THE SECOND INTER-REGIONAL RESEARCH CONFERENCE ON SCIENCE AND MATHEMATICS EDUCATION

Interfacing Arab and Asia-Pacific Science and Mathematics Education Research

CONFERENCE PROGRAM

December 8th – 9th, 2018

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	Saturday, December 8th, 2018
8:30 AM - 9:00 AM	**OPENING CEREMONY** **Bathish Auditorium, West Hall**
9:00 AM - 10:15 AM	**PLENARY SESSION (1)** **Bathish Auditorium, West Hall**
	Higher-Order Thinking Competences in the Lebanese Mathematics Curricula - A Main Concern and Research Focus *Iman Osta, Lebanese American University,* *Beirut, Lebanon*
10:15AM - 10:45 AM	**COFFEE BREAK**
	CONCURRENT SESSIONS
10:45AM - 12:45PM	**PAPER SESSION IA** **PROFESSIONAL DEVELOPMENT AND TEACHERS' PERSPECTIVES REGARDING TEACHING OF SCIENCE** **Bathish Auditorium, West Hall**
	An Integrative Analytical Framework for Responsive Professional Development: A Bakhtinian and Activity Theory Perspective *Sara Salloum, University of Balamand, Lebanon* *Saouma BouJaoude, American University of Beirut, Lebanon* **Obstacles to the Implementation of Differentiation Instruction in Science Teaching from the Perspective of Teachers in Jordan** **معيقات تنفيذ التدريس المتمايز في تعليم العلوم من وجهة نظر المعلمين في الاردن** *محمد سلامة الرصاعي، جامعة الحسين بن طلال، الاردن* **The State of Science Education Based on Total Quality Management Criteria from the Perspective of Upper Basic Education Science Teachers in Palestine** **واقع تعليم العلوم بناء على معايير إدارة الجودة الشاملة من وجهة نظر معلمي العلوم للمرحلة الأساسية العليا في المدارس الفلسطينية** *رولى جمال عبد الحفيظ الرمحي ، وزارة التربية والتعليم العالي، فلسطين*

10:45AM – 12:45PM	**PAPER SESSION IB** **STUDENTS' UNDERSTANDING AND DIFFICULTIES IN MATHEMATICS** **Auditorium A, West Hall**
	The Module Sum of Vectors: Problematic Task in First Year Secondary Classroom. Study in Terms of Didactic Variables. **Le module d'un vecteur somme de vecteurs: tâche problématique en classe de première année secondaire. Etude en termes de variables didactiques.** *Nina Hayfa, Naim El Rouadi, Mirna Achkar, Université Saint-Joseph, Liban* **Are There Better Ways for Students to Use Their Hands in Learning Mathematics?** *Hak Ping Tam, Shu-Chi Hsieh, National Taiwan Normal University, Taipei, Taiwan* **"Variables" in The Lebanese Curriculum: Approach and Difficulties** *Manal Kiwan, Lebanese University, Lebanon* **Measuring the Factor of Non-Change to Test Mathematics in the Cognitive Development Program in the Sultanate of Oman** **قياس اللاتغير العاملي لاختبار الرياضيات في برنامج التنمية المعرفية بسلطنة عمان** *يوسف عبد القادر أبو شندي، جامعة السلطان قابوس، سلطنة عمان*
12:45 PM - 2:00 PM	**LUNCH BREAK**
2:00 PM – 3:15 PM	**PLENARY SESSION (2)** **Bathish Auditorium, West Hall**
	Understanding Multiple Representations: An Important Key to Learning Science *David F. Treagust, Curtin University,* *Perth, Australia*

3:15 PM – 3:30 PM	**COFEE BREAK**
	CONCURRENT SESSIONS
3:30 PM – 5:30 PM	**PAPER SESSION IIA** **INFLUENCE OF INSTRUCTIONAL APPROACHES ON STUDENTS' SCIENCE LEARNING** **Bathish Auditorium, West Hall**
	Experiential Learning in Upper Elementary Science Classrooms: Influence on Students' Problem-Solving and Attitudes in Science *Neyoulla Al Jurdi, Irfan High School Sawfar, Lebanon* *Sara Salloum, University of Balamand, Lebanon* **Relationship between Nature of Science and Argumentation** *Rola Khishfe, & Saouma BouJaoude, American University of Beirut, Lebanon* *Fahad Alshaya, Nasser Mansour, & Khalid Alrudiyan, King Saud University, Kingdom of Saudi Arabia* **The Effect of Learning Site Using Web Quests on Improving the Academic Achievement of 9th Grade Students in Science Course** **اثر موقع تعليمي باستخدام الرحلات المعرفية (Web Quests) في تنمية التحصيل الدراسي في مادة العلوم لدى طلاب الصف التاسع الأساسي** *أصيلة بنت سليمان الشيادية، وزارة التربية والتعليم، سلطنة عمان*
3:30 PM – 5:30 PM	**PAPER SESSION IIB** **CURRICULAR ISSUES AND IMPACT OF TEACHER PROFESSIONAL DEVELOPMENT ON TEACHING AND LEARNING IN MATHEMATICS** **Auditorium A, West Hall**
	The Efficacy of Mathematics Teacher Professional Development Model Based on Pedagogical Content Knowledge (PCK) **فعالية نموذج تطور مهني لمعلمي الرياضيات يعتمد على المعرفة بتعليم التخصص** *رفاء جمال عبد الحفيظ أبو شمة، جهاد الشويخ، جامعة بيرزيت، فلسطين* **Investigating the Implementation of STEM Education within Classrooms: A Case Study** *Nour El Sayegh, Iman Osta, Lebanese American University, Lebanon*

	Perspectives of In-service Mathematics Teachers Regarding the Challenges that They Face in Teaching After They Finish Their Training Program **واقع تطبيق معلمي الرياضيات لاستراتيجيات التدريس والتحديات التي تواجههم بعد انتهاء برنامج تدريبي أثناء الخدمة من وجهة نظرهم** *أمل بنت عبد الله الراشدية، حميدة بنت حميد المفرجية، مرشد بن ناصر اليعربي، المركز التخصصي للتدريب المهني، وزارة التربية والتعليم، سلطنة عمان*
Sunday, December 9th, 2018	
9:15 AM - 10:30 AM	**PLENARY SESSION (3)** **Bathish Auditorium, West Hall**
	The Gap Between Males and Females in Science Achievement: Is There A Possibility to Reduce It? **الفجوة بين الذكور والإناث في تحصيل العلوم: هل هناك إمكانية لتقليلها؟** *عبدالله بن خميس امبوسعيدي، جامعة السلطان قابوس، مسقط، عمان*
10:30 AM – 11:00 AM	**COFFEE BREAK**
	CONCURRENT SESSIONS
11:00AM – 1:00 AM	**PAPER SESSION IIIA** **SCIENCE LEARNING IN THE ARAB WORLD** **Bathish Auditorium, West Hall**
	An Arabic Culture Model of Conceptual Change *Asmahan Al Safwan, David F. Treagust, Marjan Zadnik, Curtin University of Technology, Australia* **Arabic Diglossia and Linguistic Resources for Scientific Thinking: A Genre-based Analysis of Classroom Discourse** *Tamer Amin, Department of Education, American University of Beirut, Lebanon* **From a Corrective to a Proactive Approach in Dealing with Stereotypes about Science and Scientists** *Hagop A. Yacoubian, Lebanese American University, Lebanon*

11:00AM – 1:00 PM	**PAPER SESSION IIIB** **RESOURCES FOR STUDENTS' LEARNING IN MATHEMATICS** **Auditorium A, West Hall**
	Translanguaging to Mediate Concept Learning in Mathematics: A Case for Indian Learners in English Medium Low Cost Government Schools *Lina Mukhopadhyay, The English and Foreign Languages University, Hyderabad, India* **Are We Failing Our Highly Able Learners in Lebanon?** *Maya Antoun, Rayya Younes, Sara Salloum, University of Balamand, Lebanon* **Effects of Using Scratch Programming on Grade 6 Students' Learning Geometry** *Bassam El Hajj Ali, Iman Osta, Lebanese American University, Lebanon*
1:00 PM - 2:15 PM	**LUNCH BREAK**
2:15 PM – 3:30 PM	**PLENARY SESSION (4)** **Bathish Auditorium, West Hall**
	Meeting the Challenge of Learning and Teaching Geometrical Concepts: Students' Confusions with Lines *Hak Ping Tam, National Taiwan Normal University, Taipei, Taiwan*
3:45 PM – 4:45 PM	**PANEL DISCUSSION** **Bathish Auditorium, West Hall**
	Panelists: ***Abdullah Bin Khamis Ambu Saidi**, Sultan Qaboos University, Muscat, Oman* ***Iman Osta**, Lebanese American University, Beirut, Lebanon* ***David F. Treagust**, Curtin University, Perth, Australia* ***Hak Ping Tam,** National Taiwan Normal University, Taipei, Taiwan*

Abstracts

PLENARY (1)

Higher-Order Thinking Competences in the Lebanese Mathematics Curricula

A Main Concern and Research Focus

Iman Osta, Lebanese American University, Beirut, Lebanon

The major Lebanese curricular reform in 1997 has adopted the development of higher-order thinking competences as main standards. Particularly problem solving, reasoning, communication and meaning for life are constant general objectives in the mathematics curriculum for each level in the educational ladder and for each cycle. Developing such competencies has been one of the main central themes during the preparatory stages of the curriculum implementation, such as teacher training workshops conducted by public and private bodies. It also motivated a considerable body of research around the reformed curriculum and its fulfilment of those standards.

The presentation aims to provide an overview of the major research areas around the higher-order thinking competences in the Lebanese curriculum, the questions they raised and some of their main results. Some of the questions raised are: is the curriculum a stable entity at the different stages of the educational process? Do the textbooks serve the major goals of the curriculum? What types of instructional approaches promote the development of those competences? How are those competences tested in the national exams?

PLENARY (2)

Understanding Multiple Representations: An Important Key to Learning Science

David F. Treagust, Curtin University, Perth, Australia

Multiple representations of science concepts such as text, diagrams, analogies, models, mathematical relationships and computer simulations are primarily concerned with helping learners understand the science concepts under investigation. Without considering science concepts from the vantage point of several different representations, a full understanding of the science concepts may not be possible. In this presentation, I describe a range of examples at the secondary school and university level in chemistry, biology and physics where teachers and students used various effective multiple representations in science teaching and learning and illustrate their effectiveness.

PLENARY (3)

The Gap between Males and Females in Science Achievement: Is there a possibility to Reduce It?

Abdullah Ambusaidi, Sultan Qaboos University, Muscat, Oman

There is no doubt that the science is one of the most important subjects, and that raising the achievement of students in it is very important and should be subjected to study and research. It is noticeable in the achievement of this subject that until the end of the eighties of the last century is almost equal between males and females, and sometimes tend to male students in the

achievement of physics and to the female in the achievement of biology. However, this is no longer the case, as females are significantly outperform males in the achievement of this subject. As an example, Omani female students perform very well compare to the male students, not only at school level but also at the university level, and in the international studies such as the International Trends in Mathematics and Science (TIMSS).

The presentation / paper will initially present some evidences that show the gap between males and females students' in their achievement of science subject. Then, the presentation will focus on the reasons of this gap. Finally, some suggestions and recommendations will be proposed to reduce this gap.

الفجوة بين الذكور والإناث في تحصيل العلوم: هل هناك إمكانية لتقليلها؟

د. عبدالله بن خميس امبوسعيدي،جامعة السلطان قابوس، مسقط، عمان

مما لاشك فيه أن مادة العلوم تعد من أهم المواد الدراسية، وإن رفع تحصيل الطلبة الدراسي فيها ضرورة يجب الاهتمام بها بالدراسة والبحث. ومما يلاحظ في تحصيل هذه المادة حتى نهاية الثمانيات من القرن الماضي تساو تقريبا تحصيل الذكور والاناث فيها، وفي بعض الأحيان تميل الكفة إلى الطلبة الذكور في تحصيل مادة الفيزياء وإلى الاناث في تحصيل مادة الأحياء. لكن لم يعد هذا الشيء موجودا، إذ اصبحت الإناث تتفوق على الذكور بشكل لافت في تحصيل هذه المادة. وكمثال على ذلك، نجد أن الطالبات العمانيات يتفوقن بشكل كبير على الطلاب الذكور ليس فقط على مستوى التعليم المدرسي بل حتى على مستوى التعليم الجامعي، وفي الدراسات الدولية مثل دراسة التوجهات الدولية في مادتي الرياضيات والعلوم(TIMSS).

إن العرض/الورقة الذي سيتم تقديمه بخصوص هذا الموضوع سيعرض في البداية بعض الشواهد والإثباتات التي تبين الفجوة الواضحة بين الذكور والإناث في التحصيل الدراسي للمادة، ثم عرض أسباب هذه الفجوة، وأخيرا سيتم تقديم بعض المقترحات التي يمكن العمل بها من أجل تقليل من هذه الفجوة.

PLENARY (4)

Meeting the Challenge of Learning and Teaching Geometrical Concepts: Students' Confusions with Lines

Hak Ping Tam, National Taiwan Normal University, Taipei, Taiwan

As is well known, mathematics is one of the least like subjects in schools, a phenomenon observed worldwide. Meanwhile, geometry is perhaps the most abhorred branch within mathematics among school students. This is not surprising if one would inspect the mathematics curricula and textbooks. The materials covered are usually quite technical in nature, ranging from computing angles and areas to reading and establishing rigorous proofs. Unfortunately, the instructional efforts towards building technicality is often done at the expense of spending time in fostering students with adequate understanding of basic geometrical concepts. In this talk, we will present how students in a remote region of Taiwan perceived three kinds of lines, namely, straight line, line of symmetry and diagonal. We will discuss misunderstandings and confusions that some students might have towards these fundamental concepts and supplemented with several observations from public examinations as well as the TIMSS study. We will end this talk with a discussion of how these problems can be tackled via an inquiry and hands-on instructional approach.

PAPER SESSION IA

PROFESSIONAL DEVELOPMENT AND TEACHERS' PERSPECTIVES REGARDING TEACHING OF SCIENCE

An Integrative Analytical Framework for Responsive Professional Development: A Bakhtinian and Activity Theory Perspective

Sara Salloum, University of Balamand, Lebanon
Saouma BouJaoude, American University of Beirut, Lebanon

This paper outlines the development and utilization of an integrative analytical framework that illuminates relevant micro and macro aspects of language issues in science classrooms for informed and 'responsive' professional development. The framework adopts and integrates dialogic Bakhtinian and Cultural Historical Activity Theory (CHAT) perspectives. A Bakhtinian dialogic perspective was used to analyse speech genres and participants' multilingual language practices and their meaning making of practices and authoritarian discourse. CHAT depicted classroom practices and meanings as complex and socially situated phenomena with different mediating artifacts, symbolic tools, and rules; as such different multilingual science classrooms were represented as activity systems within the broader socio-cultural context. Through empirically-based activity systems of diverse science classroom, we demonstrate how the integrative multilevel framework as an analytical model helped us compare systems across schools to identify types of contradictions and congruence that inform more purposeful, targeted, and responsive professional development. Recommendations about the mode of enactment and characteristics of PD activities in relation to categories of contradictions within an activity system are presented and discussed.

Obstacles to the Implementation of Differentiation Instruction in Science Teaching from the Perspective of Teachers in Jordan

معيقات تنفيذ التدريس المتمايز في تعليم العلوم من وجهة نظر المعلمين في الاردن

محمد سلامة الرصاعي، جامعة الحسين بن طلال، الاردن

ينسجم التدريس المتمايز مع الاتجاهات العالمية في مجال حقوق الانسان، والحرية، وعدالة الفرص، والمساواة، وهذا يؤشر لأهمية هذا النمط من التدريس في تحقيقدور التعليم في بناء ثقافة الديمقراطية والحرية في المجتمع، لذلك تسعى هذه الدراسة لاستقصاء معيقات تنفيذ التدريس المتمايز في تعليم العلوم في الأردن من وجهة نظر المعلمين، وقدتم تصميم أداة للكشف عن المعيقات من وجهة نظر معلمي العلوم من خلال المقابلة حيث تم اختيار (15) معلماً للعلوم في منطقة معان في جنوب الأردن اختياراً عشوائياً، وتبين من نتائج الدراسة أنَّ معظم معلمي العلوم لم يسبق لهم تنفيذ التدريس المتمايز، ويعود ذلك لثقافة الصف السائدة في مدارس الأردن والتي تكرس سلطة المعلم ودوره

المركزي،والتي كانت أكثر المعيقات في هذا الصدد، وجاء في المرتبة الثانية ضعف التأهيل والتدريب لمعلم العلوم لتنفيذ تحركات هذه الاستراتيجية، وأخيراً البيئة الصفية والمعينات الادارية، وعليه توصي الدراسة تكثيف التدريب النوعي على استراتيجيات تنفيذ التدريس المتمايز، إضافة إلى تخطيط مناهج العلوم مع متطلبات التمايز والتنوع.

The State of Science Education Based on Total Quality Management Criteria from the Perspective of Upper Basic Education Science Teachers in Palestine

واقع تعليم العلوم بناء على معايير إدارة الجودة الشاملة من وجهة نظر معلمي العلوم للمرحلة الأساسية العليا في المدارس الفلسطينية

رولى جمال عبد الحفيظ الرمحي، وزارة التربية والتعليم العالي، فلسطين

هدفت الدراسة إلى التعرف على واقع تعليم العلوم بناء على معايير ادارة الجودة الشاملة من وجهة نظر معلمي العلوم للمرحلة الأساسية العليا في المدارس الفلسطينية, وأثر عدد من المتغيرات في استجابات معلمي العلوم. لتحقيقاً لذلك استُخدمت أداتان: الأولى؛ استبانة موجهة لمعلمي ومعلمات العلوم الذين يدرّسون العلوم للمرحلة الأساسية العليا, والثانية؛ مقابلات مع عدد من معلمي الدراسة من عينة الدراسة نفسها.

طبقت الدراسة على عينة طبقية عشوائية من مدارس مجتمع الدراسة، حيث بلغ عدد المدارس التي شملتها الدراسة 133 مدرسة, فيها 210 معلم ومعلمة علوم.

أظهرت النتائج أنّ واقع تعليم العلوم في المدارس الفلسطينية من وجهة نظر معلمي العلوم للمرحلة الأساسية بناء على معايير إدارة الجودة الشاملة, يحقق هذه المعايير بدرجة عالية في المجالات كافة, باستثناء المجال السابع وهو مجال الميزانية الذي حقق درجة متوسطة على معيار الجودة الذي افترضته الباحثة. وتبين أنّ المدارس تعاني من ضعف الإمكانيات المادية, ومن الاكتظاظ في الغرف الصفية, وزخم المنهاج, والضغط والاكتظاظ في برامج معلمي العلوم، وأظهرت النتائج عدم وجود فروق ذات دلالة إحصائية عند مستوى الدلالة ($\alpha \leq 0.05$) في واقع تعليم العلوم في المدارس الفلسطينية من وجهة نظر معلمي العلوم تعزى لمتغير النوع الاجتماعي, والتخصص, وسنوات الخبرة, والمؤهل العلمي.وفي ضوء نتائج الدراسة تمّ تقديم عدد من التوصيات.

The Module Sum of Vectors: Problematic Task in First Year Secondary Classroom. Study in Terms of Didactic Variables.
Le module d'un vecteur somme de vecteurs: tâche problématique en classe de première année secondaire. Etude en termes de variables didactiques.
Nina Hayfa, Naim El Rouadi, Mirna Achkar, Université Saint-Joseph, Liban

Résumé. Certains concepts en mathématiques sont assez abstraits ce qui fait de leur enseignement une tâche difficile ; tel le cas du concept « vecteur ». Ce concept se prépare en classe de EB7 et se manifeste progressivement d'une classe à l'autre jusqu'à la classe de première année secondaire là où la majorité des savoirs de base et des savoirs faire prescrits par le curriculum sont présents. Dans ce sens, notre sujet a eu naissance dans le but de repérer les difficultés des élèves dans le calcul du module de la somme de vecteurs en termes de variables didactiques. Notre recherche se place dans un cadre théorique qui fait appel à la théorie anthropologique de la didactique, à la notion de registres sémiotiques de Duval et à la notion de variable didactique.

En premier lieu, nous avons analysé l'influence de deux manuels scolaires mis à l'usage par des apprenants dans des lycées - publics et privés sur la conceptualisation de la tâche du calcul du module d'un vecteur somme de vecteurs. En deuxième lieu, nous avons sollicité deux groupes d'élèves de même niveau et de même milieu pour identifier les erreurs dans différents cas de cette tâche relativement aux registres utilisés et au changement de variables. De plus, nous avons identifié la position des enseignants à l'égard des difficultés rencontrées par les élèves.

Are There Better Ways for Students to Use Their Hands in Learning Mathematics?
Hak Ping Tam, Shu-Chi Hsieh, National Taiwan Normal University, Taipei, Taiwan

Mathematics curricula in most countries pay much attention towards the technical aspect of the subject matter. For example, there is a general tendency among curricula to highlight computation even at the secondary school level, ranging from such topics as logarithm to calculus. Though geometry is a good place to teach logical reasoning, much effort, however, are devoted to teaching students to compute all kinds of angels, lengths, areas or volumes. Even the Pythagoras theorem is rendered in textbooks as a computational formula to solve many exercise problems involving right-angled triangles. In all these learning activities, our students use their hands mainly for carrying out computational procedures and in writing down solutions to assigned problems. Though computational skill is certainly an important ability to nurture in students, one cannot help but ask, "Are there better roles for the hands in learning mathematics?" The purpose of this paper is to draw the attention of mathematics educators to this issue. We will discuss some potential ways, from paper folding to knot tying, in which students can use their hands to comprehend fundamental concepts in mathematics. We will round up our discussion by pointing out several difficulties in designing this kind of hands-on activities that facilitate conceptual understanding and beyond mere display of procedural knowledge.

“Variables” in the Lebanese Curriculum: Approach and Difficulties

Manal Kiwan, Lebanese University, Lebanon

This paper applies content analysis to highlight the way the term “variable” and the concept of variable is used in the Lebanese Mathematics curriculum prescribed by the decree No. 10227 of 8 March 1997 and still applied nowadays. It also applies semi-structured interview to investigate authors’ of the “Building Up Mathematics” series view of variables and whether they approached variables as a principal topic or an auxiliary one in the specified textbook series. In addition, it highlights middle-grade students’ difficulties related to variables using a diagnostic test.

Results revealed that the term variable is simply embedded in the books of the specified series without any definition or explanation and the concept of variables is treated as an auxiliary concept rather than a principal one. Moreover, one of the main contributors to the mathematics curriculum middle grade textbooks assured that the no special thoughts have been given to the way the concept of variables should be approached in the curriculum while several students’ difficulties have been documented.

An academic intervention that addresses variables as a topic has been designed and is still being implemented to check its efficiency. Final results are expected by the end of the academic year 2018-2019.

Measuring the Factor of Non-Change to Test Mathematics in the Cognitive Development Program in the Sultanate of Oman

قياس اللاتغير العاملي لاختبار الرياضيات في برنامج التنمية المعرفية بسلطنة عمان

يوسف عبد القادر أبو شندي، جامعة السلطان قابوس، سلطنة عمان

هدف البحث قياس ومقارنة البنية العاملية لاختبار الرياضيات في برنامج التنمية المعرفية بسلطنة عمان تبعا لمتغيري جنس المتعلم والمحافظة. ولتحقيق ذلك طبق التحليل العاملي التوكيدي Confirmatory Factor Analysis باستخدام برمجية Amos على نتائج 30439 طالباً وطالبة (15050 طالب، 14889 طالبة) من طلبة الصف السابع الأساسي الذين تقدموا لاختبار الرياضيات المكون من 25 سؤال في برنامج التنمية المعرفية عام 2017، حيث تغطي هذه الأسئلة أربعة من معايير محتوى الرياضيات: الأعداد والعمليات عليها، والجبر، والهندسة والقياس، والأحصاء والاحتمالات.

توصلت النتائج إلى تقارب مؤشرات تطابق النموذج النظري مع النموذج المفترض(البنية العاملية) لاختبار الرياضيات بين الذكور والإناث، وكذلك بين المحافظات.

PAPER SESSION IIA

INFLUENCE OF INSTRUCTIONAL APPROACHES ON STUDENTS' SCIENCE LEARNING

Experiential Learning in Upper Elementary Science Classrooms: Influence on Students' Problem-Solving and Attitudes in Science

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The purpose of this study was to identify conceptually the essential features of experiential learning, and to empirically to study the effect of experiential learning on the development of students' ability to solve science problems in new contexts and their attitudes towards science. Mixed methods that integrate quantitative and qualitative data methods in a single study were used. Data sources involved pre and post attitude survey and problem-solving test administered to the control and intervention groups, classroom observation and interviews. Results revealed that intervention students' overall average on the attitude scale increased slightly (3.45 to 3.5), whereas the control students' overall average decreased significantly from 3.40 to 2.97. The problem solving pre and posttests revealed a significant increase in learning progression levels of feedback loop reasoning in the intervention group compared to the control group. Class observations showed changing classroom dynamics and teacher and students' role.

Relationship Between Nature of Science and Argumentation

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The purpose of the study was to investigate students' understandings about NOS and their arguments in the context of controversial socio scientific issues (SSI). A total of 74 11^{th} graders in six schools in Saudi Arabia participated in the study. The instrument used was a questionnaire consisting of four scenarios addressing SSI about global warming, genetically modified food, acid rain, and human cloning. The scenarios were followed by questions relating to argumentation and NOS. Quantitative and qualitative measures were employed to analyze the data related to participants' understandings of three NOS aspects (subjective, tentative, and empirical) and their arguments components (argument, counterargument, and rebuttal). Results showed no significant correlations between argument components and the NOS aspects. On the other hand, qualitative data showed that participants who generated well-developed arguments across the four SSI also exhibited more informed understandings of the NOS aspects, especially for female participants. Further, the chi-square analyses did not show significant differences in participants' arguments and NOS understandings across the four scenarios. Again, the qualitative data from questionnaires showed differences in participants' responses to the different scenarios. The results were interpreted along contextual factors, emotional factors, and cultural factors. Implications for the teaching of NOS and arguments were discussed.

The Effect of Learning Site Using Web Quests on Improving the Academic Achievement of 9th Grade Students in Science Course

اثر موقع تعليمي باستخدام الرحلات المعرفية (Web Quests) في تنمية التحصيل الدراسي في مادة العلوم لدى طلاب الصف التاسع الأساسي

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هدفت الدراسة إلى تقصي أثر الرحلات المعرفية (Web Quests) في تنمية التحصيل الدراسي في مادة العلوم لدى طلاب الصف التاسع الأساسي بمحافظة شمال الباطنة، وقد اتبعت المنهج شبه التجريبي، حيث تكونت عينة الدراسة من (60) طالبة من طالبات الصف التاسع الأساسي بمدرسة أحد للتعليم الأساسي (9-5) بمحافظة شمال الباطنة، تم توزيعها على مجموعتين: تجريبية مكونة من (30) طالبة، وضابطة مكونة من (30) طالبة، واستغرقت مدة تطبيق الدراسة (6) أسابيع خلال الفصل الدراسي الثاني من العام الدراسي 2016/ 2017 م، وأشارت نتائج الدراسة إلى وجود فروق ذات دلالة إحصائية عند مستوى دلالة (α=0.05) بين متوسطي درجات طالبات مجموعتي الدراسة في جميع مستويات الاختبار التحصيلي (المعرفة، التطبيق، والاستدلال) لصالح المجموعة التجريبية، ، وفي ضوء النتائج السابقة توصي الدراسة بتضمين المناهج الدراسية أنشطة قائمة على البحث والتقصي عبر الانترنت لما في ذلك من أهمية في توجيه الطلاب نحو الاستخدام الأمثل والايجابي لشبكة الانترنت في ظل الانفتاح العالمي والتطور التكنولوجي الهائل، والاهتمام بتنمية مهارات التفكير المختلفة لدى الطلاب وتدريبهم عليها، لأن التفكير يساعد الفرد على تكامل شخصيته، ويعده ليصبح قادرا على مسايرة العصر ومتغيراته.

PAPER SESSION IIB

CIRCULAR ISSUES AND IMPACT OF TEACHER PROFESSIONAL DEVELOPMENT ON TEACHING & LEARNING IN MATHEMATICS

The Efficacy of Mathematics Teacher Professional Development Model Based on Pedagogical Content Knowledge (PCK)

فعالية نموذج تطور مهني لمعلمي الرياضيات يعتمد على المعرفة بتعليم التخصص

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هدفت الدراسة إلى تقصّي فعالية نموذج تطور مهني لمعلمي الرياضيات يعتمد على المعرفة بتعليم التخصص، وتحقيقاً لهذا الهدف طُبّقت الدراسة مع 24 معلمة ومعلم من معلّمي الرياضيات للصّف الثامن الأساسيّ في المدارس الحكومية في محافظة رام الله والبيرة، وُزّعوا في مجموعتين؛ تجريبية (12) معلمة ومعلماً، قُدّم لهم برنامجٌ تدريبيّ في تطوير عناصر المعرفة بتعليم التخصص، وضابطة (12) معلمة ومعلماً لم يُقدّم لهم البرنامج التدريبي، وتمّ قياس أدائهم القبليّ والبعديّ بواسطة اختبار المعرفة بكيفية تعليم المحتوى في موضوع الهندسة. وبعد انتهاء تدريب معلمي المجموعة التجريبية الذي استمر لمدة شهر (30 ساعة تدريب) تمّ مشاهدة 4 منهم وهم يدرّسون وحدة الهندسة في صفوفهم. بعد الانتهاء من التعليم طبّق اختبار تحصيلي مع طلبة المعلمين الذين تمّ تدريبهم ضمن البرنامج التدريبي. تمثلت أدوات الدراسة في اختبار المعرفة بكيفية تعليم المحتوى ضمن موضوع الهندسة، واختبار التحصيل للطلبة في الهندسة، وأيضاً المشاهدات الصفية للمعلمين الذين تمّ تدريبيهم أثناء تدريس وحدة الهندسة. تمثّلت أبرز النتائج أن هناك تحسن في أداء المعلمين في المحتوى، وفي بقية عناصر المعرفة بكيفية تعليم التخصص وهي أهداف التعليم، وخصائص الطلبة، واستراتيجيات التعليم والتقييم، والمنهاج ومصادر التعلم أما السياق فكان التحسّن طفيفاً. أما بالنسبة للطلبة فقد ارتفع تحصيل طلبة المعلمين الذين تمّ تدريبهم في الاختبار البعدي. وفي ضوء نتائج الدراسة تمّ تقديم عدد من التوصيات.

Investigating the Implementation of STEM Education within Classrooms: A Case Study

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Education is facing, in the 21st century, various global challenges such as climate change and pollution. Solutions to these problems require the integration of science, technology, engineering and mathematics (STEM). Driven by the need to promote a society that is literate in these fields, STEM education is gaining more popularity. As such, it is essential to address the barriers that impede successful implementation of STEM education at the school level. The purpose of this case study, which is part of a wider research, is to investigate the challenges and barriers that hinder proper implementation of STEM education within elementary classes in a private school in Beirut. In this study, ten semi-structured interviews were conducted with one director, three coordinators and six teachers. The findings reveal external barriers and internal barriers. External barriers include lack of vision, lack of space, financial barrier, curricular issues, lack of support

and time constraints. Internal barriers include personal challenges, insufficient technological and content knowledge and teacher understanding of STEM education. Although this study is limited to one elementary school, the identified themes may be useful for other schools that intend to go into STEM, as it informs educators about the challenges they may face, so they may remedy the problems and barriers at the right time.

Perspectives of In-service Mathematics Teachers Regarding the Challenges That They Face in Teaching After They Finish Their Training Program

واقع تطبيق معلمي الرياضيات لاستراتيجيات التدريس والتحديات التي تواجههم بعد انتهاء برنامج تدريبي أثناء الخدمة من وجهة نظرهم

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هدفت الدراسة إلى معرفة واقع تطبيق معلمي الرياضيات لاستراتيجيات التدريس والتحديات التي تواجههم للتطبيق بعد انتهاء برنامج تدريبي أثناء الخدمة طويل الأمد من وجهة نظرهم، وتكونت عينة الدراسة من (20) معلما من معلمي ومعلمات الرياضيات ممن شارك في التدريب في البرنامج التدريبي لمعلمي الرياضيات بالمركزالتخصصي للتدريب المهني للمعلمين بطريقة عشوائية، والذي استمر لمدة عامين دراسيين، واعتمدت الدراسة على المنهج النوعي وقد جمعت البيانات عن طريق المقابلات باستخدام مسجلات الصوت الرقمية.

وتوصلت الدراسة إلى أن مستوى تطبيق المتدربين للاستراتيجيات المستفادة من التدريب مرتفع بشكل، كما أظهرت النتائج أن الاستراتيجيتين :التعلم النشط وتوظيف التكنولوجيا حصلتا على نسبة أعلى من الاهتمام والتطبيق من المتدربين، أوضحت أن المتدربين يواجهون تحديات في التطبيق من أبرزها قلة توفر المعينات والمصادر المختلفة، بينما كانت أبرز الحلول المنفذة هو تعاون إدارات المدارس في تجهيز قاعة خاصة بالرياضيات وتوفير المصادر المعينة لهم في تفعيل استراتيجيات التعلم المختلفة.

وفي ضووءء النتائج أوصووت الدراسووة بالاسووتمرار بتنفيذ برامج تدريبية أثناء الخدمة طويلة الأمد للمعلمين تعزز جانب التطبيق في بيئة العمل من أجل التأكيد على جانب امتلاك المعلمين للمهارات المهنية المطلوبة، والتغلب على التحديات التي تواجههم بمساعدة المدرب.

PAPER SESSION IIIA

SCIENCE LEARNING IN THE ARAB WORLD

An Arabic Culture Model of Conceptual Change

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Conceptual understanding of thermal concepts been evaluated using Thermal Concepts Evaluation TCE developed by Yeo and Zadnik (2001). An investigation of possible explanations why today some Arabian students do not gain a scientific understanding of concepts but instead develop misconceptions that are too robust to be revised by explicit or implicit teaching and learning contradictions. Three suspect sources contributed to students alternative ideas regarding thermal concepts: students' ontological thinking, language barriers and unreliable translation of thermal concepts in students' physics textbook. Learning about these possibilities is important to improve teaching and learning in Saudi female high schools.

Arabic Diglossia and Linguistic Resources for Scientific Thinking: A Genre-based Analysis of Classroom Discourse

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The Arabic language is diglossic: two quite distinct varieties, the spoken dialect and Modern Standard Arabic (MSA), are used in different for different purposes and in different contexts. Lebanese children enter elementary school with their Lebanese spoken dialect as their main linguistic resource. They then begin to learn MSA as a language of literacy; this becomes an additional resource that they can draw on to engage with learning activities in the classroom. When science is taught in Arabic, this means that the subject matter itself and MSA are both being learned together. This study asks the following question: when science is taught in Arabic, how do Lebanese children draw on their diverse linguistic resources to engage in scientific thinking? Ten lessons, in each of two first grade Lebanese classrooms where science was taught in Arabic, were audio and video recorded and later transcribed in full. Using the concept of genre as an analytical lens, the study examined how both the teachers and students used both the Lebanese dialect and MSA to engage in various modes of scientific thinking realized through genres such as classification, explanation, and decomposition. In this presentation, the range of linguistic resources drawn on by both teachers and students will be described. Moreover, the extent to which engaging in the various modes of scientific thinking depended on the Lebanese dialect and MSA will be reported. The broader implications of the phenomenon of Arabic diglossia for engaging young learners in scientific thinking will be discussed.

From a Corrective to a Proactive Approach in Dealing with Stereotypes about Science and Scientists

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Stereotypes about science and scientists are widespread among science teachers and students, as well as prevalent in science textbooks, educational science programs, science trade books and other educational resources. Though one may wish that such stereotypes get reduced and disappear over time, instead of taking a *corrective* approach and recommending what ought to be

presented differently to students, in this theoretical paper the focus is placed on a *proactive* approach that encourages the use of those stereotypes as resources for teaching and learning. The paper highlights the importance of providing learning experiences for future citizens to engage in critical exploration of those stereotypes. This would entail empowering them so that they dig deeper into the implicit layers of some of those stereotypes with the purpose of critically and explicitly reflecting upon assumptions and political ideologies underlying them. The paper concludes with the educational benefits that such a proactive approach could have in the preparation of scientifically literate citizens.

Translanguaging to Mediate Concept Learning in Mathematics: A Case for Indian Learners in English Medium Low Cost Government Schools

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Mathematics education is interrelated to linguistic knowledge as it entails concept learning and application. Without a threshold level proficiency in the language of instruction, it becomes difficult to understand mathematical concepts and/or use mathematical discourse. In this paper, we present the case of Indian learners with low SES background and the challenges they face when their home language does not match with the language of instruction on account of attending low cost English (L2) medium government schools. These learners are being studied as part of a bigger MLE project in India funded by ESCR-DFID, UK and undertaken by the University of Cambridge in collaboration with Indian academic institutions. We discuss the use of translanguaging, a systematic alternation of learners' L1 (the stronger language) and L2 (the developing language), to scaffold and enable transfer of academic mathematical concepts and discourse from the stronger to the developing language.

The paper is organized in two parts: in the first part we discuss a preliminary set of findings from the MLE project on numeracy, word problems, and meta mathematics performance and their correlations with literacy skills of low SES Indian learners from primary grades. This is to show that the language of instruction could be a possible factor for low learning outcomes in math learning through L2. In the second part, we present three ways of using translanguaging (i) to teach mathematical vocabulary and concepts; (ii) to construct multiple meanings with learners by matching everyday quantification concepts to academic math vocabulary, and (iii) to engage learners in mathematics discourse as a model of additive bilingualism and Vygotskian socio-constructivist framework of learning. To conclude, translanguaging is suggested as a way out of the mismatch in language of instruction and learner resources and to acknowledge and explore the resources of learners with varied L1 backgrounds.

Are We Failing Our Highly Able Learners in Lebanon?

Maya Antoun, Rayya Younes, Sara Salloum, University of Balamand, Lebanon

Highly able students in Lebanon are not supported enough to perform at advanced levels based on TIMSS 2003 to 2015 results. There is a need to investigate the reasons behind the low achievement of highly able students at different levels: policy, national curricula and teacher perceptions. This paper aims to examine: (a) if policies exist in terms of catering for highly able students, (b) how the national Science and Math curricula (teaching and learning methods and content) address the needs of highly able students, and (c) how teachers in different Lebanese

schools perceive and may provide for the educational needs of highly able students. The following data sources were used to address the research aim policy document analysis, curriculum analysis and teacher interviews. Not explicit evidence of curricular provisions and attention to the needs of highly able learners was found in Science National Curriculum. Teachers shared a common misperception that gifted students do not require special services. Recommendations and implications will be shared.

Effects of Using Scratch Programming on Grade 6 Students' Learning Geometry

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The current study is a part of a wider research. It examines the effectiveness of using Scratch software as a tool to improve students' learning of geometry. The effects are examined on four factors of learning, which are knowledge, conceptual understanding, skills, and problem solving. The study used a quasi-experimental design, using two groups of grade-6 students, a control group and an experimental group. The control group was exposed to the usual methods of teaching, while the teaching model used in the experimental group integrated a set of Scratch-based learning activities. A pretest and posttest were administrated to both groups and a t-test conducted to check the significance of differences. Results showed that students who experienced the Scratch-based activities appeared to exhibit more progress on the four factors than students who were exposed to the usual methods of teaching.