas the theoretical or geometric properties represent what is given or known about the theoretical geometric object. Students sometimes get confused about what aspects of the diagram to consider and what aspects to disregard, and many of them take information directly from the diagram by using visual perception or instruments and use it for proof. This practice can hinder the student's deductive reasoning and obscure their entry in the mathematical debate that involves proof (Gobert, 2007).

In the theory of registers of semiotic representations, Duval (1999, 2006) explicated that mathematical comprehension requires the coordination of at least two registers of representations. He clarified that the proper use of geometric figures requires the articulation among the discursive register that uses language for the verbal expression of properties and the visual register that requires visualization in order to represent space. Problems arise when the work in geometry is limited to *processing* inside one of these registers and the inability to make *conversions* between them. Students sometimes rely solely on the visuospatial properties of the diagram, and their work gets trapped in the visual register. This puts them under the risk of making errors and providing wrong answers to geometry problems. On the other hand, Duval (1994, 1999) explained that there are different apprehensions of diagrams, two of which are related to this research. The perceptive apprehension provides information that is obtained from the diagram at first glance, whereas, the discursive apprehension associates properties or definitions to the geometric configuration. The latter apprehension is the only apprehension that allows deductive reasoning and it is one of the targets of teaching geometry.

Many researchers proposed diagrams with visual ambiguity or with visual-geometric conflict to minimize the reliance on the visual properties of the diagram (Kospentaris, Spyrou, & Lappas, 2011; Kospentaris, Vosniadou, Kazi, & Thanou, 2016; Kospentaris & Spyrou, 2008). In this research false diagrams were investigated. These diagrams include intended conflicts between the seen and the known properties of the diagrams. They represent the cases in which some of the geometrically significant visual properties of the diagram are not in resemblance with the geometric properties given by text or by codes (Gobert, 2007). In the literature, false diagrams have different labels such as free hand drawings, inaccurate figures, diagrams not drawn to scale, or sketchy or hazy diagrams. Such diagrams present one or many visual-geometric conflicts that are expected to shake the students' trust in diagrams and to encourage students to look for more reliable sources of information. In addition, they are anticipated to facilitate the back and forth movement between the visual and the discursive registers of representation and enhance the

coordination among these registers which is essential for allowing deductive reasoning. False diagrams are used in many international mathematics textbooks and standardized tests (such as the SAT), but there is scarcity of research that investigates their role in geometric reasoning. In Lebanon, such diagrams are not regarded in the curriculum, and they are rarely used in the mathematics textbooks. However, some teachers supplement their work with such diagrams to prepare their students for international standardized tests. This research investigates the role that false diagrams play in facilitating Grade 7 students' deductive argumentations and studies thoroughly their interactions with such diagrams. This grade level was chosen because it is considered at the center of the transition from practical to theoretical geometry. At this stage students face many challenges with abstraction and the use of deductive reasoning in proof tasks.

Three types of diagrams were defined for the purposes of this research. Two of them were induced from the definitions of false diagrams given by Coppe, Dorier, and Moreau (2005) and Gobert (2007). The three types of diagrams are:

Normal (N): The diagram displays all the given properties and does not display any extra geometrically significant property that is not given.

Completely False (CF): The diagram does not display any of the given properties or any extra geometrically significant property that is not given.

Partially False (PF): This diagram is neither N nor CF. One or many violations of the conditions that are required for these two types of diagrams qualify the diagram to be PF.

Additionally, a task was designed in the form of a paper and pencil test having a geometry problem presented in text and supplemented with a diagram. The task requires from students to conjecture the nature of a triangle and write an argumentation to justify their answer. Three forms of this test were prepared, each having one of the three types of diagrams.

In addition, two constructs were defined to measure the closeness of the students' argumentations to deductive arguments: *Geometric Deductive Validity* (GDV), and *Kind of Argumentation*

Two major research questions were raised:

Q1: Does the type of diagram (N, CF, or PF) affect Grade 7 students' argumentations as measured by *GDV* and the *kind* of argumentation?

Q2: How do grade 7 students interact with CF and PF diagrams with emphasis on their patterns of behavior, difficulties, and apprehensions of diagrams?

A mixed research design with quantitative and qualitative component was proposed to answer the research questions. For the first research question, a sample of 312 students was chosen from the population of grade 7 students in Lebanon. The students were assigned randomly to one of the diagram groups (N, CF, or PF) and were given the geometry problem with the type of diagram that corresponds to their group. Data were collected from the students' argumentations that they presented as a response to the task. Each argumentation given by a student was decomposed and analyzed using a protocol based on Toulmin (2003)'s basic model and the

definitions of deductive arguments. For the GDV measure, a scale was developed from 0 to 24, in which the 24 represents a complete deductive argumentation. Whereas, for the kind of argumentation four attributes were proposed: deductive (D), deductive incomplete (DI), empirical (E), or unknown (Un).

Two raters participated in evaluating the argumentations given by the students, and the averages of their measures were used for analysis. The Kruskal-Wallis test (a non-parametric equivalent of the ANOVA test that is rank-based) was used to test the null hypothesis of no difference among the three diagram groups in the GDV measures. Moreover, the Mann Whitney U-test, known as the Wilcoxon Rank Sum Test, was used to test the null hypotheses for the follow up questions, related to pairwise comparisons among the three diagram groups. The Chi-square test was implemented to assess the null hypothesis of no difference among the three diagram groups in the distributions of the kind of argumentations. In addition, the same test was used to answer the follow up questions related to pairwise comparisons among the diagram groups in the distributions of the kind of argumentations.

In what follows is a summary of the results obtained from the quantitative analysis of the data that answered the first research question and the related follow up questions.

There are statistically significant differences among the three diagram groups in both the GDV measure and the kind of argumentation.

There are statistically significant differences in both the GDV measure and the kind of argumentation between the N diagram group and any of the CF and the PF diagram groups, with the advantage of the N diagram group.

There is no statistically significant difference in both the GDV measure and the kind of argumentation among the CF and the PF diagram groups.

Result 1 was in accordance with our expectations, since it confirmed the difference among the diagram groups in the two measures defined earlier. However, results 2 and 3 failed to confirm our minor hypotheses related to the advantage of false diagrams over the normal in the two measures. They also failed to confirm the expected advantage of the CF diagrams over the PF diagrams in facilitating deductive argumentations, as it was hypothesized by Gobert (2007). Further analysis of the results established some of the risks that are associated with the use of N diagrams by students, such as relying on information taken directly from the diagram and using it to support their arguments without providing further justifications.

For the second research question, a parallel sample of 30 students were selected from the same population to work together in pairs on the same task. They were given a single test paper with one of the two types of false diagrams to encourage them to verbalize their thoughts. The works of these pairs were videotaped to allow the students' conversations and some of their gestures to be transcribed for further analysis. Data collected from these transcriptions and the students' inscriptions on the test papers were analyzed from different perspective. They provided a comprehensive answer for the third research question that clarified the students' interactions with false diagrams.

The qualitative analysis of the pairs' work failed to reveal any major differences between the pairs using the CF and the PF types of diagrams, which corroborated with the related quantitative results. Moreover, the analysis identified some patterns of interactions with false diagrams and the major difficulties that the pairs faced while dealing with these diagrams. On the other hand, the monitoring of the individual students' reaction to some misleading properties of the false diagrams revealed that the students' apprehension of false diagrams was not steady at all times, and the students displayed three new forms of apprehensions of diagrams that are more specific to false diagrams: discursive, adaptive, and adoptive.

This research reveals the importance of the type of diagram in geometric reasoning, but it does not confirm the hypothesized benefits of false diagrams. Moreover, this research uncovers some knowledge related to students' interaction with false diagrams, confirming and illustrating cases of difficulties and disturbances in the students' reactions towards such diagrams. With the scarcity of research related to studying the effect of using false types of diagrams on students' argumentations in geometry, the results of this research are expected to enrich and contribute to the literature in this field. In addition, this research provides a tool that allows the evaluation of the closeness of argumentations to deductive arguments based on Toulmin (2003)'s model.

This research can also be helpful for mathematics' teachers and educators, curriculum designers, and textbook narrators since it:

- Raises awareness about the importance of the type of diagram in geometric reasoning
- Clarifies the challenges and the difficulties associated with the use of false diagrams
- Provide teachers and educators with epistemological and practical means to analyze related students' difficulties
- Highlights the potential of false diagrams in minimizing the risks associated with the use of normal diagrams and in their ability to distinguish among students who rely on their perception while solving geometry problems.

In general, teachers and educators need to weigh the benefits and the risks for using false diagrams to decide when they can be valuable during the course of instruction. Finally, this research opens the doors for future research to supplement and confirm the results, using wider contexts and settings. It is also recommended to study the gradual introduction of false diagrams to minimize the effect of the abrupt introduction of false diagrams that might have affected the results of the students in this population.

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أين نحن من التخطيط للتلاميذ ذوي الاحتياجات الخاصة خلال التعلم عن بعد؟

Carol Shehaimi and Fatima Koubaissi
مدارس المبرات/ثانوية الكوثر, Lebanon

لم يشكل إقفال المدارس خلال جائحة كورونا تحديا أو تهديدا كما سببه للتلامذة ذووي الإحتياجات الخاصة. هؤلاء المتعلمين الذين تتزايد أعدادهم كل عام في مدارسنا و نحن لا نزال في العالم العربي في بداية صياغة القوانين و التشريعات التربوية التي تأخذ إحتياجاتهم التعليمية و النفس- إجتماعية بالإعتبار وجدوا أنفسهم و ذويهم و معلميهم أمام أساليب التعليم المنضوية تحت مسمى «التعلم عن بعد». و عليه و في غياب الأبحاث و الآليات

الواضحة للتعامل مع هذه الفئة من المتعلمين في هذه الظروف أخذت ثانوية الكوثر هذا الموضوع على عاتقها و نشطت في إعتباره إستحقاقا و اخضعته لعملية بحث إجرائي ضمن برنامج تمام. سنقدم لكم في هذه الجلسة ملخصا عن مسار هذا البحث الإجرائي و نتائجه ووصفا موجزا لواقع الحال في الثانوية بما يتعلق بعملية التعلم و التعليم و

الخدمات المساعدة الأخرى المقدمة لهذه الفئة خلال جائحة كورونا.

A Community of Mathematicians

Nadine Daya
Wellspring Learning Community, Lebanon

The perspective of teaching Mathematics during the pandemic has evolved drastically. In this session, participants will look at the different examples of building a community of Mathematicians among learners and educators. They will reflect on various engaging tools and strategies that facilitate the learning and teaching of mathematics. At Wellspring Learning Community, building a community of mathematicians has been implemented among colleagues and within online sessions. Educators worked collaboratively to determine the learning needs of students and to worktowards learners' engagement and participation in the online sessions. Educators have explored their relationship with math and thought of strategies to deepen learners' conceptual understanding of math. Such strategies like Visible Thinking Routines, Number Talks, Virtual Manipulatives, Math Problem-Based and open-ended story problems have strengthened learners' communication, thinking and social skills. Based on the data collected, Mathematics had the highest online participation among other disciplines. This was due to implementing Math Workshop Model and engaging tools and strategies within math sessions. That also fostered a positive mathematical mindset among learners and educators. As a team, a list of mathematical tools that would be convenient for exploring mathematics has been developed. This helped to build a community of mathematicians within the online sessions as the "tools" or "strategies" and within educators as "collaborative planning meetings", "weekly plans" and "mapping of mathematical concepts".

Developmental Workshops

Using Multimodal Practices in Teaching Mathematics with the Different Learning Styles in an Online Environment

Jana Abdallah
Rawdah High School, Lebanon

The purpose of this workshop is to discuss the enhancement of the asynchronous online discussions and assessment using multimodal interactive tools that allow text, video and audio

posts. The workshop identifies teaching strategies in online courses considering the four learning styles.

Through the workshop you will conclude that the performance of the students in mathematics will be improved if the teacher is providing instruction in a way consistent with each student's learning style. However, an instructor should keep in mind that, even if a student can learn best in certain ways, he/she should be exposed to a variety of learning experiences to become a more versatile online learner. The combination of different techniques can make it possible for students with all types of learning styles to be successful in an online course.

Transition from Classroom Learning to Online Learning

Ali Shalhoub and Khalil Bader Eddine
Rawdah High School, Lebanon

Online teaching is a complicated mode of teaching. Teachers and students feel that it is not easy to communicate; hence, knowledge is not easily transferred from teachers to students.

The purpose of this workshop is to find ways to benefit from this stay-home situation and challenge students to learn physics in a practical way. The workshop will focus on the different modes of communication that enhance distant learning. Moreover, it will present few strategies for teaching physics in an interesting way, ensuring all types of learning are considered.

E-Learning Strategies and Tools

Rania Zeid Saad, Hanan Attieh Moussa, Kristel Yaacoub, Naya Sabbagh and Raymond Melhem
Saint Mary's Orthodox College, Lebanon

Many factors have caused the shift from traditional chalk and board method of teaching to remote learning. Yet, while the technological resources that make the so called e-Learning effective and motivating may be available, the educators that are in charge of it lack essential training on the usage of these resources and on the strategies and tools that lead to its success. This workshop is an attempt to bridge the gap between the teaching skills that educators possess currently and the ones that are needed for e-Learning. Empowering educators with e-Learning strategies and tools is essential for an effective learning process and successful learner's engagement. The session provides professional development opportunities, primarily focused on online and hybrid/blended learning academic tools. This workshop will bring the participants closer to the competencies of the 21st century educator: enhanced planning and new tools that are more adapted to e-learning.

History and Storytelling in Mathematics Classrooms

Heba Khanafer
Al Baraem School; Lebanese American University, Lebanon

In most mathematics classrooms all around the world, mathematics is perceived as a dry, repetitive, pure, and abstract subject that doesn't make sense. It is all about formulas, memorization, and procedural thinking. Many students tend to feel bored, uninterested, and disengaged in math classes. The reason behind this is the way we, teachers, are teaching math concepts. Most of our students feel that they don't belong to mathematics classrooms. Storytelling might be a good way to minimize students' distractions especially in online settings. Telling stories help our students build deeper connections with math. With this online learning, students are more likely to be listeners and teachers are lecturers. That is why storytelling might be a successful approach to introduce math concepts at any level. When introducing a math concept through a story, students will not forget the concept because they will not forget the story. Mathematics is filled with stories, applications, science and nature, games and puzzles, history, and fiction. Using stories is not a distraction but a great inspiration that gets students excited and motivated, makes content more memorable, show careers and people who use math, and encourage students to keep interest in future STEM careers.

Introduction

In this time of online teaching and learning, math teachers are always searching for new and effective ways to teach their students. As it is hard for them to engage their students in hands-on activities for them to discover and explore by themselves, and as it seems hard for students to cooperate and work collaboratively, storytelling might be one of those ways that will keep students' motivation and excitement. Since in online settings students are more likely to be listeners and reflectors, and teachers are more likely to be lecturers, telling stories might be helpful.

In mathematics, each concept has epistemological roots behind it. Each concept can be linked to a story, whether real or fictional. That story can be the mathematician who discovered the concept, the history of the concept (how it was first applied), and the links between the concept and our real life. Providing students with background information about whatever we are explaining can be engaging to learn. Since students are curious, by telling stories, teachers are meeting their students' needs. Moreover, students' attention span is short; especially when learning online, they are easily disengaged. However, when we introduce the math lesson with an amazing story, we will gain their attention throughout the explanation, and we will not lose it. We all perceive the world in terms of stories; we dream, we think, and we imagine things. Mathematics is an amazing visual of pieces, and these pieces coming together infinitely not just represent mathematics, rather; they represent us- our stories coming together.

Singh (2020) argued that we have all been marked in history and we passed through many events that lead us to where we are now; these events give us a sense of belonging. All the different

races, cultures, civilizations, and tribes utilized mathematics. When we tell their stories, we build stronger connections with math and also with our students (Singh, 2020).

"If we don't tell stories, forget about the facts" (Singh, 2020). It is essential to mention the origins and the roots of things. Telling math stories fills the gaps and gives our students a sense of belonging they really need.

Storytelling is linked to the imagination too. Imagination plays a fundamental role in understanding math concepts that range from the most basic such as numbers to the more abstract such as dimensions and infinity (Balakrishnan, 2008).

It is only through engaging students' imaginations that we can bring emotional value and meaning to the array of seemingly irrelevant facts, rules, and algorithms they encounter at school (Egan, 2005).

Strategy

A. Stories to accompany a concept:

Archimedes, the ancient Greek of Syracuse's two famous stories:

1. "Eureka" story:
   - ✓ Leaves the door open for mathematical exploration into the concepts of volume and buoyancy.
   - ✓ The excitement of discovering a mathematical truth. Compare this to students' excitement when they get the answer of a challenging math problem after trying really hard or the AHA moment.
2. "Don't disturb my circles" story:
   - ✓ The degree to which he was engrossed in a math problem so that he neglected his own safety and he was killed by a Romanian soldier.
3. Sophie Germain's inspiring story. Mentioning the stories of female mathematicians who faced prejudice and discrimination empowers the girls in our classrooms.

B. Stories to intertwine with a concept:

1. Mount Everest, the highest mountain on Earth: to introduce trigonometry or properties of a triangle. Indian Mathematician Radhanath Sikdar was the first person to calculate the height of mount Everest using advanced geometrical techniques.
2. Princess Dido: maximizing the area of a shape using circles.
   Queen Dido founded the ancient city of Carthage using this property as a trick.
3. Cicadas population: least common multiple, properties of prime numbers.
   Cicadas population emerge from underground in the late spring. In North America, they emerge every 13 years and, in the South, they emerge every 17 years. Why these numbers?
4. Pingala: Fibonacci sequence
   Pingala was the first one who came with the Fibonacci sequence when he was studying Sanskrit poetry. Fibonacci sequence in nature (spirals, petals of a flower, tree branching, leaves, fruits, geometry of plants…).

Description of the session

Introduction Introducing the topic through questioning the audience about the obstacles they are facing in teaching online, the techniques they are using to overcome the obstacles, and the use of stories in their classrooms. Background about storytelling from literature. *PowerPoint presentation for the whole session.*	15 minutes
Archimedes stories Asking the audience how and where we can make use of these stories.	10 minutes
Sophie Germain	6 minutes
Radhanath Sikdar Interactive discussion with the audience about the ways we measure the height of mountains nowadays and in the past. Also, asking the audience about the concepts that can accompany this story.	10 minutes
Princess Dido	10 minutes
Cicadas population The audience will be asked to solve a problem and share their answers: What if predators emerge each 6 years to kill cicadas? At which years both populations will emerge at the same time?	10 minutes
Pingala Discussing with the audience the origins of Fibonacci sequence. Asking the audience about the links between poetry and Fibonacci. Showing the beauty of mathematics (Fibonacci in nature).	10 minutes
Conclusion	4 minutes

Conclusion:

If we are going to build a rich curriculum, then it's really important that we weave in all these elements (Singh, 2020):

1. Grounding the unit in a compelling storyline: Math history and facts from the past which are important to the unit.
2. Situating the problem in relevant and interesting contexts.
3. Making space for connection and reflection: Students need time for wondering and space for wandering.
4. Sparking curiosity with tales and discoveries from math history: Make your students leave your class everyday curious about the world and about mathematics.

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Analogy in Chemistry Teaching

Fatima Al Zahraa
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Chemistry is a big part in our everyday life. Students usually find sciences and in particular chemistry difficult to understand (Treagust, Duit, and Nieswandt, 2000). This is because of the abstract nature of many chemical concepts, teaching styles applied in class, lack of teaching aids and the difficulty of the chemistry language (Woldeamanuel, Atagana, and Engida, 2014). Grade 10 is the stage where secondary level starts. The concepts that are learned in this grade (number of moles, concentration in solution, stoichiometry, concentration in stoichiometry, etc..) (Chami, 1998) are abstract in nature (Chong, Goolamally, and Leong, 2019) and are foundational to chemistry (Berg, 2012; Moss and Pabari, 2010; Paideya, 2010). By not fully and appropriately understanding fundamental concepts, many students have trouble understanding the more advanced concepts that build upon these fundamental concepts (Ali, 2012; Woldeamanuel, Atagana, and Engida, 2014). Science educators believe that most people learn best through personal experience and by relating new information to what they already know. They also understand that learners need to construct their own scientific knowledge by actively taking control of their own learning. This requires that students develop a strong conceptual base and essential problem solving and critical thinking skills that they can apply in a variety of situations. In short, students should be able to use their prior knowledge to answer new questions, solve new problems, and relate what they have learned to everyday life; that is, they need to experience meaningful learning (Mayer, 2002 as cited in BouJaoude and Tamim, 2008). Analogy is one of the meaningful learning methods that relate unfamiliar (scientific) concepts to more familiar (analog) concepts (Orgill and Bodner, 2005). Researchers found that analogies have potential to aid in understanding of new knowledge and thus can be efficient tools for meaningful learning (Akçay, 2016; Rahayu and Sutrisno, 2019). In chemistry, where concepts are often novel and challenging or difficult to visualize, the use of analogies may have beneficial effects on learning (Harrison and Treagust, 1996) (as cited in O'Brien, 2002). They can increase students' achievement in chemistry (Balfakih, 2011). There are several systematic applications of analogy, such as Teaching with Analogy (TWA) (Rahayu and Sutrisno, 2019). The aim of introducing analogies in this session is to make analogy as the students' eyes through which they view the

chemistry concepts in grade 10 in order to grasp them chemistry concepts and relate chemistry to their daily life.

Plenary Session Science

Reports of School Research and Development Projects

Conceptions and Misconceptions of Infinity in the Light of the Lebanese Curriculum

Layla Nasr
Lebanese University, Lebanon

The infinity concept is no doubt one of the most abstract and conflicting concepts faced by the human mind. This is due to the duality in its meaning: a process or a concept. The present study investigates the conception of infinity of students in some official secondary schools of Lebanon (Aley caza). In the first phase of the study, the presentation of the concept of infinity in the Lebanese curriculum was analyzed. In the second phase, a questionnaire was administrated to a group of 215 students of grades 10 and 11 for the aim of unfolding their conceptions/misconceptions of infinity in different contexts and for checking the impact of the curriculum on their conceptions of infinity. Results showed that the majority of students conceptualize infinity as endless or huge number. Moreover, students have difficulties in comprehending the infinite and hold various misconceptions that will bediscussed and categorized in this session.

Flipped Classrooms: Benefits and Challenges

Zeina Jaffal
مدارس جمعية المبرات ثانوية الكوثر, Lebanon

انطلاقا من رسالتها التي تؤكد على تحقيق الخدمات التعليمية التي تضمن حصول تلاميذها على كافة المهارات التعليمية والاجتماعية التي تساهم في بناء شخصياتهم وتطلعاتهم , حتى خلال الأزمات , وفي ظل استمرار جائحة كورونا والتحديات التي تـ تطلبها الاجراءات المرتبطة بهذه الحالة الطارئة، عملت مدارس المـات على وضع مخطط متـ كامل ينسجم مع التعليم المختلط , فمع انطلاقة العام الدراسي 2021-2020 اعتمدت جمعية المـات اسـاتيجية تعليمية تقوم على مبدأ عكس العملية التعليمية بحيث يقوم التلميذ بتحضـ المحتوى التعليمي في المنزل قبل حضوره للصف من خلال تحضـ المادة المطلوبة , مشاهدة الفيديو التعليمي,تنفيذ أنشطة المطلوبة,القراءات المنزلية...إلخ(ومن ثم تدوين كافة أسئلته واستفساراته(، وفي اليوم التالي عندما يحضر التلميذ للصف يقوم المعلم من خلال التفاعل المباشر بينه وبـ التلميذ بتـ ثبيت الأهداف التعليمية المطلوبة والاجابة عن كافة الاستفسارات مع اقامة بعض الأنشطة داخل الصف التي توفر للطلاب فرصًا لتعميق الفهم .من خلال هذه الجلسة سنقوم بوصف هذه التجربة وكيفية تطبيقها في مدارس المـات مع وصف معايـ اسـاتيجية الصف المعكوس وفوائدها بالاضافة الى بعض المعوقات الي تحول دون العمل بها أحيانا .وأخـا ,إن أهمية هذه الاسـاتيجية تـ كمن في أثرها على التلميذ حيث تعتـها بعض الأبحاث من أهم الأسـاتيجيات التعليمية التي تنمي مهارات التعلم الذاتي عند التلميذ، تسمح له بتحقيق الأستقلالية في تطبيق المكتسبات التعليمية وتضمن التفاعل المباشر بـ التلميذ والمعلم في نفس الوقت .

Preparing Scientifically Literate Citizens in Times of Crises

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In this plenary talk, I revisit the notion of scientific literacy and focus on the role of K-12 science

Developmental Workshops

teachers in preparing scientifically literate future citizens. Building upon my and other scholars' research, I argue that future citizens need to be empowered in science classrooms so that they develop a critical mindset, engage in democratic decision-making processes, and be advocates of social justice. Drawing upon several examples of local and global crises such as the ammonium nitrate explosion of the Beirut Port and the COVID-19 pandemic, I construct a profile of a scientifically literate citizen and recommend practical implications of how science teachers can create learning experiences conducive to the preparation of critically-engaged and proactive citizens. Finally, I situate my recommendations along a developmental pathway and show examples of how the learning process can unfold as learners move up the educational ladder from the elementary to the middle and secondary levels.

Assisting and Limiting Factors in Integrating Technology in Mathematics Education

Houssam Kasti
Hariri High School II; Lebanese International University; Haigazian University, Lebanon

Plenary Session Mathematics

With the exception of perhaps the innovator him/herself, technology adoption is innately social, influenced by peers, change agents, organizational pressure, and societal norms. Change agents play a role in the innovation diffusion process of individuals by: first, creating a need for change, establishing information exchange, diagnosing problems, creating an intent to change, helping transform intent to action, and finally, ensuring continued adoption. For decades we have been preaching teachers on the advantages of integrating technology in their practices but not much change was seen. In this session, I will try to answer the following questions among others: (1) what are the limiting and assisting factors that come in the way of teachers integrating technology in their teaching before and during the pandemic?, (2) How can we as educators, administrators, coaches assist teachers in integrating technology?, (3) What are the roles of communities of practice in increasing the effectiveness of technology integration?, (4) what are the roles of students, parents, teachers, and administrations in online teaching?, and (5) what has changed with teachers shifting to online practices from a zone theory lens?

Embrace the Change and Let's Dive in the World of E-Learning!

Nour El Akhdar and Fawzieh Hnaini
Makassed Aisha School, Lebanon

The COVID-19 pandemic has created the largest disruption of education systems; The teachers are not ready; the students are not engaged and even the governments are not well prepared for such an orientation. Education has changed dramatically, with the distinctive rise of e-learning, wherebyteaching is undertaken remotely and on digital platforms. But we, as resilient teachers, are the soldiers that can change the vision and let the whole world think of the new educational system as a challenge not a problem. In order to succeed in this highly-demanding challenge, teachers should dig in the world of innovation and develop their capabilities in technology to levels much beyond what was considered acceptable in the past. So, in this workshop we aim to introduce the teachers to some of the new interactive platforms used in online learning through an engaging presentation made using Nearpod. The platforms are mainly entitled "engaging platforms" that engage students' participation and achievements. These platforms include: Wakelet, Quizizz, Bamboozle, Wordwall and Gimkit.

Experience-Based Learning and the Lebanese Curriculum

Nasser Barakat,
Greater Beirut Evangelical School, Lebanon

Year 2020 had been an exceptional year. COVID-19 crisis locked all the world down and changed most of our standards. However, something good can be learned from any disaster, and COVID 19 is no exception: the lock down proved for all educators that the student-centered learning approachis essential and vital for the future of education. Many theories and strategies focus on this, such as IBL, PBL, STEAM… However, applying any of these strategies requires a major change, a change that is hard at the time being. To solve this issue, and to take a small step towards better education whether face to face or at distance, I turned towards building concepts using experience. A teaching strategy which highlights the use of experience as a foundation to build new concepts and develop them. This process is referred to as Experiential Learning. A simple and powerful strategy which can be applied at any time and proves to be an excellent addition or rather say foundation for the teaching process. Use some experience from the learner's life and introduce new concepts basedon it, then develop global conceptualization about it. Experiences require no pre-designed perfect setups but are found there intrinsically, all we must do is to provoke them and bring them to surface. Teachers of the Lebanese curriculum can benefit of this technique and take their first step towards the future of education where students help teachers building new concepts and mastering them.

Go Online, Go Inventive

Hanadi Hammoud,
Saint Georges School, Lebanon

Due to the COVID-19 crisis, learning is transformed from actual classes to virtual ones. It is our responsibility as educators to promote students to higher levels, even in online classrooms. E-learning has a high potential if the educator is inventive, determined, and clear. During this session, the presenter will share some critical and essential practices to be followed along the online learning procedure as well as some insights on practices that can be done to ease the procedure of online learning such as the use of virtual labs, journals of demonstrations, concept maps and videos with embedded questions. The suggested activities will be also discussed in detail, and will be applied interactively with the attendees, so as they can apply them later with their students. These activities can assure a multilingual and positive reacting environment in the science classes and strengthen the communication between the instructor and the students in this virtual context. Willing to learn the implementation of new methods is the job of the educators, and their savior into online teaching as well.

As schooling have progressed and changed drastically in recent times, especially with the onset of the COVID-19 crisis, the needs and actions of teachers have shifted significantly. Now, the educators are looking for new and different ways to inspire students and help them succeed. As biology teachers, we teach our students to always expect the unexpected from microbes. COVID-19 is now giving such an accurate, yet heartbreaking example of this. As for our domain, it is putting the global educational system to test by forcing face-to-face learning environments to immediately shift online.

To maximize the impact of online learning, instructors must implant methods to communicate with students on a daily basis, or even continuously throughout each day. From students' perspective, the feeling of being alone and distant from their teachers and classmates while learning may increase anxiety and decrease their ability to meet the learning goals expected from them (1). Our challenge as educators is to find new ways to take-off part of this load from the students' shoulders, by finding new methodologies for online learning. We would even like to take this transformational learning opportunity to our benefit. By using science inquiry, we will allow students to engage in the investigative nature of science (2). They will be able to develop active constructional ideas and connections among each other, in a context different than the traditional methods with which we have grown up. This workshop aims to bring in the concept of science inquiry, as it can be applied in our current transformational learning context.

Scientific inquiry can be defined in general as a process that scientists perform to answer a research question, by collecting data and analyzing them in order to reach conclusions. This concept can be expanded to the context of our current transformational classrooms and implemented with students through several activities such as: the use of virtual labs, scientific method experimentation, concept maps, data tables and graph drawing tools. These methods form the building capacity of transformational learning. Through science inquiry, the students will be able to improve their 'scientist' skills by asking scientific questions and actively finding

the answers through hands-on activities. This gives the students their own particular area along which the teacher can lead them to extend their abilities to other areas in life.

In our culture, the teacher-student relationship is an interactive oriented one, with a tight bond that is formed alongside the schooling duration. To be able to reach out to the students now, virtually, and to maintain as much as possible this relationship even in online classes, the teacher plays an essential meditative role. Not to forget that also the student-student relationship is to some extent lacking in the current situation. Some critical and essential practices could be followed along this online learning procedure, such as: (**These practices and the qualifications of the teacher will be presented and discussed during the workshop through a power point presentation and will last for a total duration of 25 minutes**)

- The teacher must be flexible, yet consistent and understands limitations that might face the students due to current times, such as internet availability and technical issues. This will support students with stability and predictability
- The educator should assure repeatedly that he/she is always available to support the students, and to specify clearly the time expected to hear back from him regarding any questions
- In out-of-class times, it is preferable to record videos to convey messages instead of typing them, as this can be comforting for them in such troubling times.
- Deliver the best practices in the curriculum, very clearly and in an organized way to allow the students' efficient understanding of the topics.
- Remind students frequently of assignments and due dates.
- Apply online self quizzes to prepare students for the formative and summative assessments.
- Specify exactly the tools, references and requirements of any assignment sent to the students, to enhance their practices and widen their skillset.
- Let the students know that the teacher cares.
- Balance between being close enough to the students through his/her support and keeping the professional distance to avoid losing the teacher-student limits.

The teacher in this context can be described as a transformational teacher, one who leads, by example, the students through this sharp shift from normal classrooms to virtual ones. These educators should assume several qualifications, such as (3):

- Intellectual illumination: promote creativity among students by exploring new ways of doing things and taking advantage of the new opportunities in hand
- Individualized consideration: offer support to students individually in order to foster supportive relationships
- Inspirational motivation: educators are able to articulate to followers a clear vision, and able to help them experience the same passion and motivation.

The participants in this workshop will be introduced to several hands-on activities that can be implemented in our current virtual classrooms. The transformational teacher is expected to use multimodal practices for teaching science in this context, and the following activities can assure

a multilingual and interactive environment in the science classes. In same time, such activities can improve the quality of the scientific deliverables given to the students. **The following set of activities will be done after the strategy is presented, and will last for a total duration of 95 minutes, using several online platforms/technologies:**

a. Icebreaker: Shadow teacher activity: (20 minutes) in this activity, several ones of the attendees will be asked to present their understanding, opinion and suggestions on the previous part of the workshop where the strategy of science inquiry and transformational leadership was discussed. In the student classrooms, the shadow teacher student will teach the students a certain concept in his own way, using technology to convey the information. The goal is to develop an active learning society.
b. Videos with embedded questions: (20 minutes) this activity aims to engage the students in a certain way to maintain consistent informative contact with the teacher. It is done using an online platform called: Edpuzzle, or any other similar platform. By presenting to the students the link of a video which has embedded questions that have to be answered in real time by the students. The video can be taken from an online website or prepared previously by the teacher. The teacher receives a report of individual answers from the students. This allows the teacher to evaluate the level of understanding of each student, and of the class in general.
c. Virtual lab: (20 minutes) this activity creates a new level of critical thinking and troubleshooting to interpretations and analyses. This virtual experimentation method allows to simulate real classroom environments, as well as going beyond them. Through this activity, science inquiry concept is clearly promoted, by which the students are asked to formulate hypotheses, to pose problems, and to choose the variable conditions of the experiment, and by performing virtually the experiments, the students are able to draw out conclusions after collecting data and documenting them. The suggested platform for this activity, which will be used during the workshop, is Gizmos Explore Learning, and the activity will be done to study the conditions of photosynthesis.
d. Journal of demonstrations: (20 minutes) in this activity, the attendees will be asked to create photos or videos about the virtual experiments such as the ones done on the previous suggested platform. A collective power point presentation including the results of all the students will be created, using for example Google Slide, whereby each student is allowed to edit it. The main goal of this activity is to build a 'virtual' scientific relation between the students, that somehow simulates what was the norm in the past educational context. This activity will be done during the workshop with the interaction of the attendees, on the topic of tests to identify food, also using Gizmos Explore Learning.
e. Concept maps assignment: (15 minutes) this activity is one usually applied in actual classrooms, and that can be also implemented in virtual ones today. Each student is asked to draw a concept map, either by hand or by using a platform of their choice (paint, Active Inspire, Open board, …) and requested to send or present their results during class. Aside from explaining the main idea of the topic, this strategy enhances critical thinking and drawing a path mentality. During the workshop, a concept map showing the regulatory system of the ovarian hormones will be presented and discussed interactively with the attendees.

Research says everyone is a science person, and students can reach any level in science, it is our responsibility as educators to promote them to higher levels, even in online classrooms. E-learning has a high potential if the educator is determined, concise and clear. Of course, the commitment of the students is required, but this can be accomplished by the educators' structures of presentation and delivery. Willing to learn the implementation of inquiry-based methods is the job of the educators, and their savior into online teaching as well.

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Teaching Mathematics from the Lens of 21st Century Educators: A Practical and Authentic Implementation!

Israa Fawaz,
Makassed-Houssam Eddine Hariri High School, Lebanon

This workshop tackles the topic of how schools are shifting toward implementing various learning strategies as a way of increasing students' engagement and responsibility about their own learning and encouraging them to build their knowledge based on researches, prior knowledge and experiences. To achieve that, teachers should provide a suitable learning environment and encourage students to communicate positively and accept all individuals with their different abilities and learning styles. Mathematics makes a lot more sense when it is applied to real (or authentic) situations. During this workshop, participants will be actively involved in

practical and interesting activities that enrich their understanding of implementing differentiated instruction to develop the conceptual knowledge of order of operations, powers, and other math concepts. They will be subjected to a real implementation. This workshop is going to show how students and teachers play an equal role in the learning process through various learning strategies that reflect the students' deep understanding and analysis skills with the integration of innovative activities that illustrate the conceptual knowledge of the order of operations, powers, and other math concepts.

Escaping Educational Stereotypes

Roweida Bawab,
Houssam Eddine Hariri High School, Lebanon
Dalia Sous,
Rafic Hariri High School, Lebanon

With digitization on the rise and new trends in educational technology already making their way, what does the educational technology scene look like after the year 2020? How can we integrate social media, technological tools, and new developments into our classroom? Should we wait for 100% digitization in our classes, or are there any integrated solutions we can adopt? Through practical hands-on play and fun, our workshop looks into the above questions and offers up-to-datetechnological trends, tips, and tricks that teachers can adopt in their classes, no matter how these classes look like. We live in a vigorous world running at an impeccable speed. New discoveries, articles, and pieces of information are created by the nanosecond. The walls of our classroom are no longer able to encompass that amount of information! Therefore, we'll look into ways in which we can expand these walls to increase the love of students for learning, an integral skill of any 21st century learner!

The Effect of Problem Based Learning on High School Students' Achievement and Conceptual Understanding in the topics "Solution Preparation and Titration" and on their Attitudes toward Chemistry in Secondary School in Beirut District

Fatima Al Zahraa
Gebran Andrawos AlTweini Public High School, Lebanon

The purpose of this study was to determine the effect of problem-based learning (PBL) on students' achievement and conceptual understanding in the topics "solution preparation and titration" and on students' attitudes towards Chemistry. The study was carried out in a public school in Beirut district. The approach of this study was quasi-experimental. The participants were two equivalent groups in grade 11 (scientific). PBL strategy was used in teaching the experimental group, while thetraditional method was used with the control one over 13 periods. Three instruments were used for measurement: (1)"solution and titration" test: used as pre-test and post-test to investigate the effect of problem-based learning (PBL) strategy on students' achievement and conceptual understanding in the topics "solution preparation and titration"; (2)Chemistry-attitude test: a questionnaire usedas pre and post-test to determine the effect of PBL

on students' attitude toward chemistry; (3) Focus group interviews for the experimental and the control groups which aimed to investigate the conceptual understanding of the students and to explore the effect of the learning method on students' attitudes toward chemistry and triangulate

the data with the previous instruments. Descriptive statistics and content analysis were used to analyze respectively quantitative and qualitative data. The results have shown the importance of using PBL as a strategy to improve students' achievement and conceptual understanding in the topics "solution preparation and titration". Moreover, the attitudes toward chemistry increased upon using PBL especially towardchemistry as a course.