THE FIFTEENTH ANNUAL SCIENCE AND MATH EDUCATORS CONFERENCE (SMEC 15)

CONFERENCE PROCEEDINGS

(ENGLISH, ARABIC, AND FRENCH)

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SMEC 15 MISSION STATEMENT

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

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

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

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

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

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

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Only abstracts included for the following sessions:

Plenary - Science

Beyond the Scientific Method: Alternatives for Science Teaching[i]

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One of the aims of science is to produce credible knowledge about the natural world. Scientists use a variety of innovative methods that include material, logical, and mathematical tools. Thus, scientists creatively generate knowledge *and* methods. The scientific method is typically upheld as the hallmark of science. This notion is acceptable if the method refers to a process of disciplined inquiry aimed at improving understanding, but it is not acceptable if it refers to a specific procedure. Why is it problematic to think of scientific method in terms of a lock-step procedure? Three main reasons are offered: 1) There is no established interdisciplinary method that all scientist use, 2) Reference to a single method obscures the diversity and creativity of methods in the sciences, and 3) Focus on one method results in misconceptions leading students and the general public to reject as non-scientific any claims resulting from non-experimental methods or experimental methods that deviate from the set procedure. Science curriculum goals around the world vary in terms of their emphasis on learning the diversity of scientific methods. In the case of Lebanon, even though about a third of the science curriculum goals relate to nature of science, almost none make reference to improving student understanding of scientific methods. However, teaching students the nature and range of scientific methods is necessary for engendering better understanding of science concepts and nature of scientific knowledge. The latter includes how scientists test claims, how they consolidate findings, and how they construct reliable knowledge.

How can teachers improve students' understanding of scientific methods? This presentation proposes a practical tool derived from Brandon's (1996) work that can be used to focus students' attention on a variety of these methods in the context of science teaching. Scientific methods range from purely observational to purely experimental (and everything in between) that may or may not involve the testing of hypotheses. For example, the theory of natural selection draws on evidence obtained from investigative methods that use experimental hypothesis testing, manipulative description, observational studies that employ non-manipulative hypothesis testing and those that use non-manipulative description. In contrast, the theory of plate tectonics relies mostly on investigative methods that use non-manipulative hypothesis testing and non-manipulative description. Rather than use the proposed tool to characterize a whole field of study (e.g. earth science, astronomy), it is best used in conjunction with discussions on investigative methods known to provide the empirical basis for specific theories taught in school science. Exposing students to multiple examples throughout the school year with explicit discussions about methodological similarities and differences could help students realize how scientific explanations are typically grounded in the consilience of evidence obtained from a variety of methods. Teachers could co-

construct with students the relationship between claims, methods and explanations, and highlight the contributions of the various methods to validating knowledge claims in different science disciplines.

This presentation encourages science teachers to use the proposed heuristic to bypass the popular and misleading lock-step model of the scientific method, and illustrate instead the diversity and creativity involved with a broad range of methods. This approach provides opportunities for students to examine evidence obtained from different methods more critically, and appreciate the process of coordinating evidence from different sources and methodological traditions in the development and validation of scientific explanations[ii].

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i. *An expanded version of this presentation is included in a chapter to appear in a forthcoming book by Erduran & Dagher to be published by Springer (2014).*

ii. *Future work involves developing and evaluating instructional resources to be used in pre-service and in-service science teacher education settings* **.**

Plenary - Mathematics

Beyond Student Centered Learning: Towards Socially Response-able Mathematics Education

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This presentation discusses the origins and limitations of the movement towards the student-centered approach in mathematics education. It identifies the emergent learning theories of the last century, the human rights argument as well as the critical education movement and factors supporting a student centered curriculum. However, such a focus on the student fails to take into consideration the complexity of the classroom and, in particular, the rights and needs of the teacher. More importantly, uncritical adoption of student-centered education hides the important social aspects in mathematics education. Based on the discourse of ethics as elaborated by Levinas, it argues for a socially responsible (in its original meaning response-able) mathematics education. The implications of this approach to the curriculum and pedagogy in mathematics education are discussed. The challenge for the socially response-able mathematics education is to support the teacher to be able to respond to the needs of the student and support the students to be able to respond to the needs of their lives.

The term student centered (sometimes called child-centered) education has become a widely accepted canon for educational design and classroom teaching – albeit it remains not well defined and, arguably, in many countries around the world, more aspired to than actually practiced. It is not the intention here to present a detailed critical discussion of the different theories that hold this perspective. Rather, in the first part of the presentation, I will attempt to present a wide-brush discussion of the main and varied sources of its discourse and point out some of its limitations. My choice of the term "beyond" in the title is a challenge for not abandoning this dogma and going back to the so called "traditional" forms of teaching and learning but to build upon it towards highlighting the role of the social dimension in education. Hence, I will adopt a critical approach to the term. As Christie (2005) argues in another context, we need to "work with and work against" (p. 240) the construct at the same time. In the second part of the presentation, I will outline an approach to mathematics education that is based on the ethical concept of responsibility – or its original meaning response-ability. I will conclude the presentation by discussing some implications for this approach to curriculum and pedagogy.

Some Origins of the Student Centered Approach

For our purposes here, I will identify three different, although related, sources of the discourse on student centered approach. First, the contributions of many theorists of the past century such as John Dewey, Jean Piaget, Lev Vygotsky and Carl Rogers have challenged our thinking about how learning occurs in children and have lead to theories and practices known as constructivism (or more appropriately, constructivism, e.g. Maypole & Davies, 2001) that highlight the active role of students in learning and hence in educational planning and execution. Such varied theories contain some common elements. They point out that teaching is not equal to learning – that is what students learn is not the same as what we attempt to teach; students are active participants in the construction of their own knowledge development; knowledge is not conveyed or transmitted; and learning occurs as a result of actions and reflections by the students and negotiated through working with others. Lastly, knowledge is meaningful if it is related to a student's interest and past experiences. (I have italicized the word interest since I will discuss it further below.)

The second source of the student centered learning relates to a human rights perspective. Increasingly children are not seen as adults-in-preparation but as citizens in their own right. The United Nations (UN) Convention on the Rights of the Child1 came into force in 1990, not without some controversy, as a universal acknowledgement of rights of children. The Convention sets out standards which ensure that rights apply to all young people without exception, that the best interests of all young people must be of primary concern and that the views of young people must be taken into account. In educational discourse the movement of student voices (Cook-Sather, 2006; Fielding, 2004) represent a dual acknowledgement of students' rights to be involved in decision making in education and of the pedagogical value of such involvement.

Lastly, the focus on student centered education can be traced to the rise of the critical education movement within general education (e.g. Michael Apple, Paulo Freire) and within mathematics education (Franskstein, 1983; *Skovsmose* 1994). From this perspective, education is not only about preparing young people for work or a consumer society but also as a vehicle of 'empowerment' and a means of developing in young people active citizenship. Similarly, democratic participation is not only preparing young people for their future society but it implies active participation in decision making in their school and classroom.

What is the Student Centered Approach?

To understand the student centered approach it is helpful to compare it with its alternatives. The teacher centered education places the focus on the teachers as main source of teaching leadership in the classroom and hence as the main target of research and reform in education. Teachers' knowledge or ability and teaching methods become central to both understanding what is happening in the classroom and to reforming it. Similarly a content centered education focuses on the disciplinary knowledge being taught, its structure and methods of knowledge generation. From this perspective, the content of the curriculum and sequencing of topics become the focus of attention of educational design and delivery. In contrast, a student centered learning approach focuses on the needs of the students and their abilities and learning styles rather than teachers, administrators or official curriculum. Students' interest takes precedence over the needs of the curriculum or of society.

Perhaps few notes on these alternative approaches are in order. First, due to the great hegemony of a student centered approach in the current educational literature, it is difficult to find a theoretical defense of either content centered or teacher centered learning. In fact they are often dismissed together under the banner of traditional teaching and learning in favour of a student centered approach. Secondly, I note that at different periods in the history of research in mathematics we have oscillated from one of these foci to the other. Similarly, the emphasis has varied from one country to another. For example, in the first half of the 20th century, and in particular in the USA, curriculum design was based on rational or scientific

[1] See http://www.unicef.org/crc/

basis and tended to be content centered. Curriculum was conceived in the writings of Ralph Tyler (1949) as a product that could be achieved through rational and systematic planning following well formulated steps consisting of identification of educational purposes, experiences likely to attain them, their organization, and assessment. This understanding of the curriculum lead to educational research that looked at what kind of mathematics was needed for everyday life and for careers. Mathematics identified in this manner gave rise to the content taught in school. A relatively more recent development in the second half of the last century the New Math movement which dominated mathematics education in the USA and to a lesser extent Europe and other countries brought this content focus to a new level in taking the structure of mathematics as the organizer of school mathematics. At the same time in Europe (e.g. Piaget) and the then USSR (e.g. Vygotsky) concentrated on the child's mental development and the effect of instruction on mental development (Kilpatrick & Wirszup, 1996). These more student centered approaches gave rise to theories of constructivism that has become a worldwide movement (e.g. Davis, Maher & Nodding, 1990).

There are signs of change in this focus back to the teacher. At the turn of the millennium, along with a colleague from Mexico (Atweh & Arias Ochoa, 2001) we argued that as a result of the failures of many of the reforms in education that dominated the last three decades of the past century (Sprinthall, Reiman & Thies-Sprinthall, 1996), there has been a re-focus of attention on the role of the teachers and their needs in educational policy and research. Such focus is illustrated by the significant increase in research studies and international publications on teachers' concerns and teacher change as well as the increase in various forms of involvement of teachers in research activities (Atweh, 2004).

Limitations of Student Centered Learning

In the current educational climate that is dominated by increasing government control and standardization of the curriculum and an increasingly widespread adoption of national testing, teachers face considerable pressure to maximize students' achievement and performance on externally specified criteria. Also, increasingly, students' achievement is used for the purposes of school funding and teacher promotion. Arguably, these demands on teachers act against building pedagogical experiences based on the individual student's interests and abilities. The double message given to teachers is that on one hand, society holds the teacher as responsible for the student learning and on the other hand, from student centered discourse, the responsibility lies with students.

Further, the everyday reality of many classrooms around the world discourages the implementation of a student centered approach. Recent TIMSS studies have demonstrated that class size in many counties vary considerably. Significant variations were also found between public and private schools and between urban and rural schools. Class sizes of around 50 students are not uncommon in many countries around the world. Similarly, many countries, such as the Philippines for example, conduct mathematics classes in languages other than the first language for many of the students. It is hard to imagine how students can take control of their learning activities and how the teacher can manage their learning under such adverse conditions.

Perhaps a more important limitation to a real student centered approach to learning is the distinction between the two uses of interest as used above. In English, the word interest can be used in many ways, two of which are relevant to our purposes here. According to the Cambridge Dictionary Online2, one

[2] http://www.dictionary.cambridge.org/

meaning of interest is involvement – things we might enjoy doing or pursue (like *I have no interest in sports*). Another meaning relates to advantage – something that affects us or bring us benefit (*like it is in my interest to pay attention in class*). Often, these two meanings point to conflicting interests. For example, some students might have an interest in breaking into cars or homes. Few however, in ordered societies, would argue that such activities are to the students' best interest Conversely, students who may have no interest in learning mathematics might benefit from its study. Moreover, people – arguably, more young people who have not developed sufficient life experiences - often are not aware of the implications of what they are interested in as it relates to their overall best interests. Care should be taken in understanding that this argument is not a call for complete control of students' choices or to privilege the teachers' decisions unconditionally. However, it is meant to point out some difficulties in uncritical adherence to student centered learning. It is a call for the sharing of responsibility one for the other in negotiated decision making in the classroom. In pedagogical settings this shared responsibility is in line with principles of reciprocal learning and teaching between students and teachers proposed by Vygotsky (Crawford, 1996).

Lastly, concern about uncritical adoption of student centered learning is the argument about the aims of mathematics education. A focus on student centered learning may lead to privileging the individual over the collective. Often this is manifested in constructing the primary motivation of studying mathematics as increasing access to higher education, jobs or accumulation of wealth. When social benefits of mathematics education are considered, the economic and technological developments are identified (Kuku, 1995). However, social needs and aspirations are not satisfied by preparing students for jobs and being consumers – but by them being active and critical citizens. Borrowing the terminology from Down, Ditchburn and Lee (2007), the role of mathematics education as it relates to citizenship can be at three levels. Mathematics education can contribute to the ability of students to function as effective citizens in the world. The authors call this a conforming ideal. This is consistent with the dominant justification of mathematics as developing skills useful for preparation for work. However, mathematics can also be used to enable students to understand how the world works (or does not work) in order to change some aspects of their world. This, the authors refer to as reforming. Furthermore, mathematics has an additional capacity. It can be used to create the world in a new way. The authors call this the transforming capacity. This is consistent with the aspirations of the critical mathematics movement.

To summarize, while a student centered approach to learning and teaching has come a long way to explain and promote student learning it does not guarantee sufficient attention to the needs and responsibilities of other players in the education process, nor does it take into account the reality of the classroom into consideration, or promote the needs of society and the role of the individual in it. The challenge in mathematics education should be how to engage teachers in practices that engage students and how to focus on the students and also on pedagogy and curriculum. Perhaps, the very concept of "centered" is problematic since it implies that other factors are peripheral and hence it fails to deal with the complex phenomenon of educating students in mathematics. Here we posit an alternative approach to mathematics education based on mutual responsibility between the student and their teachers – an approach that enhances the teachers' responsibility towards the students and students' responsibility in their society. A discussion on responsibility brings us to the heart of the discourse of ethics.

Socially Response-able Mathematics Education and Ethics

Very infrequently the discussion of ethics is raised in mathematics education literature and this silence is paralleled by the avoidance of discussions of ethical questions in most traditions of Western philosophy. Cohen (2005) explains this avoidance of ethical discussion in philosophy as a fear of moralising, preaching and questions of values by philosophical discourses that are mainly focused on ontology rather than meaning. Similarly, in Western thinking there is a movement away from essentialist thinking represented in the universality of ethical principles (Christie, 2005) and their foundation on rationality as established by philosophers such as Kant.

For Levinas (1969, 1997), ethics is before any philosophy and is the basis of all philosophical exchanges. It precedes ontology "which is a relation to otherness that is reducible to comprehension or understanding" (Critchley, 2002, p.11). This relation to the Other that precedes understanding he calls "original relation". Chritchley points out that Levinas's original contribution to ethics is that he does not see ethics as a pre-determined set of principles that can be used to make decisions about particular instances of behavior. Rather it is an adjective that describes a relationship with the Other that precedes any understanding and explanation. Using a phenomenological approach, Levinas argues that to be human is to be in a relationship to the other, or more accurately, in a relationship for the other. This relation is even prior to mutual obligation or reciprocity. Roth (2007) argues that this original ethical relationship discussed by Levinas consists of an "unlimited, measureless responsibility toward each other that is in continuous excess over any formalization of responsibility in the law and stated ethical principles".

Puka (2005) suggests that a great contribution to ethics is the feminist3 distinction between responsibility and "response-ability". Response-ability highlights the ability to respond to the demands of our own well- being and the ability to respond to the demands of the other. This is similar to what Roth (2007) points out, that responsibility "etymologically derives from a conjunction of the particles re-, doing again, spondere, to pledge, and –ble, a suffix meaning "to be able to." Responsibility therefore denotes the ability to pledge again, a form of re-engagement with the Other who, in his or her utterances, pledges the production of sense. Each one, on his or her own and together, is responsible for the praxis of sense, which we expose and are exposed to in transacting with others" (p. 5).

To summarize, here I understand the primary role of Socially Response-able Mathematics Education is to equip students with knowledge, skills and dispositions to respond to the demands of their current and future lives. To achieve these aims, students need not only to develop knowledge of mathematics and knowledge of the world, but also the ability to use mathematics to read the world (i.e to understand it) and write the world (i.e. to change it) (Gutstein, 2006). In the following two sections, I turn to the implications of this approach both to the curriculum and pedagogy.

[3] For diverse feminist stances with respect to Levinas see Chanter, T. (Ed.). (2001). Feminist interpretations of Emmanuel Levinas. Pennsylvania: Pennsylvania State University.

Implications of Social Response-ability for the Curriculum

The dominance in school mathematics of the content needed for mathematically based careers – mainly science and engineering - is unwarranted and, perhaps, is a residue of times when few students finished high school and went to university. Notwithstanding the importance of jobs in science and engineering for social technological development, only a few students end up in such careers. The approach to mathematics taken here is that all students need considerable amount of mathematics for effective citizenship in the increasingly mathematized world of today – albeit different type of mathematics. As Skovsmose (1998) asserts, mathematics plays a role in "formatting" the world. This power of mathematics is, of course, double edged. On one hand, great achievements in history are mathematically based. But also mathematics is implicated in technologically caused catastrophes such as wars and mass destruction (D'Ambrosio, 1998). Hence, a utilitarian approach to mathematics falls short of developing a response-able student. As Ernest (2002) argues a critical approach to mathematics and citizenship is needed. This ethical response-ability discussion applied to mathematics education posits the primary aim of mathematics education is to enable the response-ability of students in their current and future lives as citizens.

A Socially Response-Able Mathematics Education (SRaME) approach that aims to increase social response-ability requires that a shift be made away from mere content and procedures into problem solving and applications. Further, while it is usual to find applications in mathematics from science and natural world of the student, applications from social life often remain neglected. Social applications in mathematics are often seen as contrary to rigorous mathematics that is needed for higher studies and often dealt with in special less academic courses targeting less able students. However, this binary might be counter- productive by denying the majority of students, taking the so called social or practical mathematics, the opportunity and the ability to develop their generalized abstractions of mathematical concepts and procedures. Further, in spite of the rhetoric of curriculum documents, and the assurance by many teachers that the two streams deal with equally valuable mathematics – albeit for different needs - for many students a hierarchy of values exists between them resulting in higher status to the formal academic mathematics.

A SRaME approach implies a shift in the sequencing of developing mathematics knowledge and its application. The common practice in many mathematics classrooms is that students develop mathematical understandings and skills before they are able to apply them in problem solving. Hence mathematical knowledge is often presented decontextualized and abstract. This often leads students into asking "why are we studying this?" and can result in students switching off mathematics before real and interesting applications are encountered – if indeed they are ever covered in a crowded curriculum. Mathematics education that promotes social response-ability must aim at not only developing mathematical knowledge and skills, but also knowledge and skills about the real world. The approach promoted here is for the use of real world activities to promote students' learning about their social world while they are learning mathematics and, at the same time, learn about mathematics while they are engaging with real world activities. A SRaME teacher needs to always ask what mathematics, higher order mathematics in particular, is learnt by such activities and what significant learning about the social world is anticipated. In particular, they need to raise the question 'have we learnt about mathematics, its assumptions, power and limitations as result of these activities?'

Implications of Social Response-ability for Pedagogy

In this context we understand pedagogy in the sense discussed by Lingard (2005) who, using Bernstein's (1971) elaboration, states that pedagogy goes beyond mere teaching methods or instructional techniques to include teachers' interpersonal competencies for interacting with students as well as contextual considerations and questions of power relationships enacted in the classroom.

A SRaME approach stipulates relationships between teachers and students in the classroom that are not common in traditional practices. Neyland (2004) demonstrates how in mathematics education the demand for accountability or responsibility as portrayed in the world-wide push towards standards and testing reflects a 'scientific management' rationality that posits institutions and norms as the cause of ethical behavior. Using Levinas writings, he goes on to argue that such institutions externalize and mechanize ethical behavior and thus "sometimes erode a primordial ethical relation between people" (p. 517). In this context, we argue that a focus on ethical response-ability shifts the focus of interactions between students and teachers from technical and system demand consideration to an encounter between two human beings, and while this is not totally free from system demands (Habermas, 1987), it allows for teachers' decision making based on the interest of the student.

Similarly, a SRaME approach implies a socially just pedagogy that necessarily raises the question of inclusion of marginalized groups of students in the study of mathematics. Education is often discussed as the most effective solution to addressing disadvantage in society and between societies. After at least fifty years of development and reform in education, it is important to raise the question as to whether education has been able to address this challenge. Perhaps Basil Bernstein (1971) was correct in his conclusion that schools do not compensate for society. However, there is some good news. Wide ranging reviews of the effect of educational interventions aiming to alleviate disadvantage show that increasing quality teaching does contribute to improving opportunities for marginalized groups of students (Hayes, Mills, Christie & Lingard, 2005). This research shows that quality education assists all students; but, as Christie (2005) comments, "it is for the most disadvantaged children that improvements in school quality will make the most difference in achievement" (p. 245). Further, out of all the school factors that effected students' achievement the most critical was the teacher. Hence good teaching "can make a difference, but not all the difference" (Hayes, Mills, Christie & Lingard, 2005, p. 178). The danger of exclusion is not in challenging disadvantaged and under achieving students to higher intellectual quality, but in "dumbing down" the curriculum for them - thus locking them into marginalization and disempowerment.

This however, should not be taken to imply that a focus on quality automatically result in equity. The authors go on to discuss Productive Pedagogy[4] as a framework for reflection on pedagogy to assure it focusing on both quality and equity. The Productive Pedagogy framework consists of four main categories with each divided into several subsections:

- Intellectual quality
- Connectedness
- Supportive classroom environment, and
- Recognition of difference

[4] See http://education.qld.gov.au/corporate/newbasics/html/pedagogies/pedagog.html

An ethical response-ability places the primacy of ethical considerations in the teacher-student pedagogical encounter. There are two dangers in this encounter that erode ethical response-ability for the student. First, to deal with the students as individuals with no regard for their gender, ethnicity or socioeconomic background – factors that are demonstrably related to student achievement in mathematics - is to relate to an "abstract" student. Not only is this a recipe for failure – it also is dehumanizing and is unethical as argued by Nayland (2004). Similarly, the other extreme of seeing a student only as being of a particular gender, ethnicity or social status is equally counterproductive. This stereotyping also limits the possibility of an authentic encounter with the real Other. An ethical encounter attempts to be open to any possibility that exposes itself and responds to the students' needs and aspirations rather than in a stereotypical fashion. In supporting the students' response-ability a teacher can provide the opportunity to develop the high intellectual quality to the maximum of the students' needs and capacities. This is consistent with Vithal and Skovsmose's (1997) argument that a focus on the background of the student can obscure and hinder a focus on the foreground that sees possibilities as to what the student can be rather than a focus on where they have come from.

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The Effects of Large Amounts of Data in Math Problems on the Reasoning of Students at the End of Cycle 2 (BE6)

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Abstract

Solving a math problem requires many steps: students have to read, understand and interpret text and numbers; apply knowledge of mathematical concepts and procedures to answer, define and select the relevant information; and finally solve the problem using the appropriate procedures and communicate the results. In these steps, selecting the information is primary to problem solving, especially when the problem contains a large number of data. In order to study the effect of unnecessary data in the problem, we made an experiment with students in grade 6 at a rural private school in Northern Lebanon. We proposed a math exercise containing a large amount of data, where the solution is relatively easy once the necessary data is selected. The problem contains two questions: although the second is relatively difficult and requires a very good understanding of the problem, the first one requires a very simple use of multiplication which the students are very familiar with. The only difficulty is selecting the data from the problem. Our results show that very few students were able to make a good selection and use of the data and give a correct answer. We have concluded from our study that 6th grade students are very easily disrupted when the amount of data – whether necessary or not – given in the problem gets larger.

Introduction

Solving a math problem requires many steps: students have to read, understand and interpret text and numbers; apply knowledge of mathematical concepts and procedures to answer, define and select the relevant information; and finally solve the problem using the appropriate procedures and communicate the results. In these steps, selecting the information is primary to problem solving, especially when the problem contains a large number of data. In order to study the effect of unnecessary data in the problem, we made an experiment with students in grade 6 at a rural private school in Northern Lebanon. We proposed a math exercise containing a large amount of data, where the solution is relatively easy once the necessary data is selected. The problem contains two questions: although the second is relatively difficult and requires a very good understanding of the problem, the first one requires a very simple use of multiplication which the students are very familiar with. The only difficulty is selecting the data from the problem. We present hereafter the theoretical framework of our study, and the results we found after presenting the problem to 24 students in the 6th grade (BE6).

Teaching situations

In every teaching situation, teachers must be aware where the learners are in terms of their learning, the level they are at and their past experiences; they must also understand their learning needs and the goals the teaching is aiming. In addition to that, teachers must know in which category the situations they're giving to their students are. There are indeed three different situations where children can learn: teaching situations, non-teaching situation, and a didactic situation.

Teaching situations
By definition, teaching situations are situations where one person (the teacher) has the intention to teach another one (the student) certain knowledge (the lesson). The teaching is intentional and the lessons have a certain goal. Both teachers and students are aware of the teaching that is aimed at.

Non-Teaching situations
Non-Teaching situations don't have any teaching purposes. The student learns from the situation he's facing but there is no intentional teaching, nor specific goals for these situations. Both the teacher and the student are unaware that teaching/learning is happening. This is, for example, when a student learns to put back his chair simply because his teacher does.

Didactic situations
Didactic situations are the part of a teaching situation where the intention of teaching is only explicit to the teacher but not to the student. The student is usually unaware that he's learning and acts as if it were a non-teaching situation. He makes decisions, engages strategies and evaluates their efficiency.
Solving a problem in math can contain didactic situations: the goal of problem solving is not only to do the mathematical operation (addition, subtraction, etc.); the student also mainly learns how to read the problem, recognize the useful data, and build a strategy of resolution. The steps the student follows to solve a problem are developed here below.

Steps to solve a problem

Solving a math problem may seem easy to the teachers, but it is not as fluent for the students. In fact, a student must follow many steps in order to solve a problem:

Read the problem
Reading a problem is the first step to problem solving. Although it may seem easy, reading the problem is sometimes challenging to students. The student must read the sentences and comprehend the text of the problem, he must identify the question that needs to be answered and know what type of information is being asked for. Reading a math problem requires symbol processing which involves the ability to derive meaning from symbols (equations, numbers, words, etc.). "If the student lacks the ability to process symbols, then he or she cannot read nor can they "do" math." (Fite, 2002).

List and group the given data
After the student has read and understood the problem, he must list and group the given data. This involves picking the data from the text of the problem, and grouping them in different categories, depending on what they stand for.

Search for the useful data
Once the student has listed and grouped the data of the problem, he must search for the useful data, which will be relevant in solving the problem. In fact, most students are used to using all the data given, and face great difficulties when the amount of data is large. We will discuss this point further in the next part of our paper.

Build a strategy of resolution based on the cognitive system
After picking the useful data among the given information, the student must create a link between them and build a strategy of resolution and follow it to get the solution. The strategy the student uses is based on the cognitive system. He uses perception (what we perceive from the external world through our senses), long term memory (the stock of what we have perceived), creativity (material created by joining elements we have stocked in long term memory) and readjustment (adjusting what we have stocked in long term memory and what we created through creativity to what we perceive).

The impact of excessive data

One of the most important steps of solving a problem is choosing the useful data. In fact, when teachers tend to give only the useful data in the problem, the students get used to using all the data given and get lost when the amount of data is large. To view the effect of large amounts of data on problem solving, we submitted the following problem to 24 students in grade 6 (BE6).

The problem
A dairyman receives his order of eggs in cartons. In a box, there are 240 eggs. These eggs are in boxes of 6 and 12. A box of 6 weighs 20g empty. One egg weighs 50g. In a carton, there are 8 boxes of 12. The empty carton weighs 300g. Full, it weighs 13.2kg. The dairyman sells the box of 6 eggs in 1 Euro and the box of 12 in 1.90 Euros.

- How many boxes of six eggs are there in a carton?
- What is the weight of a box of 12 eggs empty?

Solving this problem may seem, at first sight, very difficult for 6th graders or even for older or more advanced students. Nonetheless, if we follow the steps we described earlier in our article, solving the problem will become much easier.

Desired way of solving

First Question: How many boxes of six eggs are there in a carton?

List and group the given data:

- One carton:
    - 240 eggs;
    - Weighs 300g empty;
    - Weighs 13,2 kg full;
    - 8 boxes of 12;
    - …? boxes of 6.
- One egg:
    - Weighs 50g.
- One box of 6:
    - Contains 6 eggs;
    - Weighs 20g empty;
    - Costs 1€.
- One box of 12:
    - Contains 12 eggs;
    - Weighs …? g empty;
    - Costs 1€90.

Search for the useful data:

- One carton:
    - 240 eggs;
    - Weighs 300g empty;
    - Weighs 13,2 kg full;
    - 8 boxes of 12;
    - …? boxes of 6.
- One egg:
    - Weighs 50g.
- One box of 6:
    - Contains 6 eggs;
    - Weighs 20g empty;
    - Costs 1€.
- One box of 12:
    - Contains 12 eggs;
    - Weighs …? g empty;

    - Costs 1€90.

Solution:

- Number of eggs in 8 boxes of 12: **8*12= 96**
- Number of eggs in boxes of 6: **240-96= 144**
- Number of boxes of 6: **144/ 6= 24**
- There are 24 boxes of 6 in a carton.

Second question: What is the weight of a box of 12 eggs empty?

Search for the useful data:

- One carton:
  - 240 eggs;
  - Weighs 300g empty;
  - Weighs 13,2 kg full;
  - 8 boxes of 12;
  - 24 boxes of 6.
- One egg:
  - Weighs 50g.
- One box of 6:
  - Contains 6 eggs;
  - Weighs 20g empty;
  - Costs 1€.
- One box of 12:
  - Contains 12 eggs;
  - Weighs …? g empty;
  - Costs 1€90.

Solution:

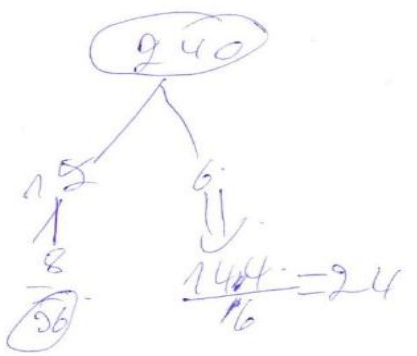
- The carton weighs 13,2kg = 13 200g
- The weight of the eggs is: 240*50 = 12 000g
- The empty carton weighs 300g
- The 24 boxes of 6 weigh: 24*20=480g
- The 8 boxes of 12 weigh: 13 200 – 12 000 – 300 – 480 = 420g
- One box of 12 weighs: 420 / 8 = 52.5g
- One box of 12 weighs 52.5g

Methods used by students

We present in the following section the methods that the students used to solve the two questions of the problem. We tried to interpret the solutions, whether they're correct or not, understand the methods the students used to give the answers, and group them in categories. We got two different methods used to solve the first question, and three methods to solve the second question.

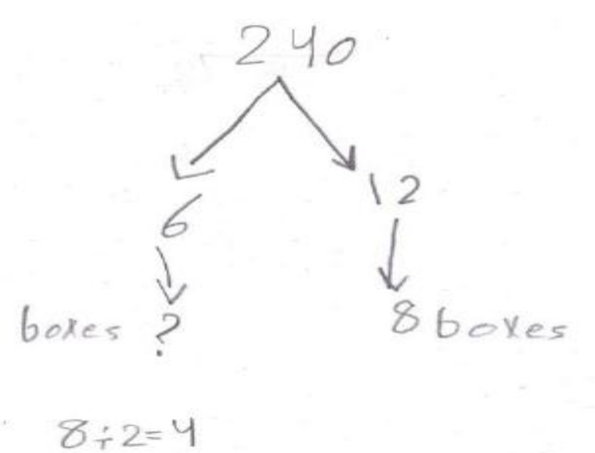
First question: How many boxes of six eggs are there in a carton?

First method: In this first method, used by only one student, we can clearly see the division of the total number of eggs between those in boxes of 6 and those in boxes of 12.



The student got the correct number of boxes of 6 by following the correct method: he/she deduced the number of eggs in boxes of 6 by multiplying 12 eggs by 8 boxes, subtracted this number from the total number of eggs to get the number of eggs in boxes of 6. He/she then divided that number by 6, deducing the correct number of boxes of 6. Overall, this first method is correct; however, there aren't any units used with numbers, which makes us wonder about the signification of the each number. The operations done are not clear, so we can't know exactly where the student got each of the numbers (26 and 144) or why any of the operations were done. Finally, even though the answer is correct, it is not presented in a clear way. In conclusion, we find this method correct, but its presentation and the presentation of the operations unclear.

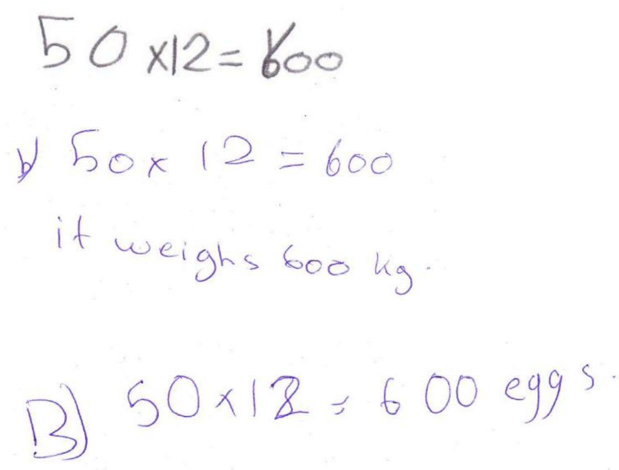
Second method: This method, used by 18 of the students, supposes that there is proportionality between the numbers.



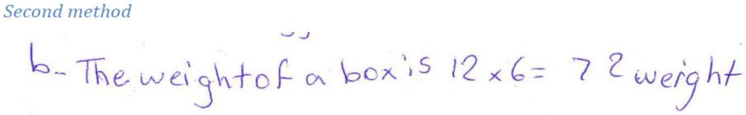
The students assumed that because 6 is half of 12, then the number of boxes of 6 should be half the number of boxes of 12. The students who used this method made a connection between the numbers without understanding the meaning of each of the numbers, or the relation that links them.

Second question: What is the weight of a box of 12 eggs empty?

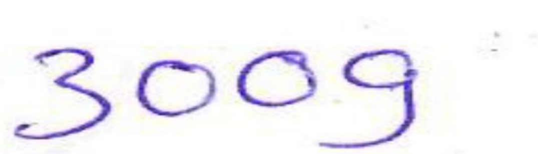
First method: In the first method, used by 15 students, the question is not understood correctly. The students look for the weight of the eggs contained in one box of 12. They therefore do not take into consideration the weight of the empty box, which is the original question. The use of this method indicates the lack of understanding of the original question, and the difficult categorization of the data. We encountered three variations of this method. In the first one, students don't use any units; in the second, they don't use units in the operation but give one for the answer. We note here that the students using this variable gave the answer in kilograms, while the data is in grams. In the third variety, students put the unit "eggs" to the answer.



Second method



Second method: In this second method, used by one student, the number of eggs contained in a box of 12 is multiplied by the number of eggs contained in a box of 6. We notice the unit "weight" that the student affiliated to the result. This method also clearly shows the lack of understanding of the question and of the data.



Third method: In this third method, used by one student, the lack of understanding of the terms used in the question is very clear: the student gave the weight of the empty carton instead of giving the weight of an empty box of 12.

Conclusion and interpretation:

This is a preliminary study; we didn't submit the experiment to a large number of students. The aim of this study was to view its feasibility and the possible results and complications we might encounter in a larger scaled study. We will submit this problem to students in French speaking and English speaking school in Northern Lebanon, in both rural and urban areas, in public and private schools. One of the most important results this study showed is that 6th grade students have major difficulties in all four steps of problem solving:

- Reading and understanding the problem seem to be problematic; the answers the students gave show the difficulties they have identifying the question that needs to be answered and knowing what type of information is being asked for.
- Listing and grouping the data is nonexistent; in such a problem with large amount of data, grouping it is primary. It helps the understanding of the problem and makes finding the solution much easier. However, we don't find any trace of such grouping in any of the students' answers.
- Searching of the useful information also a primary step in solving problems with large amounts of data. We can clearly see the attempt to such process in the students' answers.
- As for building a strategy of a resolution and following it until the result is found, we cannot see if the students really do that since the previous steps are not achieved.
- We believe that, even giving the problem to a larger number of students, the majority of them will not be able to find the correct answer. In fact, the already given examples and the strategy of resolution presented showed the difficulty of such problems. Only one student among 24 in the English speaking school and 2 among 50 in the French speaking school gave the correct answer. We believe that if we teach students the steps described earlier to solve such a problem, it will be much easier for them to follow them and therefore reach the correct answer.

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--- Only abstracts included for the following sessions ---

مدى تجسيد مبحث الرياضيات للصف الرابع الأساسي للاتجاهات التربوية الحديثة التي اشتملها مشروع تطوير التعليم نحو الاقتصاد المعرفي (ERfKE)* من وجهة نظر معلمي المدارس الحكومية في الأردن

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هدفت هذه الدراسة التعرف إلى مدى تجسيد مبحث الرياضيات للصف الرابع الأساسي للاتجاهات التربوية الحديثة التي اشتملها مشروع تطوير التعليم نحو الاقتصاد المعرفي *(ERfKE) من وجهة نظر معلمي المدارس الحكومية في الأردن؛ تكونت عينة الدراسة من (62) معلماً ومعلمة من (15) مدرسة في مدينة عمان، تم اختيارهم بالطريقة العشوائية البسيطة. قام الباحث بتطوير استبانة لمعلمي الرياضيات، احتوت الاستبانة في صورتها النهائية على (69) فقرة، موزعة إلى خمسة مجالات هي: النتاجات التعليمية التي يحتويها كتاب الرياضيات للصف الرابع الأساسي، تقديم المادة التعليمية في كتاب الرياضيات، وتقييم التعلم في كتاب الرياضيات للصف الرابع الأساسي، المواصفات الفنية للكتاب، الأدوات المرافقة للمنهاج. دلت النتائج على أن النتاجات وتقييم التعلم والأدوات المرافقة لكتاب الرياضيات للصف الرابع الأساسي لا تتوافق تماماً مع معايير الاقتصاد المعرفي، بينما يتوافق تقديم المادة التعليمية، والمواصفات الفنية في كتاب الرياضيات للصف الرابع الأساسي بدرجة كبيرة مع معايير الاقتصاد المعرفي . أوصت الدراسة بضرورة الاهتمام بالأدوات المرافقة للمنهاج، من حيث تزويد المدارس بأشرطة الكاسيت والفيديو المناسبة، وضرورة تفعيل استخدام منهاج الرياضيات المحوسب. الكلمات الدالة: تطوير التعليم نحو الاقتصاد المعرفي (ERfKE) مبحث الرياضيات.

What Motivates Science Teachers to Teach in Urban Settings: A Mixed Method Approach

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Abstract:

The high rate of teacher turnover in the United States has prompted a number of studies into why teachers leave as well as why they stay. Several reasons teachers in general choose to stay have been identified in previous studies including faith in their students. The importance of such a study is providing an insight to design programs that reinforce teacher success through understanding the personal and professional reasons of teachers who choose to stay. Studies have shown teachers who are extrinsically motivated will need external rewards to encourage them while teachers who are intrinsically motivated will have their own internal reasons. Some studies have suggested that teachers who decide to remain teaching tend to be intrinsic motivators. The environment in most Western country educational systems presents a challenge to achieving these intrinsic goals. The study examined the perspectives of secondary school science teachers, regarding why they opted to remain within urban districts. It was conducted utilizing interviews and surveys of teachers working within urban school districts in Arizona and California. The sample consisted of 94 science teachers. Questions were based on self-determination theory and used Likert scale responses. Follow-up interview requested information regarding teachers' social interaction within urban settings. The results of this study provide insight on what works to motivate science teachers to continue teaching in such high bureaucratic impediments as standardized testing. It demonstrates that science teachers do seem to be intrinsically motivated and suggests some areas in which this motivation can be fostered.

This study was initiated as a result of interest in the reasons why science teachers in urban settings tend to stay and teach. Much of the previous research was conducted to investigate the rate of turnover among teachers in urban settings, but few researchers studied teachers who stayed and taught, and the motivational factors behind their staying. The pursuit of answers to the unanswered questions led to the purpose of this study, which intended to find out what influences and motivates science teachers to persist in urban settings. This objective was met through a mixed method study that involved 194 middle and high school science teachers' responses to the survey about self- determination theory. Teachers who scored high in the survey were contacted for an individual interview, which included questions about both intrinsic and extrinsic motivation. The study contributed to research about motivation among teachers, and supported future studies related to motivation among teachers in urban schools and the

influence of demographic characteristics upon their decision to stay.
Central questions that the study sought to answer were:

- Are science teachers in urban setting intrinsically motivated to persist in urban schools?
- Do years of experience and or race affect science teachers' motivation?
- What are the roles of autonomy, relatedness, and competence?
- How was the decision to stay affected by science teachers' practice and identity?

Answers to these questions were based on results from the Intrinsic Motivation Study. The results of the study suggested that persisting teachers have intrinsic motivations as well as extrinsic motivations. It was found that years of experience and ethnicity did not affect teachers' motivation to stay and teach in urban schools. The following paragraphs provide a brief summary of the findings of the study, discussion, implications, and recommendations for future research.

Results and Interpretation of Findings

Survey

The majority of teachers did not agree on which intrinsic motivation factors were more important to them. There might be additional motivational reasons (extrinsic or intrinsic) that result in their job persistence. In this study, I only investigated autonomy, relatedness, and competence among science teachers.

Moreover, findings from the analyses revealed that none of the dependent variables were impacted by the independent variable. The results from ANOVA indicated that the survey instrument could not attribute differences in intrinsic motivation and working experience to either ethnicity or teaching experience. The independent variables that were studied did not significantly affect the majority of science teachers' intrinsic motivation.

In terms of years of experience, my findings reinforced Huang and Moon (2009), who found that after 21 years of teaching experience, student achievement dropped. In this dissertation, 36.2% teachers reported more than 15 years of teaching experience. Also, The National Board for Professional Teaching Standards (NBPTS) certification found that many teachers were still gaining proficiency and improving their effectiveness after an average of 11 years of teaching. So, experience might not be a precise variable to test competence, autonomy, and relatedness. Hence, it is recommended for future researches to compare beginners with stayers.

In terms of the ethnicity, the majority of teachers were white; 68.1% of them identified White/Caucasian ethnicity. The high percentage of Caucasian ethnicity was likely to bias the data; however, my data supported the findings of The National Education Association (2007), which reported that more than 38% of schools across America do not have teachers of color in their classrooms. I did not have an exact idea about the number of teachers and their ethnicity in each school. I could not determine the percentage of participation of non-white teachers or teachers of color. As a result, the ethnicity variable was not precise due to variations in the number of the participants' ethnicity.

From these findings, one can see that relatedness, competence and autonomy were insignificant motivational factors. Also, it was difficult to draw clear conclusions about the significance of the survey with a large sample. The limited findings of the survey recommend future research, which should include a comparison study between extrinsic and intrinsic motivation.

Interview

The second phase of the study produced vivid insights into intrinsic motivations. The selected participants, who had scored highest in the survey, were interviewed once, in which they reported their views and shared some of their feelings about teaching science in urban schools. All of the teachers in the interview were pleased with their present levels of autonomy, and mentioned their independence of choice in terms of how to teach science to their students, design assessments, and customize instruction for their students. They reported feeling freedom in their decisions regarding how they taught science. Even though their levels and forms of freedom varied, they still experienced freedom over their classes and curriculum.

The results of the interview portion of the current study strongly supported the importance of autonomy to the teaching community. The findings from the interviews also supported Brunetti's (2001) definition of professional autonomy as an intrinsic reward providing high levels of career satisfaction. The findings were similarly in accordance with Bavendam's (2001) argument that employees are more satisfied when they have enough freedom working in a certain position. The interview section also supported the conceptual framework of self-determination theory. During the interviews, teachers' responses emphasized the following:

- Classroom environment variables (autonomy support, positive teacher-principal interaction, and teacher relatedness),
- Psychological needs of autonomy and relatedness,
- Self-determined motivation.

The reason interviewees had relatedness, competence, and autonomy was that they also reported extrinsic motivation. Interviews also discussed other factors – love of students, service, and making a contribution toward the community. Teachers experienced autonomy, supported by their principal, and a sense of community, which, in turn, predicted teachers' motivation regulation. Intrinsic regulation was reported as feelings of enjoyment, while external over-regulation predicted hopelessness, and interjected regulation positively predicted hopelessness and a feeling of guilt. The nine teachers felt that they had to fix situations, help the community, and guide their students to a better future. Interviewees also had interjected regulation – guilt. These findings were supported by Self-Determination Theory, which is based on the assumption that people have innate tendencies to grow and develop psychologically, and to combine experience into self-concept (Deci & Ryan, 1985, 2000). SDT is a macro-theory of human motivation, personality development, and satisfaction (Ryan, 1995). The theory focuses especially on self-determined behavior and the social and cultural conditions that stimulate it (Deci & Ryan, 1985).

Teachers felt related to either students or school community or both. Teacher reported that they wanted to stay to see students' succeed. Teachers felt accepted by peers and/or their principal. As I mentioned in the literature review, relatedness can sometimes be perceived as friendship because people want to feel accepted and supported. Brophy (2004) noted that interaction with others is important, and it fulfills a need to belong to a group. The desire for belonging reflects a need for connection to others; thus, people feel more secure and composed when they are accepted in a group (Brophy, 2004). The need for relatedness can be satisfied in the working environment when individuals are allowed to interact freely with peers without imposed limitations on whom to interact with. Autonomy develops best in situations where individuals feel a sense of relatedness. The interviewees expressed their satisfaction and belonging throughout our dialog. They also felt competent because they expressed that they were able to control their classes. They managed to teach science despite many barriers. Brophy (2004) explained the concept of competence as needs that can be met when individuals successfully deal with the environment to control things around them.

From the analysis of the data and interviews, I have reached the following conclusion. The teachers are not inclined to leave their job in urban schools for several reasons, which include loving their students, feeling appreciated by the community, and being trusted by their principals. The existing set of factors, which are favorable for the teachers to continue their teaching career, include living in the same community as their students, which implies a stronger emotional connection and a feeling of responsibility as an educator; financial issues – teaching science does not always provide stable income; and personal life issues, which influences female educators' decision-making in leaving or staying in school. Long-term experience in teaching also contributes to the choice to continue teaching rather than getting involved in science.

A Call for Public Policy

There is a big difference between preparing a teacher to survive regulations such as NCLB, and enriching teachers with knowledge and empowering them with extrinsic motivators so that they provide the community with better education. Deci and his collaborators (1995) found out that human interaction and sharing help integrate and organize complex experiences into meaningful social relationships. At the workplace, for example, one is able to engage, interact, and organize information through constant peer interaction. Extrinsic motivation should work toward empowering teachers and enriching their abilities to teach science. In the interviews, almost all teachers had the freedom to speak and they had a voice among administration, principals, and school community.

Furthermore, instead of listing reasons for teachers to leave teaching, this study supports Neito's (2003) viewpoint about finding and focusing on successful teachers, and tries to make sense of the reasons behind their motivation to teach in urban schools. It is obvious that discrimination and prejudice have played a role in the failure of large urban public schools. The overemphasized stereotypic image about urban schools may similarly play a role in lowering expectations. The stereotypes have resulted in lowering self-esteem and achievement among teachers, and may have caused some to leave. Yet, there is no justification to apply such beliefs to the entire school system since there are good administrations, principals, and leaders in the education sector, who care for their teachers and students. If policy makers are not leaving children behind, they should rethink the exhausted teacher who is left behind. Thus, policy makers should not design regulations that punish teachers, like retention based on student scores, or reduced pay when they are teaching in inner cities or "under-resourced" schools.

Implications

To have more motivated science teachers in urban settings, the findings of this study could be implemented into practice in the following ways:

- Teacher education departments at the universities should include educational psychology classes with an emphasis on motivation. This will increase awareness among teachers of various ways regarding how to motivate themselves in the course of teaching.
- Teacher colleges should provide opportunities for multicultural student teachers and should offer them scholarships. This may increase teachers from different communities to go back and teach in their communities with some diverse experience about other communities.
- Experienced teachers should mentor new teachers, support them, and provide them with hints that they learned over the years, in order to help new teachers reduce work pressure.
- There should be structured meetings for teachers in which they may share their problems and discuss possible solutions.
- Authorities should implement extrinsic motivation in a beneficial approach to increase teachers' persistence in urban schools.
- Public school administrators must develop and manage policies that provide teachers with suitable support, rewarding them instead of punishing them.

Recommendations for Future Research

Further research should be conducted in multiple settings to assist active specialists in providing universities with greater insight in developing better programs. The results of this study may vary when larger samples are investigated and when teachers from different ethnic populations are included – even if they have to be oversampled. Future research may also include a comparison study to investigate the role of intrinsic and extrinsic motivation among teachers, or teachers and their administrations, as measured by the IMI. I also recommend looking at the quality of instruction based on intrinsic and extrinsic motivation of teachers. If the future research is quantitative, additional possibilities for improving external validity of the study exist, which include extending the eligibility for participation through applying quantitative methods of causal reasoning to the collected data, and improving the methods of geographical clustering in order to generalize results to the country level.

Cognitive Comparability of Grade 12 Lebanese National Examinations in Chemistry from 2001 to 2012

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Abstract

The purpose of this session was to introduce participants to the concept of maintenance of standards and to share with them the findings of a study that investigated whether the cognitive demands in Chemistry National Exams (CNE) in Lebanon at Grade 12 have been maintained over time. This study was carried out to evaluate the appropriateness of using CNE as parallel versions having same overall difficulty -as they are used in Lebanon. The test items of 23 CNE at Grade 12 Life Science section from 2001 to 2012 (1^{st} sessions and 2^{nd} sessions) were analyzed and categorized using a four-level taxonomy developed by Webb and his colleagues (Webb *et al.*, 2005) to classify science objectives and science test items. Results show that the cognitive demands of CNE for Grade 12 Life Science section are not maintained neither from 1^{st} session to 2^{nd} session nor from year to year.

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The session was organized as follows:
A PowerPoint presentation divided into three parts:
Part I

- A brief introduction of the concept of maintenance of standards
- Explanation of cognitive comparability over time in national examinations
- Rational for studying cognitive comparability in Lebanon
- Research questions
- Scope of the study

Part II

- Framework to analyze the cognitive demands of Grade 12 Lebanese Chemistry National Exams
- Procedure

Part III

- Results
- Discussion
- Recommendations for action

The PowerPoint presentation was followed by engaging the audience in an interactive discussion on suggested solutions to maintain cognitive demands in Chemistry National Examinations.

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The Effects of Problem Based Learning in Chemistry Education on Middle School Students' Academic Achievement and Attitude.

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Abstract

The purpose of this study was to determine the effects of problem-based learning (PBL) on student performance and attitude toward chemistry. In the study, data was obtained through the use of pre-test post-test, research-control group model. The data obtained from both groups was analyzed using t-test scores, mean, and standard deviation. The study was conducted on 7th grade students, in a private school in Lebanon. Two types of instruments were used for measurement: achievement tests, and an attitude questionnaire. The research group was taught chemistry using PBL while conventional teaching methods were applied in the control group. Results indicated that implementing problem-based learning approach had improved students' achievement and attitude. This study encouraged teachers to implement problem based learning method in teaching science concepts especially chemistry for middle school students.

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The session was organized as follows:

A PowerPoint presentation divided into three parts:

Part I

- A brief introduction of the concept of problem based learning
- Rational for applying this approach in middle school science (the research addresses students learning, motivation , attitude and performance in Lebanese students in standardized exams such as the TIMSS and finally new Lebanese curricula anticipated for 2013 which address problem based learning)
- Research questions
- Scope of the study

Part II

- Method used to carry out the study (This research has a quasi-experimental design with a control group, pretest and post- test design**.**

- Procedure: instruments and data collection
- Lesson plan devised for PBL as applied on the content on the chapter of separation techniques for grade 7 in Lebanese curriculum)

Part III

- Results
- Discussion
- Recommendations for action

The PowerPoint presentation was followed by engaging the audience in an interactive discussion on suggested ideas to apply this approach for other chapters as well as the obstacles to implementing such approach.

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What Does This Thing Called Productive Pedagogy Have to Do with My Class?

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Abstract:

There is ample evidence from research that there are no universally appropriate teaching styles or methods of teaching that produce the required results in all classrooms, with all teachers and with all groups of students. Yet, the world spends billions of dollars on research which aims to improve teaching. How do we learn from that research without losing the contextual nature of effective teaching? A framework for effective pedagogy called Productive Pedagogy is an attempt to integrate research findings on effective teaching from a variety of areas of research that provides principles for effective pedagogy yet does not provide ready-made techniques for teaching. This workshop discusses the elements of this framework and invites participants to examine their own teaching practices in its light.

During the second half of the twentieth century, in English speaking countries, significant shifts have occurred in theories and research on teaching and learning through the introduction of perspectives that includes the social nature of learning and its relation to the social context of students, classrooms and schools. Speaking about mathematics education in particular, Stephen Lerman (2000), calls this shift the social turn, in that its impetus came from research and theorization from outside the field of psychology and education and is rooted in anthropology, cultural psychology, sociology, and sociopolitical critiques. Undoubtedly, this shift in mathematics education is paralleled in other areas of education. Here I turn the attention to the question of the role of the teacher and teaching with respect to these developments.

The international educational literature contains many ideas for different teaching methods and instructional techniques appropriate for developing deep and effective learning based on some from the knowledge and theories from cognitive and social sciences. However, ample evidence exists that there are no universally appropriate teaching styles or methods that produce the required results in all classrooms, with all teachers and in with all groups of students. Effective teachers are those who, not only are confident of their content knowledge and have a repertoire of teaching skills, but also know their students and their contexts and are able to make informed decisions about what is appropriate for them. Effective teaching and learning is always contextualized. What is of greater value for informed pedagogical decisions are frameworks that allow teachers to reflect on their practices and to enter into dialogue with the community of teachers, policy makers and the general public about issues related to teaching and learning. This is in line with the professionalization of teachers (Atweh, 2004).

Several frameworks exist in the literature that allows the development of a variety of teaching techniques based on certain theoretical underpinnings. Perhaps most widely known such frameworks are those of Bloom's Taxonomy, Gardner's Multiple Intelligences, Debono's Thinking Hats and Myer-Briggs Personality Types and so on. These different schemes have few characteristics in common. None of them contain prescriptive teaching tools for the teacher. Rather they are provided as tools of reflection for the teacher in their critique of their own pedagogy and in designing alternative pedagogy. Similarly, none of these schemes are content-based. That is they can be used in a variety of subject areas and at different levels of teaching. Without dismissing their value for teachers, I note that the educational research base on which they are based is perhaps limited in that they are focused more on higher order thinking and intelligence constructed under the individualistic models of learning. Similarly, they don't take into account the social dimension of learning as discussed by Lerman. While some of them might acknowledge individual differences in thinking style and preference to learning, they do not account for the effects of student background and their social context.

One framework developed recently in the state of Queensland in Australia, called Productive Pedagogy[5] is an example of an attempt to integrate research findings on effective teaching from a variety of areas of research within education itself. The framework was based on the previous work of Newman and his colleagues (Newmann & Associate, 1996) at the University of Wisconsin on Authentic Pedagogy and based on a longitudinal study conducted in that state (Queensland School Reform Longitudinal Study, 1999). Similar to the previous frameworks the Productive Pedagogy model does not provide readymade techniques for teaching. Rather, it

> is an approach to creating a place, space and vocabulary for us to get talking about classroom instruction again. It isn't a magic formula (e.g., just teach this way and it will solve all the kids problems), but rather it's a framework an vocabulary for staffroom, in-service, pre-service training, for us to describe the various things we can do in classrooms – the various options in our teaching 'repertoire that we have – and how we can adjust these … to get different outcomes. (Luke, 1999, pp5-6)…,

The Productive Pedagogy framework consists of four main categories:

- Intellectual Quality
- Connectedness
- Supportive Classroom environment, and
- Recognition of difference

Each dimension is divided into 4-6 dimensions. See Table at the appendix for an exploration of the meaning of the various dimensions. Classroom activities or lessons can be reflected upon using each dimension. Further each dimension can be high or low, although different grading in between can be utilized.

Some comments on the overall use of this framework for reflection on classroom pedagogy may be useful. First, naturally, different segments of classroom activities may reflect some of these dimensions

[5] *Further information about the Productive Pedagogy can be available from the Website of the Queensland Department of Education and the Arts at http://education.qld.gov.au/corporate/newbasics/*

more than others. It is not the intension that every single activity should achieve a high demonstration on each dimension. For example, there is a room in some classes to develop low level intellectual qualities such as spelling in Language subjects and memorizing number facts in mathematics. However, if most activities in Language classrooms are of low quality, then only limited outcomes can be expected from the students in these classrooms. Second, these dimensions are not mutually exclusive. That is, one activity can demonstrate high intellectual quality and attempt to connect learning in the subject area to the real life of the student. Similarly, in the conduct of that activity the classroom teacher may attempt to achieve a supportive classroom environment to students of different cultural background who may not be familiar with the content of the activity. Third, the demonstration of the various dimensions in a classroom may not necessarily be reflected in the selection of specific activity, but through classroom talk and modes and frequency of interactions with students. Lastly, this framework does not attempt to provide a reliable quantitative measure of the various dimensions. That is two observers can give different ratings for one observed classroom. This is not a limitation in the framework. The intention is not to provide a scheme to evaluate lessons, but a means of reflection on classroom interactions. If two observers differ, that will be a useful opportunity to start talking about the lesson and of ways to improve it.

Likewise, I can make some comments on the different possible ways in which this framework can be used. First, individual teacher can reflect on their own lessons, either at the planning stage or after the conduct of the classroom, using four categories of the framework. The teacher can ask how my lesson has demonstrated high quality. Where in this lesson I have provided support to students? How can I increase the recognition of different social and cultural groups in my classroom? Secondly, teachers can provide critical friends' comments on each other classrooms. This allows both teacher and classroom observer to enter into substantive conversation about pedagogy. It can also be used in group planning for the curriculum in the school for one level in one subject, or across levels and subjects. Thirdly, this framework can be used to as professional development of teachers and as induction means for new teachers in the schools. It is worthwhile to stress that this framework is not intended to be used in a top down way for teacher assessment and promotion. However, it is an effective means to use for giving feedback to teachers for commencing a conversation about promoting authentic and quality learning in the classroom.

I conclude with a few remarks on the use of Productive Pedagogy in teacher training in particular. While this framework is not developed for teacher education in particular, it has been used in many teacher education courses in some universities in Australia (Gore, Griffiths & Ladwig, 2001; Zyngier, 2005). The framework was used in introductory units on teaching and learning as well as a tool for classroom observations in practice teaching. Gore, Griffiths and Ladwig summarize their recommendations as follows. More broadly, PP principles challenge conventional understandings about what is important and what should be emphasized in teacher education programs. It suggests a re-thinking of what is offered and what is valued. In particular, the principles of PP require teacher educators to address:

- The overemphasis on classroom environments and processes rather than on substance and purposes
- The relationships between foundational studies, curriculum studies and field experiences which are currently insufficiently connected
- The purpose and structure of field experiences which center too often on practicing teaching techniques with relatively little concern for what is being taught and the quality of learning produced
- The focus on student management relative to student learning, which mistakenly assumes that management should be addressed first and separately
- The emphasis on syllabus content and constraints of the formal curriculum relative to identifying central concepts and producing depth of understanding.

However, the value of the Productive Pedagogy goes beyond its value for the pre-service teachers. Developers of pre-service teacher education courses can use this framework to reflect on their own subjects. As teacher education is under scrutiny in many countries around the world, improving teaching and learning by modeling the principles it teachers in its own subjects is a worthwhile endeavour.

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<table>
<tr><td rowspan="3">Intellectual quality</td><td colspan="2">We want to ensure that students manipulate information and ideas in ways which transform their meaning and implications, understand that knowledge is not a fixed body of information, and can coherently communicate ideas, concepts, arguments and explanations with rich detail.</td></tr>
<tr><td>Higher-order thinking</td><td>Higher-order thinking requires students to manipulate information and ideas in ways that transform their meaning and implications. This transformation occurs when students combine facts and ideas in order to synthesize, generalize, explain, hypothesize or arrive at some conclusion or interpretation. Manipulating information and ideas through these processes allows students to solve problems and discover new (for them) meanings and understandings. When students engage in the construction of knowledge, an element of uncertainty is introduced into the instructional process and makes instructional outcomes not always predictable; i.e., the teacher is not certain what will be produced by students. In helping students become producers of knowledge, the teacher’s main instructional task is to create activities or environments that allow them opportunities to engage in higher-order thinking.
Lower-order thinking occurs when students are asked to receive or recite factual information or to employ rules and algorithms through repetitive routines. Students are given pre-specified knowledge ranging from simple facts and information to more complex concepts. Such knowledge is conveyed to students through a reading, work sheet, lecture or other direct instructional medium. The instructional process is to simply transmit knowledge or to practice procedural routines. Students are in a similar role when they are reciting previously acquired knowledge; i.e., responding to test-type questions that require recall of pre-specified knowledge. More complex activities still may involve reproducing knowledge when students only need to follow pre-specified steps and routines or employ algorithms in a rote fashion.</td></tr>
<tr><td>Deep knowledge</td><td>Knowledge is deep or thick when it concerns the central ideas of a topic or discipline and because such knowledge is judged to be crucial to a topic or discipline. Knowledge is deep when relatively complex connections are established to central concepts.
Knowledge is shallow, thin or superficial when it is not connected with significant concepts or central ideas of a topic or discipline, and it is dealt with only in an algorithmic or procedural fashion. Knowledge is also shallow when important, central ideas have been trivialized by the teacher or students, or when it is presented as non-problematic. This superficiality can be due, in part, to instructional strategies such as when teachers cover large quantities of fragmented ideas and bits of information that are unconnected to other knowledge.</td></tr>
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	Deep Understanding	For students, knowledge is deep when they develop relatively complex understandings of these central concepts. Instead of being able to recite only fragmented pieces of information, students develop relatively systematic, integrated or holistic understandings. Mastery is demonstrated by their success in producing new knowledge by discovering relationships, solving problems, constructing explanations, and drawing conclusions. Students' understanding of important concepts or issues is taken to be superficial when ideas are presented by students in a way which demonstrates that they only have a surface acquaintance with the meaning. Evidence of shallow understanding by students exists when they do not or cannot use knowledge to make clear distinctions, arguments, solve problems and develop more complex understandings of other related phenomena.
	Substantive conversation	In classes with substantive conversation there is considerable teacher-students and student-student interaction about the ideas of a substantive topic; the interaction is reciprocal, and it promotes coherent shared understanding. This element describes the extent of talking to learn and to understand in the classroom. Features of substantive conversation include: *Intellectual substance*: The talk is about subject matter in the discipline and encourages critical reasoning such as making distinctions, applying ideas, forming generalizations, raising questions. It moves beyond just the recounting of experiences, facts, definitions, or procedures (e.g., technical language, analytical distinctions and categories being made, levels of differentiations between types and arguments stated, grounds for disagreement stated). *Dialogue*: The conversation involves sharing of ideas and is not completely scripted or controlled by one party (as in teacher-led recitation). Sharing is best illustrated when participants provide extended statements, direct their comments, questions and statements directly to others, redirect and select next speakers. *Logical extension and synthesis*: The dialogue builds coherently on participants' ideas to promote improved collective understanding of a theme or topic. In short, substantive conversation resembles the kind of sustained exploration of content characteristic of a good seminar where student contributions lead to shared understandings (e.g., teachers and students may make principled topic shifts, may use linking words, make explicit references to pervious comments, and may summarize). *A Sustained exchange* extends beyond a routine IRE (initiate/response/evaluate). This can occur between teacher and students or student and student and involves several consecutive interchanges. Dialogue consists of a sustained and

		topically related series of linked exchanges between speakers. In classes where there is little or no substantive conversation, teacher-student interaction typically consists of a lecture with recitation where the teacher deviates very little from delivering information and routine questions; students typically give very short answers. Discussion here may follow the typical IRE pattern: with low-level recall/fact-based questions, short utterance or single-word responses, and further simple questions and/or teacher evaluation statements (e.g., 'yes, good'). This is an extremely routine, teacher centered pattern, that amounts to a 'fill in the blank', or 'guess what's in the teacher's head' format.
	Knowledge as problematic	Presenting *knowledge as problematic* involves an understanding of knowledge not as a fixed body of information, but rather as being constructed, and hence subject to political, social and cultural influences and implications. Multiple, contrasting, and potentially conflicting forms of knowledge are represented. *Knowledge as given* sees the subject content represented as facts, ie. a body of truth to be acquired by students. The transmission of the information may vary, but is based on the concept of knowledge as being static and able to be handled as property, perhaps in the form of tables, charts, handouts, texts, and comprehension activities.
	Meta Language	*High metalanguage* instruction has high levels of talk about talk and writing, about how written and spoken texts work, about specific technical vocabulary and words (vocabulary), about how sentences work or don't work (syntax/grammar), about meaning structures and text structures (semantics/genre), about issues how discourses and ideologies work in speech and writing. Teachers tend to do a good deal of pulling back from activities, assignments, readings, lessons, and foregrounding particular words, sentences, text features, discourses, etc. *Low metalanguage* instruction has little explicit talk about talk and writing, about how written and spoken texts work, about their features, characteristics, patterns, genres and discourses. There is an emphasis on simply doing text-based activities, without any pulling back and talking about curriculum and evaluation of texts.
Connectedness	**We want to ensure that students engage with real, practical or hypothetical problems which connect to the world beyond the classroom, which are not restricted by subject boundaries and which are linked to their prior knowledge.**	
	Knowledge integration	*Integrated school knowledge* is identifiable when either: a) explicit attempts are made to connect two or more sets of subject area knowledge, or b) when no subject area boundaries are readily seen. Topics or problems which either require knowledge from

		multiple areas, or which have no clear subject areas basis in the first place are indicators of curricula which integrate school subject knowledge. *Non-integrated school knowledge* is typically segregated or divided in such a way that specific sets of knowledge and skills are (relatively) unique and discrete to each specified school subject area. Segregated knowledge is identified by clear boundaries between subject areas. Connections between knowledge in different segregated subject areas are less and less clear the stronger the dividing knowledge boundary. In the extreme, such boundaries prevent any interrelation of different subject areas.
	Background knowledge	*High-connection* lessons provide students with opportunities to make connections between their linguistic, cultural, world knowledge and experience and the topics, skills and competencies at hand. Background knowledge may include community knowledge, local knowledge, personal experience, media and popular culture sources. *Low-connection* lessons introduce new content, skills and competencies without any direct or explicit opportunities to explore what prior knowledge students have of the topic, and without any attempts to provide relevant or key background knowledge that might enhance students' comprehension and understanding of the 'new' material being offered.
	Connectedness to the world	*Connectedness* describes the extent to which the lesson has value and meaning beyond the instructional context, making a connection to the larger social context within which students live. Two areas in which student work can exhibit some degree of connectedness are: a real-world public problem; i.e., students confront an actual contemporary issue or problem, such as applying statistical analysis in preparing a report to the City Council on the homeless; students' personal experiences; i.e., the lesson focuses directly or builds upon students' actual experiences or situations. A high level of connectedness can be achieved when the lesson entails one or both of these. In a *low-connectedness* lesson with little or no value beyond the classroom, activities are deemed important for success only in school (now or later), but for no other aspects of life. Student work has no impact on others and serves only to certify their level of competence or compliance with the norms and routines of formal schooling.
	Problem-based curriculum	A *problem-based curriculum* is identified by lessons in which students are presented with a specific practical, real, or hypothetical problem (or set of problems) to solve. Problems are defined as having no specified correct solution, requiring knowledge construction on the part of the students,

<table>
<tr><td></td><td></td><td>and requiring sustained attention beyond a single lesson.</td></tr>
<tr><td rowspan="2">Supportive classroom environment</td><td colspan="2">We want to ensure that students influence the nature of the activities they undertake, engage seriously in their study, regulate their behavior, and know of the explicit criteria and high expectations of what they are to achieve.</td></tr>
<tr><td>Student direction</td><td>Student direction sees students influence what specific activities or tasks they will do in the period, or how these will be realized. Such activities are likely to be student-centered, as in group work or individual research or investigative projects. In this way the students assume responsibility for the activities with which they engage, or how students complete them.
A low level of student direction is exhibited where students do not influence the class activities and the teacher, or some other educational/institutional authority, explicitly determines what activities students do, and hence how they will meet the specified objectives required within the period. The appropriateness of an activity towards meeting these criteria is thus decided by the teacher and/or external authority.</td></tr>
<tr><td rowspan="2"></td><td>Social support</td><td>Social support is present in classes when the teacher supports students by conveying high expectations for all students. These expectations include: that it is necessary to take risks and try hard to master challenging academic work, that all members of the class can learn important knowledge and skills, and that a climate of mutual respect among all members of the class contributes to achievement by all. Mutual respect means that students with less skill or proficiency in a subject are treated in ways that continue to encourage them and make their presence valued. If disagreement or conflict develops in the classroom, the teacher helps students resolve it in a constructive way for all concerned.
A lack of social support will be evidenced when teacher or student behavior, comments and actions discourage effort, participation and taking risks to learn or express one's views. For example, teacher or student comments that belittle a student's answer, and efforts by some students to prevent others from taking seriously an assignment serve to undermine support for achievement. Support can also be absent in a class when no overt acts like the above occur, but the overall atmosphere of the class is negative due to previous behavior. (Note: Token acknowledgments by teacher of student actions or responses do not constitute evidence of social support.)</td></tr>
<tr><td></td><td>Academic engagement is identified by on-task behaviors that signal a serious psychological investment in class work; these</td></tr>
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	Academic engagement	include attentiveness, doing the assigned work, and showing enthusiasm for this work by taking initiative to raise questions, contribute to group activities and help peers. *Disengagement* is identified by off-task behaviors that signal boredom or a lack of effort by students; these include sleeping, day dreaming, talking to peers about non-class matters, making noise or otherwise disrupting the class. It is assumed these behaviors indicate that students are not taking seriously the substantive work of the class.
	Explicit quality performance criteria	*Explicit quality performance criteria* are frequent, detailed and specific statements about what it is students are to do, to achieve. This may involve overall statements regarding tasks or assignments, or about performance at different stages in a lesson. *Implicit criteria* are identified by lack or absence of written or spoken reference to criteria, requirements, benchmarks or levels of acceptable performance expected of students. This may not be an indicator of neglect but a deliberate strategy for students to discover or construct their own outcomes.
	Self-regulation	*High implicit control* is identified by teachers not making or not having to make statements that aim to discipline students' behavior (e.g., 'you're not being good today, put your pens away') or to regulate students' bodily movements and dispositions (e.g., 'sit down', 'stop talking', 'eyes this way'). *Low implicit control* is identified by teachers who devote a substantial amount of verbal work to disciplining behavior and regulating student movement.
Recognition of difference	**We want to ensure that students know about and value a range of cultures, create positive human relationships, respect individuals, and help to create a sense of community.**	
	Cultural knowledge	*Cultures* are valued when there is explicit valuing of their identity represented in such things as beliefs, languages, practices, ways of knowing. Valuing all cultural knowledge requires more than one culture being present, and given status, within the curriculum. Cultural groups are distinguished by social characteristics such as gender, ethnicity, race, religion, economic status, or age. Thus, their valuing means legitimating these cultures for all students, through the inclusion, recognition and transmission of this cultural knowledge. *Devaluing of cultures* is apparent when curriculum knowledge is constructed and framed within a common set of cultural definitions, symbols, values, views and qualities, thus attributing some higher status to it.

	Inclusivity	*Inclusivity* describes the degree to which non-dominant groups are represented in classroom practices by participation. Non-dominant groups are identified in relation to broad societal-level dimensions of social inclusion/exclusion. Lack of inclusivity is apparent when the students' backgrounds are ignored and they are treated as a homogenous group. This often results in some groups being unable or unwilling to contribute.
	Narrative	*Narrative* is identified as a sequence of events chained together. The use of narrative in lessons is identified by an emphasis in teaching and in student responses on structures and forms. These may include the use of personal stories, biographies, historical accounts, literary and cultural texts.
	Group identity	Group identity in contemporary social theory emphasizes the need for schools to create learning communities in which difference and group identities are positively recognized and developed within a collaborative and supportive classroom community. This requires going beyond a simple politics of tolerance. A classroom which manifests this ideal is one where differences and group identities are positively developed and recognized while at the same time a sense of community is created. For example, in a given classroom, Aboriginal identities are given positive recognition in classroom practices and representations; Aboriginal students and teachers are given opportunities to pursue aspects of the development of Aboriginal identities and cultures; all class participants value this as a positive and legitimate aspect of their classroom community; and racism is challenged within the classroom, school, and wider communities.
	Active citizenship	*Active citizenship* acknowledges that in a democratic society all individuals and groups have the right to engage in the creation and re-creation of that democratic society; have the right to participate in all of the democratic practices and institutions within that society; have the responsibility to ensure that no groups or individuals are excluded from these practices and institutions; have the responsibility to ensure a broad definition of the political includes all relationships and structures throughout the social arrangement. *Active citizenship* is present in any classroom in any subject domain when the teacher elaborates the meaning of such citizenship and facilitates its practice both within the classroom and outside.

Performance Assessment in Mathematics: Doing Rather than Just Knowing

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Abstract

Performance Assessment is a deviation from traditional assessment in which it requires students to perform particular tasks in order to demonstrate their understanding of certain concepts. In mathematics, students might need to collect data, manipulate objects, measure, record findings, construct graphs, design a product, analyze, draw conclusions, or communicate findings. The effective use of performance assessment lies in two factors: the choice of the task, and the evaluation of it. After presenting the definition of performance assessment, participants in this workshop took part in an interactive discussion regarding the importance and difficulties of using performance assessment in mathematics classrooms, and they were exposed to some samples of performance assessment tasks, as well as, rubrics for evaluating students' work on these tasks. Moreover, participants were required to work in groups in order to design their own performance assessment tasks that can be used in middle school mathematics classes, and the related rubrics.

Introduction

In the educational system there is a continuous demand for reforms due to the changing societal expectations from schools. Nowadays the emphasis is on developing life-long learners that possesses all needed talents and skills to be able to dig for their own knowledge, and to know how to make use of it in order to cope with the rapid changes in the society. The role of the teacher in the instructional process, as well as, the role of the students is changing consequently. Assessment of students usually reflect the changes in the instructional process since it must be interrelated with the instructional goals, as well as, the teaching practices that take place in the classroom. Assessment is a process that allows teachers to observe students' behaviors in order to draw inferences about students' knowledge and abilities (Ormond, 2006). There are growing criticisms of traditional forms of assessment that are usually presented in the form of paper and pencil tests. These forms emphasize mainly factual knowledge, understanding, and application, rather than students' analytic skills and critical thinking. To go with the educational reforms, the emphasis is expected to shift more towards knowledge application as well as performance of tasks to demonstrate understanding (Grabe & Grabe 2007), and here comes the idea of performance assessment.

Performance assessment requires students to demonstrate their understanding and their mastery of specific skills and competencies, by performing these skills, or by producing a specific product. While traditional measure of assessment can provide us with information about how well students know the information, performance assessment can tell us how well students can use and apply the information they have learned. In mathematics, for example, students can:

- Develop, interpret, and use a graph
- Design an activity and carry out experiments
- Integrate, or apply information
- Write an explanation that proves a statement
- Build models
- Collect and analyze data
- Report findings.

Advocates of performance assessment believe that it goes more with instruction than traditional assessment, and it provides higher possibility to measure complex skills and communication skills which are needed these days in the society (Palm, 2008). Performance assessment has lots of characteristics: it encourages active learning, in which students are engaged in a process; it is rich and motivational; it encourages decision making, critical thinking, and creativity; it is usually authentic and very close to real life practices; and it is essential and related to the curriculum.

Strategy

After presenting the definition of performance assessment, participants in the workshop had an interactive discussion about the characteristics of good performance assessment tasks and the possibility of developing their own tasks that can be applicable in their classrooms. Their discussion led us to two major findings; the first one is that a good performance assessment task must be:

- Engaging: All students must be engaged in doing certain activity
- Active: Students must be active participants in the activities
- Rich: The task must integrate as many related concepts together
- Motivational: Students must be excited to work
- Decision making: Students must be given the chance to make choices
- Essential: The performance must have a meaningful context, and demonstrate the application of certain knowledge
- Related: The performance must be related to the lesson objectives
- Authentic: Activities are supposed to be very close to real life practices

The second finding was that, in order to develop a performance task that can fit with your instructional practices, the teacher must follow three main steps:

- Select learning objectives: After defining the learning objectives of your lesson, you must carefully choose the ones that you want to assess using performance assessment. Usually, performance assessment cannot cover wide range of objectives the same as traditional assessments.
- Create or select the task: Although creating your own task can be time consuming, but these tasks can fit best to your classroom needs. Some good performance assessment tasks are available in textbooks and online resources.
- Decide on the evaluation criteria for the students work: This is one of the most difficult parts since you need to specify clearly how the student's work will be judged and inform students about it before hand. Usually rubrics, checklists, criteria lists, or rating scales can be used in order to evaluate the work of the students. The nature of the performance task being used, as well as, the purpose of the assessment determines the form of the rubric or other scales.

Description of the session

After defining performance assessment and deciding on major characteristics, as well as, steps to design good performance assessment, participants in the workshop worked in pairs to fill in a worksheet about benefits and limitations of performance assessment. The results were discussed and they came out with the following:

Benefits of performance assessment

- Reflect long term complex Instructional goals
- Develop complex understanding and skills
- Motivate students
- Assess process as well as product
- Active participation of students
- Promote creativity
- Provide students with good learning opportunities
- Provide realistic context
- No single right or wrong answer
- Less anxiety than traditional tests

Limitations of performance assessment

- Difficulty in evaluating the task
- Unreliability among different raters
- Time consuming
- Inefficient to cover all factual knowledge in any one assessment
- Difficulty in preparing such tasks

Afterwards, some performance assessment tasks were introduced and samples of criteria list and rubrics were provided.

Sample Performance assessment task I for middle school mathematics:

Background: Students can perform operations with decimals and fractions, and they have an understanding of the relation between them.
Task: Find the cost of a homemade cake
Audience: Grade 7
Purpose: Perform operations using fractions and decimals in an authentic setting.

*Procedure***:**

- Choose a partner from your class
- Look for a good clear recipe for cake
- Plan a visit with your partner to a supermarket or a grocery shop to buy the ingredients of the cake.
- List down the prices of each item you buy for the cake.
- Design a plan to find out the exact price of the material that you will be using for the cake.
- Find out how much the cake will cost.
- Prepare a paper that includes the chosen recipe, describes the difficulties that you faced, and explains the plan that you made.
- Prepare to present it in front of your classmates, and use visuals like charts or tables to clarify you presentation.
- Deadline: ….

For this task a criteria list was provided to the participants in the workshop. This was designed to fit, as much as possible, the task at hand.

Criteria list for performance assessment task I for middle School mathematics

	Possible Points	Student	Teacher
The recipe chosen is clear	2		
The prices of each of the bought items is listed	2		
The prices of each of the bought items is reasonable	2		
The operations that were used to calculate the price of the used items are correct	4		
The price of the used items is calculated properly	4		
The price of the cake is correct	2		
The recipe chosen is presented in the paper	2		
The difficulties are stated clearly in the paper	3		
The explanation of the plan is complete, clear, and unambiguous in the paper	5		
The oral presentation is informative and clear	4		
The oral presentation is interesting	3		
The visuals are clear and effective	4		
The paper was presented before the deadline	3		
Total	40		

This task and the corresponding criteria for evaluating students work was discussed during the session. Some participants were wondering about the student column, therefore the importance of students' self-evaluation was discussed briefly at this point. Two other tasks were introduced briefly to the participants.

Performance Assessment Tasks II and III for middle school mathematics:

II. Design a house using blocks (students are supposed to use blocks with known dimensions). Figure out a way to find the volume of this house. Present a paper that includes an image of the house and clarifies your steps.

III. For the month of March, record the temperature 3 times every day. Calculate the average temperature per day, and find the average temperature of the month. Compare the average temperature with the same month for the previous 10 years. Do you notice any pattern? Prepare a presentation to report your findings using spreadsheets and graphs.

At the end, participants were given the time to work in groups to try to design their own performance assessment tasks and their related rubric. These tasks were discussed and some of them were really good, but some of the participants found it hard to design the related rubrics. We agreed that evaluating a performance assessment task needs to be carefully studied, and it takes good amount of time.

In general, the involvement of the participants in this workshop was very good; some of them were hesitant at the beginning to participate in the discussions. But as the session progressed, they gained more confidence and they were more interested, moreover, their contributions were very helpful and informative.

Conclusion

Performance assessment might not be able to replace traditional assessment, but it can supplement it. The extra emphasis on written ‘paper and pencil tests’ and on the test results raised lots of issues in the educational field, and led lots of critics to argue that it is affecting learning and pushing teachers to teach for the test (Linn & Miller, 2005). Performance assessment might put extra pressure on teachers due to the fact that it is time consuming and it needs lots of preparation, but if we don’t want our students to be limited to factual knowledge, and we care about developing their higher order thinking skills and their ability to apply what they have learned in a real life setting, then performance assessment is a choice we have to consider. It is known in Lebanon that teachers (especially in mathematics middle school) always complain about the amount of material they are supposed to teach every year, and the time constrains that they face, but with good management of time performance assessment tasks can smoothly fit in the curriculum.

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http://www.smarterbalanced.org/smarter-balanced-assessments/
http://www.balancedassessment.concord.org/

Introducing GeoGebra 4.2

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Abstract

GeoGebra is a free math software, students from all age groups, schools and colleges by using GeoGebra can "see" abstract concepts, connect different areas of mathematics and learn mathematics by discovery. (Hohenwarter, 2012). In this workshop we actively went over most of the GeoGebra (Latest version 4.2) features; our activities covered intermediate as well as secondary levels. The topics covered were: Locus, continuity, operations on vectors, introducing derivatives, linear functions, and translation of functions.

Introduction

GeoGebra is a free math software (used for 10 years now) improved by math teachers for math teachers and students. Its power lies in being user friendly and in encompassing most math areas K-12 and also college level. Its main difference from other software is working simultaneously with multi windows.

Strategy

The strategy used in this workshop was hands on activities that combine both the GeoGebra 4.2 most important features and math concepts. Teachers worked independently from the presenter who circulated to answer questions and help teachers.

Description of session

The presenter started by introducing the software to teachers and asked how many knew it before and how much they think they know about it? And very few knew about GeoGebra and they don't consider themselves professional in it. After 10 minutes teachers started applying the activities provided for them. The activities were written in detail (step by step) so that any teacher can apply. At the end the presenter introduced some other features and also introduced GeoGebra 5.0 which is still in its beta version (under construction) and that include 3 dimensions geometry with coordinates.

Conclusion

Teachers need such workshops but it should be divided into two levels: Introductory and intermediate and each one should be at least 4 hours long. Teachers should collaborate in order to decrease preparation time.

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Making it Easy for the Brain to Learn Math

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Abstract

Ever wonder why your students keep forgetting the steps of long division? Why even when babies can distinguish between small quantities, your sixth grader still can't recall the multiplication facts? We are born with a brain that has a natural innate tendency for approximating and representing numbers. However, somewhere along the way, it starts to become very challenging to young children and, sometimes even adults, to recall basic algorithms or to understand different number systems. Well, the answer to these questions lies in that very complex organ, the brain. The brain controls how we represent numbers and deal with these quantities and yet there is little understanding among educators on the nature of these mechanisms. More awareness of how the brain works with mathematics can explain the difficulties we find in the classroom and can facilitate brain compatible instruction. This workshop aims to introduce educators to the mechanisms of the brain and to the instructional strategies that are compatible with these mechanisms. Activities and strategies will be suggested for classroom applications.

Most students complain that math strains their brains! If this is indeed true, then it is necessary to take a closer look at how the brain deals with different mathematical tasks. Understanding the mechanisms of the human brain ultimately means designing brain compatible instruction that will no longer "strain the brain" but rather help the brain "grow". The purpose of this workshop is enlightening participants about how the brain works with Math and to give participants innovative and engaging strategies and activities that they can apply in the classroom and out.

The session was planned as follows:

- **Introductory Question:** How do you think the brain stores numbers? Record participants' answers on a flip chart and discuss the answers. Present "Numbers are stored as words" and discuss with participants what implications this has in the classroom. **(15 minutes)**

- **Description of the session:**

    - **Video Viewing:** The session will commence with viewing a video: participants watched a short video about classroom applications of brain compatible instruction with follow up questions. **(25 minutes)**

    - **Activity 1:** Car parking problem: participants are given the problem and they will work in groups of 4 or 5. A group will be asked to present their solutions and the strategy they used to arrive at the solution. Participants will be asked if there are other ways to solve the problem and another group will be asked to present the way they thought of the solution. This will allow participants to deduce the importance of discussion and cooperative learning for students in developing their critical thinking and allowing them to think at a higher level of reasoning.

(20 minutes)

- **Activity 2:** Bean Activity: Give one bowl filled with beans to each group. Ask participants to estimate how many beans are in the bowl. Then they record this result at the bottom of the page. Then they take turns taking handfuls and estimating each how many beans in their hand. They will record the data and then they will be asked to discuss how close their estimates were. This activity will be related to brain compatible instruction and the importance of discourse in mathematics**. (20 minutes)**

- **Break:** Brain teasers **(10 minutes)**

- **Activity 3:** Name that number: participants will play a game in groups of 4-5. They will explore different ways to name the same number. Activities as such can be used in the classroom to develop students' number sense. This will be followed by a discussion on how the brain deals with number sense and why it is important that educators enhance students' number sense. **(15 minutes)**

- **Conclusion:**

Distribute the reading "A Head for Numbers". We read the captions together and relate those to everything done during the session. Participants will be asked to continue the sentence: The most important concept for my classroom that I gained from the workshop today is ….. **(15 minutes)**

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الملخص :

تعتبر الصعوبات التعليمية من المسائل جديدة المتابعة في مجتمعنا لما لوحظ من أهمية لها في سبيل تنمية مهارات الفرد في مختلف النواحي , وقد يقع الكثير من المعلمين في فخ تقييم مستوى التلميذ دون معرفة اسباب هذه المشكلة التي قد تكون إحداها عسرالحساب , لذلك سوف يتاح للمشاركين الإطلاع على معنى dyscalculia وعوارضها وطرق رصدها وبالتالي عرض بعض الخطوات المساعدة في التخفيف من حدتها ,فضلا عن ذلك سيقوم المشاركون بمشاهدة امثلة عن تلامذة مصابين بعسر الحساب للوصول إلى خلاصة تتضمن الحلول المناسبة للتعامل مع هؤلاء التلامذة.

ان الهدف الأساسي من هذه الورشة هو تعريف المشاركين بالصعوبات التعليمية بشكل عام والرياضية بشكل خاص , كما تسلط الضوء على كيفية رصد التلاميذ المصابين بعسر الحساب (dyscalculia) والتمييز بينهم وبين التلامذة العاديين من خلال بعض المؤشرات الواضحة والأخرى غير الواضحة.

اما سير الورشة فعلى الشكل التالي:

عصف ذهني لمعنى الصعوبات التعلمية ثم تكوين تعريف مبدئي لها من مختلف المصادر مع ذكر أنواعها واحصاءات عن مدى شيوعها. يلي ذلك عمل مجموعات من قبل المعلمين في محاولة لوضع مؤشرات تدل على وجود عسر في الحساب في الحلقة الأولى والثانية، وبعد عرض العمل يتم وضع ملخص بالمؤشرات الدقيقة، ثم مناقشة جماعية عن ارتباط عسر الحساب بعسر القراءة للوصول إلى عرض بعض الأخطاء الشائعة الخاصة بالصعوبات التعلمية من خلال طرح الفكرة ثم التصويت على صحتها .يقوم المشاركون بعدها بمحاولة إيجاد الأسباب الرئيسية للإصابة بعسر الحساب من خلال المناقشة الثنائية وعرض الأفكار ثم يقومون بعمل فردي يتضمن استمارة تشخيص اولية للإصابة بالديسكالكوليا. يلي ذلك عرض بعض الإختبارات من تلامذة مصابون بعسر الحساب ومحاولة المشاركين إيجاد المؤشرات التي تدل على ذلك من خلال ملاحظة طريقة حل التلميذ للإختبار للإستنتاج ان هناك فرق بين بعض الأخطاء والمؤشرات الدلالية .

ثم جمع مقترحات عامة تعرض بعد عمل المشاركين بشكل مجموعات من 3 أفراد تشمل طرق مساعدة هذا النوع من التلامذة سواء في الشرح أو طريقة صياغة الإختبار بالتعاون مع المعلم المساند. كما سوف يتم عرض فيديو تعبيري عن الصعوبات التعلمية مع المناقشة والتعليق على الفحوى للوصول إلى الخلاصات كتابياً من قبل كل مشارك .

--- Only abstracts included for the following sessions ---

Make Teaching Math Meaningful With Conceptual Understanding

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Abstract

It has become clear that teaching skills required answering “How should students learn in the 21st century?” on a deep and broad basis. Students with conceptual understanding know more than isolated facts and methods. They understand why a mathematical idea is important and the kinds of contexts in which is it useful. Teacher must maintain student interest by helping them see how what they are learning, prepares them for life in the real world. They must instill curiosity which is fundamental to lifelong learning. Students’ lack of motivation and often disengagement reflects the inability of education systems to connect content to real world experience. There is a profound need to rethink the significance and applicability of what is taught, and to strike a far better balance between the conceptual and the practical. In this session, participants will be introduced to the conceptual understanding in mathematics. Learning activities and teaching strategies that help students understand, apply and enjoy mathematics will be suggested for classroom applications.

الدعم التشاركي

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ملخص الورشة

تهدف هذه الورشة الى اكساب المعلمين القدرة على التخطيط المتعدد المستويات وذلك عبر تدريبهم على تقنية جديدة تعرف بالدعم التشاركي والتي طبقت في مؤسستنا وكان لها دورا بارزا في تحسين نتائج التلاميذ. وهذه العملية تسهم في تبادل الخبرات بين المعلمين حيث تعمل بمبدأ المشاركة بينهم (معلم اساسي مع آخر زميل). في القسم الاول من الجلسة سيتم عرض التعريف بسير العملية والخطوات التي تتبع قبل الدعم، واثناء الدعم، اي التخطيط للدعم التشاركي والذي يتم بعد دراسة نتائج مادة لمحطة تقييمية، وكيفية تقسيم التلاميذ حسب مستوى الصف الى مستويات ثلاث (مستوى اول هو المتقدم عن مستوى الصف، ومستوى ثان الذين هم بمستوى الصف، والمستوى الثالث الذين هم دون مستوى الصف). بعدها تعرض معايير إعداد الانشطة للمستويات الثلاث. اما القسم الثاني فيكون تدريب تطبيقي للمرحلتين. ما يسق الدعم واثناء الدعم حيث يوزع على كل مجموعة نسخة من معايير اعداد الانشطة وعليهم تحديد نشاط يلائم المستوى (تناقش النتيجة وتقدم التغذية الراجعة). والنشاط التطبيقي الثاني هو تنفيذ عملي لعملية دعم تشاركي حيث يشارك بالعملية معلمين، ويكون على اساس اعتبار التلاميذ من صف خامس، والدعم يكون في مادة العلوم ويكون المدرب قد خطط مسبقا لانشطة تلائم المستويات الثلاث للمادة . توزع الانشطة على المجموعات الثلاث، وهنا على المعلمة الاولى ادارة تنفيذ الانشطة مع مجموعتين: الاولى الذين هم بمرحلة متقدمة، والثانية من هم بمستوى الصف، . اما المعلمة الاخري فتكون متمركزة مع المجموعة الثالثة والذين هم دون مستوى الصف، تراقب عملهم لتكتشف كيف يخطئون، فتعمل على تصويب تفكيرهم نحو المسار الصحيح . اما القسم الثالث من الجلسة سيكون فقرة تأملية للمتدربين تهدف الى ذكر الدروس المستفادة واقتراحات التطبيق مع ذكر المعوقات التي قد تواجهنا اثناء تطبيق هذه العملية:

- تصميم الجلسة: مقدّمة وجيزة عن الهدف من الدعم التشاركي (15 دقائق) حيث يتم عرض جدول يلحظ التقنية التي تمّ الاعتماد عليها في تقسيم مستوى الصفّ.
- نشاط اكتشافي لمعايير اعداد انشطة المستويات الثلاث يليه عرض للمعايير المعدة (15 دقيقة).+ سير العملية التي توضح المسار خلال التخطيط للدعم والتفيذ له .
- نشاط تطبيقي لعملية التخطيط حيث توزع على كل مجموعة جدول لنتائج التلاميذ وعليهم تقسيم التلاميذ الى مستويات

ثلاث مع اقتراح نشاط لكل مستوى مراعيا المعايير (20 دقيقة)

- نشاط تطبيقي لعملية التنفيذحيث يتمّ تطبيق نموذج دعم تشاركي. يقسم الصف الى ثلاث مستويات ويتم العمل بالنماذج المحضرة حسب كل مستوى (35 دقيقة)
- نشاط ختامي (25دقيقة): نشاط تاملي ينفذ من قبل المتدربين على التجربة المعاشة ومناقشة للمعقات الدروس المستفادة بالاضافة الى اقتراحات التطبيق.

الموافق: .../......../ ...142هـ

القسم :...الصف/ : ....

اليوم والتاريخ	المعلمة	المعلمة المساندة	الحصة	طلاب الدعم + الدمج التربوي

مخطط التدريب:

النشاط	نوعه\تقنيته	الهدف منه	وصفه	الوقت
الاول	فردي	تعارف	كل متدرب يعرف عن نفسه عبر رمي الطابة	5 دقائق
الثاني	فردي	تحديد التوقعات من الدورة	كل فرد يكتب على ورقة لاصقة توقعاته من الورشة تعلق على لوحة جدارية وتقرأ جماعيا	10 دقائق
الثالث	عرض \ جماعي	التعرف على مفهوم الدعم التشاركي+عبر تلخيص لمدخلات ومخرجات العملية	يتم عرض المفهوم وتقنيته مع التركيز على مدخلات العملية ومساهمتها في انجاح العملية	15 دقائق
الرابع	جماعي	ان يتعرف المتدرب على تقنية تقسيم التلاميذ .	يتم عرض نموذج صف تم تقسيم الصف الى مستويات تكون النماذج مع المتدرب ثلاث مع عرض ثلاث نماذج انشطة معدة بمادة العلوم	10دقيقة
الخامس	ثنائي	التعرف على معايير التمايز في اعداد انشطة تناسب مستويات التلاميذ المختلفة	حيث يطلب من كل ثنائي قراءة المعايير باستخدام استراتيجية الثنائية التبادلية ويطلب من كل ثنائي شرح معيار واحد يحدده المدرب	10 دقائق
السادس	فردي \جماعي	ان يميز بين انشطة التلاميذ كل حسب مستواه	حيث يعرض على التلاميذ نماذج انشطة وعليهم تصنيفها لاي مستوى مع مناقشة وهنا يتم تسليط الضوء على الفرق بين انشطة متعددة المستويات	15 دقيقة .

			وانشطة التعلم المتمايز	
السابع	مجوعات	القدرة على تقسيم تلاميذ الى مستويات ثلاث	حيث يوزع على امتدربين شبكة مع علامات وعليهم تقسيم التلاميذ الى ثلاث مستويات وهنا يتم التطرق الى برنامج الدعم التشاركي وما يتم التنسيق بين المعلمين المساندين لشبكة	15 دقيقة
الثامن	جماعي	التعرف على شكل الخريطة الصفية و شروطها .	يتم عصف ذهني ثم عرض لشكل البيئة وقواعدها	10 دقائق
التاسع	مجموعات \تمثيل ادوار	على كل مجموعة تمثيل نموذج حصة دعم تشاركي لهدف رياضيات	حيث يوزع ثلاث انشطة على كل مجموعة وعليهم لعب ادوار حصة دعم تشار كي	20دقيقة
العاشر	جماعي	مشاهدة حصة دعم تشاركي	عرض فيلم فيديو لحصةدعم تشاركي	5 دقائق
الحادي عشر	جماعي	عرض نماذج لمخرجات الدعم في مواد الرياضيات والعلوم	يتم عرض بعض مخرجات عملية الدعم	5 دقائق
االثاني عشر	تقييمي فردي	التعبير عن نتاجات	يطلب من كل فرد بان يذكر ماذا تعلم؟ ماذا يريد ان يعرف؟ ما هي الصعوبا ت التي قد تواجه	5 دقائق

❖ **نطاق التركيز: للدعم التشاركي**

❖ **مفاتيح التقييم:** 1 = يحتاج إلى تحسين 2 = مقبول 3 = جيد 4 = جيد جداً

الرقم	المحكات	المفتاح	الشواهد
1	تقسيم التلاميذ الى مستوايات متجانسة 3 أو 4		
2	الخريطة الصفية مناسبة لمستويات التلاميذ وتسهل حركة المعلم .		
3	حركة المعلم وصوته /حالة التشويش		
4	وجود انشطة محضرة مسبقا مع ملائمتها لمستويات التلاميذ		
5	مطابقة التخطيط للحصة مع ما دوّن على ملف الدعم.		
6	تدخل المعلم مناسب ويبرز ذلك من خلال توجيه تفكير التلاميذ بالشكل الصحيح.		
7	يستفيد المعلم من اخطاء التلميذ ليقترح نشاط آخر خاص به.		
8	يعتمد المعلم سجل توثيقي يسجل ملاحظاته عن آداء كل تلميذ ليستفيد منه .		

◆ **رأي المشاهد الخاص:**

1. ما هي برأيك عناصر القوة (نقاط إيجابية بارزة)

....

....

2. ما هي النقاط التي تحتاج إلى تطوير:

....

....

3. ملاحظات اضافية:

....

....

اسم المشاهد .... **التوقيع** .... **التاريخ** ....

Put One's Thinking Cap on: Think outside the Box

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Abstract

Nowadays, activities that challenge students to become dynamically involved in thinking are at the core of science instruction in the classroom. ***"****Put One's Thinking Cap on: Think outside the Box*" provides students with a variety of strategies that help them organize information for understanding and remembering, motivate them and help them focus attention to transfer skills and ideas from one situation to another, thus giving them opportunities to be independent learners. In this workshop, participants will be involved in a series of activities that will help enhance their students' reading abilities, thinking skills and decision-making strategies. In addition, participants will experience creative biology activities (Reproduction and Biotechnology) for different levels (middle and secondary). These activities will help students to think out of the box and be creative thinkers.

Introduction

The primary purpose of this session is to increase participants' understanding of how to use different hands-on and minds-on activities to develop students' understanding of how to think freely and imaginatively, using new ideas instead of traditional or expected ones. During the session, participants will take on the role of the learner by actually using a variety of strategies such as graphic organizers that are based on isolated tasks versus thinking maps that are based on fundamental thinking skills. Also, participants will be asked to organize their information by creating their own thinking maps, hands-on and minds-on activities to explore scientific concepts by creating models and concept maps where they relate scientific terms. Moreover, participants will watch a video, using their visual thinking skills to deduce information and organize them. The primary purpose of this session is to increase participants' thinking skills by keeping them involved and engaged in these activities. During the session, participants will be asked to move around and work in groups to discover information for themselves. At the end, they will have the chance to become active, creative thinkers.

The session is planned as follows:

- Brain teasers as ice breakers **(5 minutes)**.
- Brief introduction about the chosen title and pace of the workshop **(5 minutes).**
- Participants will have the chance to get involved in different activities each of which follows a different strategy. These activities are related to one topic for the middle level. Participants will work in four different learning centers, one center at a time, to explore each strategy. **(40 minutes)**
- These activities will be followed by a brief discussion about each strategy. **(20 minutes).**
- Break. **(5 minutes).**

- Participants will perform the same procedure as done before for different biology topics for a higher level (secondary). **(40 minutes)**
- Participants will summarize the main issues that were discussed during the session, discussing the limitations and feasibility of applying and implementing these strategies across different disciplines. **(15 minutes)**

Activity 1
An Inventory of Mating and Fertilization

Purpose:
Students take an inventory of mating and fertilization in ten species. Working in groups of five, they observe that species differ in mating and fertilization. Students record their observations in a table and make a bar graph to show the relation between mating and fertilization and indicate the most common season of mating.

Learning Objectives:
- Infer that mating is not obligatory for all species.
- Identify the two forms of fertilization: internal and external.
- Indicate the importance of mating in internal fertilization.
- Identify the most common season of mating.
- Give examples of species which mate but undergo external fertilization.

Materials:
- Power point of cards describing mating and fertilization in 10 species
- Cardboard
- Circular cardboard cut outs
- Markers
- Long ruler
- Glue
- Worksheet #1

Instructions:
- Divide students into groups of five, and have them successively follow the directions provided in the worksheet.
- Two students read the descriptions of mating and fertilization in ten species.
- Simultaneously, another student fills the information on the provided table.
- Another student constructs the corresponding bar graph.
- The fifth student constructs the same bar graph on a cardboard placing circular cardboards indicating the number of species in each independent variable (X-axis).

Worksheet #1
An Inventory of Mating and Fertilization

Purpose:
Observe that species differ in mating and fertilization.

Directions:

- Divide the tasks among the members of your group/
- Two of you read the descriptions of mating and fertilization in different species, so the other members of your group will be able to follow you.
- Meanwhile, one of you fills the information in the table provided in worksheet #1.
- One of you constructs the corresponding bar graph on a cardboard by circling for each number of species.
- One of you constructs the same bar graph on worksheet #1.

A. Fill in the table below.

Characteristics	**Number of species**
Mating and internal fertilization	
Mating and external fertilization	
No mating and internal fertilization	
No mating and external fertilization	
Mating in spring	
Mating in summer	
Mating in fall	
Mating in winter	

This table represents the inventory of mating and fertilization in10 different species.

B. Construct the corresponding **bar graph**.

Activity 2
An Inventory of Mating and Fertilization
Writing with Thinking Maps

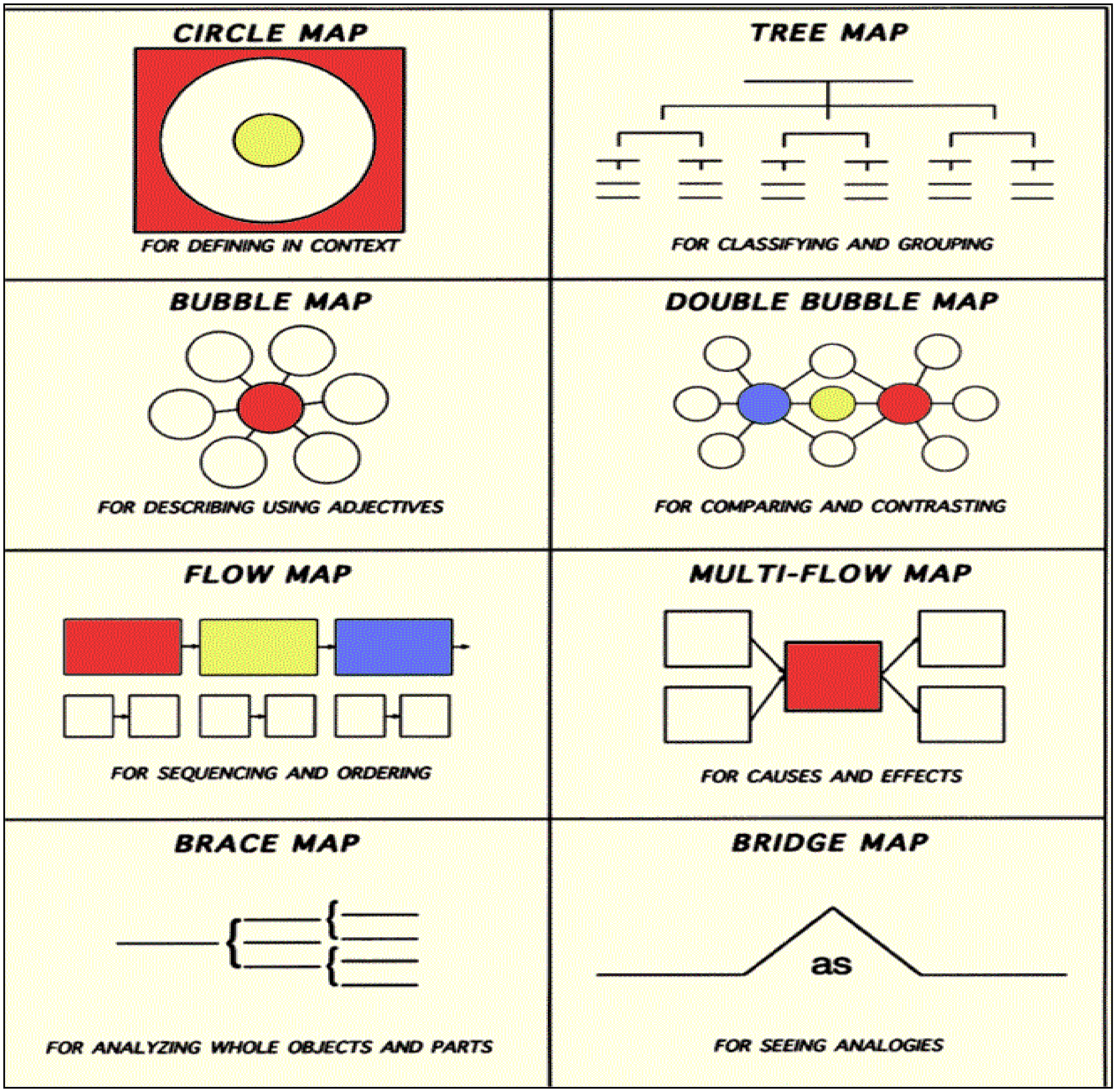
Purpose:
Students take an inventory of mating and fertilization in ten species. Working in groups of five, they observe that species differ in mating and fertilization. Students organize the information into one of the chosen thinking maps to show the relation between mating and fertilization and indicate the most common season of mating.

Learning Objectives:
- Infer that mating is not obligatory for all species.
- Identify the two forms of fertilization: internal and external.
- Indicate the importance of mating in internal fertilization.
- Identify the most common season of mating.
- Give examples of species which mate but undergo external fertilization.

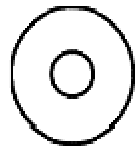
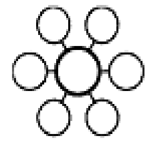
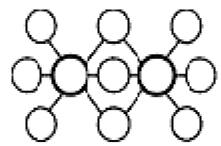
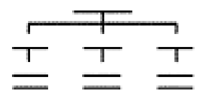
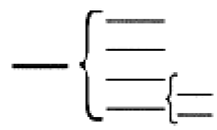
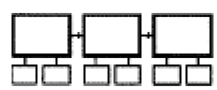
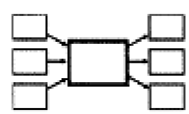
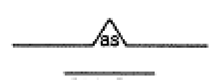
Materials:
- Cards describing mating and fertilization in 10 species
- Cardboard
- Circular cardboard cut outs
- Markers
- Long ruler
- Glue
- sheet #2

Instructions:
- Divide students into groups of five, and have them successively read the descriptions of mating and fertilization in ten species.
- Students chose one of the thinking maps to organize the information.
- Students pick the information according to the chosen concept map.

Sheet 2
An Inventory of Mating and Fertilization
Writing with Thinking Maps



Writing with Thinking Maps

Questions from Texts, Teachers and Tests →	Thinking Processes →	Thinking Maps as Tools	
How are you defining this thing or idea? What is the context? What is your frame of reference?	**DEFINING IN CONTEXT**	Circle Map	
How are you describing this thing? Which adjectives would best describe this thing?	**DESCRIBING QUALITIES**	Bubble Map	
What are the similar and different qualities of these things? Which qualities do you value most? Why?	**COMPARING AND CONTRASTING**	Double Bubble Map	
What are the main ideas, supporting ideas and details in this information?	**CLASSIFYING**	Tree Map	
What are the component parts and subparts of this whole physical object?	**PART-WHOLE**	Brace Map	
What happened? What is the sequence of events? What are the substages?	**SEQUENCING**	Flow Map	
What are the causes and effects of this event? What might happen next?	**CAUSE AND EFFECT**	Multi-Flow Map	
What is the analogy being used? What is the guiding metaphor?	**SEEING ANALOGIES**	Bridge Map	

Activity 3
Fertilization Model

Purpose:
Prepare a 3D cut-and-attach model depicting the chronological order of a fertilization model.

Learning Objectives:

- Translate the intangible order of fertilization into a tangible one.
- Identify the different steps of fertilization in chronological order.
- Identify the aspect of each of the spermatozoa and the ova during each step.
- Indicate that the fertilized ovum which is the zygote capable of giving a new sea urchin.

Materials:

- Cut-outs of ova, spermatozoa, plus signs, arrows, fertilized ovum, sea urchins.
- Sticks
- Stand
- Markers
- Worksheet #3

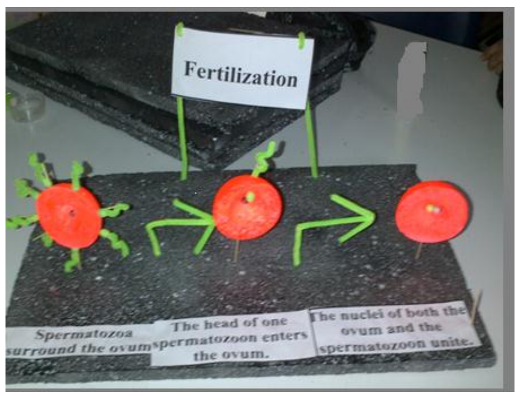
Instructions:
Have students follow the directions in worksheet #3 to prepare the model.

Worksheet #3 - Fertilization Model

Purpose:
Prepare a 3D cut-and-attach model depicting the chronological order of a fertilization model.

Directions:

- While four of you work on the model, one of you should answer the questions.
- Gather all the cut-outs.
- Attach several ova and spermatozoa at the left end of the stand. Label them with a marker.
- Then, attach an arrow next to them.
- Attach ova surrounded by spermatozoa. Label them.
- Attach another arrow.
- Attach fertilized ova, and label them.
- Attach another arrow.
- Finally, attach mature sea urchins. Label them.
- Your model should look like this:



<u>Answer the question below.</u>

List in chronological order the steps of fertilization.

Activity 4
An Inventory of Reproduction

Purpose:
Construct a concept map relating all the parts of the reproductive systems together.

Learning Objectives:

- Translate the intangible order of fertilization into a tangible one.
- Identify the different steps of reproduction in chronological order.

Materials:

- Cardboard
- Glue
- A pair of scissors
- Markers
- Worksheet #3

Instructions:
Have students follow the directions in worksheet #3 to prepare the concept map.

Worksheet #4
Concept Map about Reproduction

Purpose
Construct a concept map

Directions

- Cut the terms below.
- Use the terms to construct a concept map which describes the reproductive organs in animals.
- Link the words with arrows.
- Use linking words/action verbs on the arrows.

Reproductive Organs	**Testicles**	**Ovaries**
Male Reproductive Organs	Mobile	Spermatozoa
Immobile	Ova	Small
Big	Head & Tail	Numerous in Number
Few in Number	Nutritive Reserves	Female Reproductive Organs

Activity 5
Explore the Frog's Insides

Purpose:
This lab activity is to help students learn the anatomy of a frog and give them a better idea of the reproductive organs.

Learning Objectives:

- Identify the locations involved in the dissection procedures.
- Identify the locations of the major organs within the body cavity of a frog, given a list of these organs.

Materials:

- Worksheet #4
- Animation of dissection
- http://frog.edschool.virginia.edu/Frog2/
- http://www.biologycorner.com/worksheets/frog_alternative.html
- LCD projector
- Preserved frog
- Dissection Pan
- Gloves
- Lab Coat
- Dissection kit
    - Scalpel
    - Forceps
    - Scissors
    - Dissecting Pins

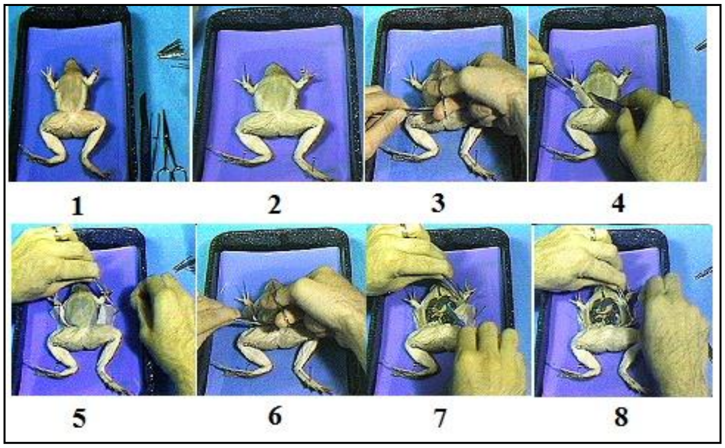
Instructions:

- Play the animation of dissection to allow those who can't watch live dissection watch it in the animation.
- Place the frog in pan.
- Pin the frog.
- Begin the first skin incision.
- Separate skin and muscles.
- Pin skin flaps.
- Begin the first muscle incision.
- Separate muscles and organs.
- Pin the muscle flaps.
- Have students observe the different layers of organs.

Worksheet # 5
Explore the Frog's Insides

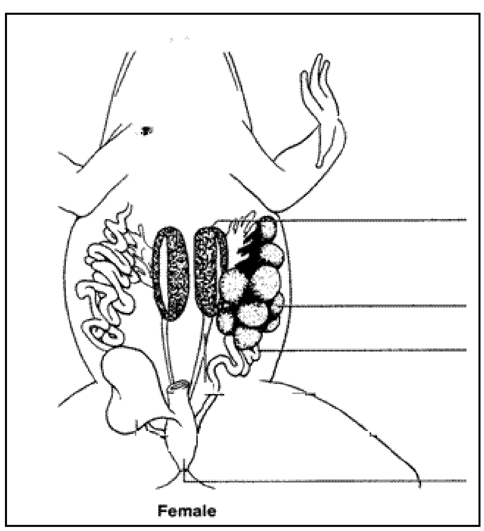
Purpose:
This lab activity is to help students learn the anatomy of a frog and give them a better idea of the reproductive organs.

Procedure



- Place the frog in pan.
- Pin the frog.
- Begin the first skin incision.
- Separate skin and muscles.
- Pin skin flaps.
- Begin the first muscle incision.
- Separate muscles and organs.
- Pin the muscles

Directions:
Observe the different organs and label the document below.



Activity 1
Production of Insulin by Gene Splicing

Purpose:
Gene-splicing is a process in which scientists can take the genes from one organism and attach them to the genes in another organism. Working in groups of four, students will make a model of gene splicing of insulin.

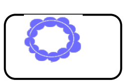
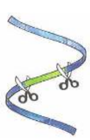
Learning Objectives:

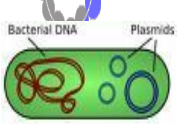
- Define gene splicing, restriction enzyme, ligase and plasmid.
- Identify the steps of production of insulin by gene splicing technique.

Materials:

- Pipe cleaner (3 different colors)
- Cardboard (A4)
- Scissors
- Pencil
- Glue gun
- Worksheet #1

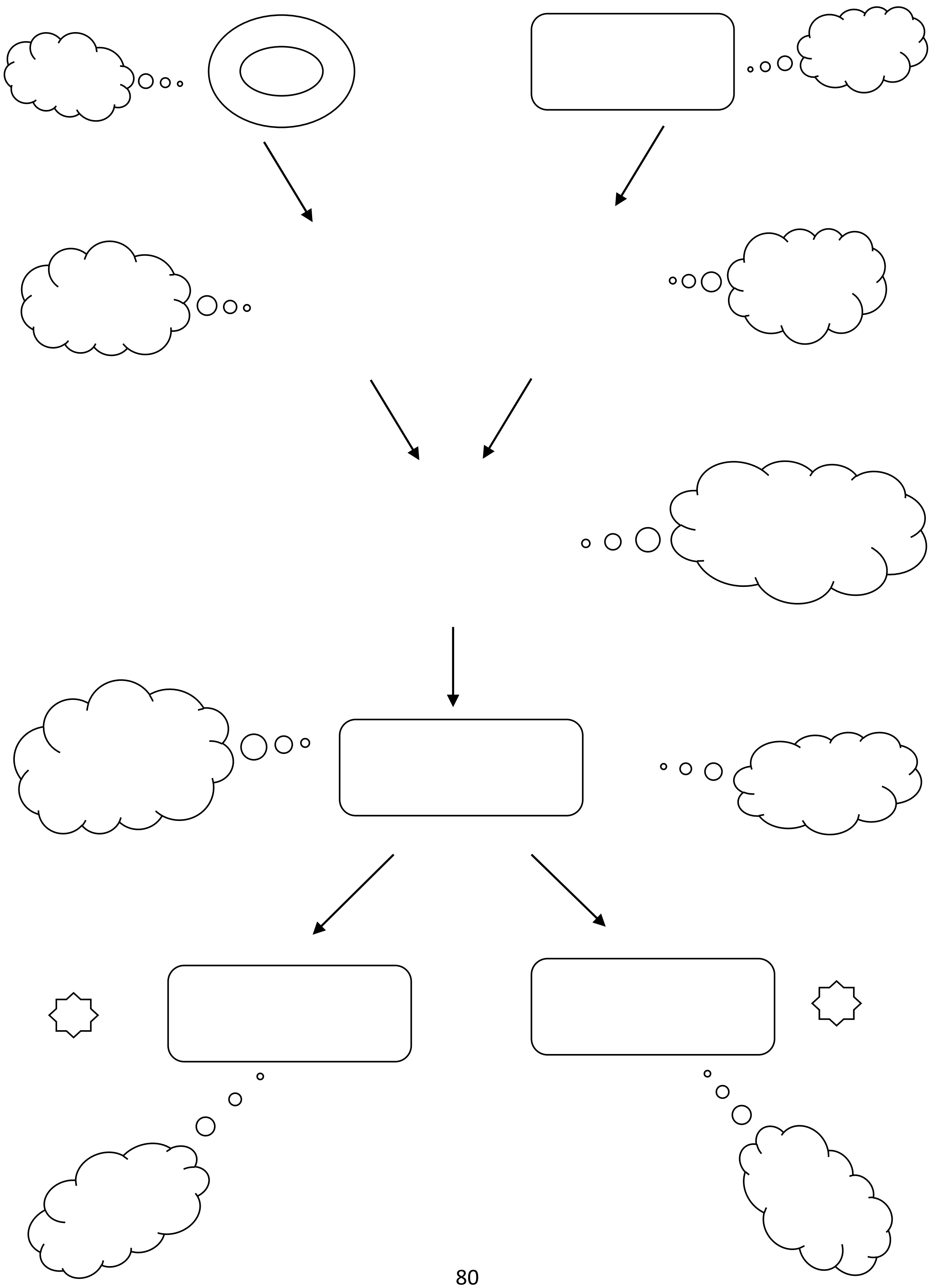
Instructions:

- Glue a red piece of pipe cleaner that represents chromosome carrying insulin gene on the circle (that represents human cell).
- Glue on a bacterium cell a blue circular piece of pipe cleaner that represents bacterium's plasmid.
- Using a pair of scissors that represents restriction enzyme, cut the insulin gene from the pancreatic chromosome.
- Using a pair of scissors open the bacterium's plasmid.
- Glue the insulin gene to the open plasmid, using a glue gun (that represents ligase).
- Glue a piece of yellow pipe cleaner on an oval shape that represents a new bacterium.
- Introduce the plasmid containing insulin gene into new bacterium. This bacterium begins producing insulin.
- This genetically engineered bacterium starts to duplicate making more insulin

Worksheet #1
Insulin Gene Splicing Diagram



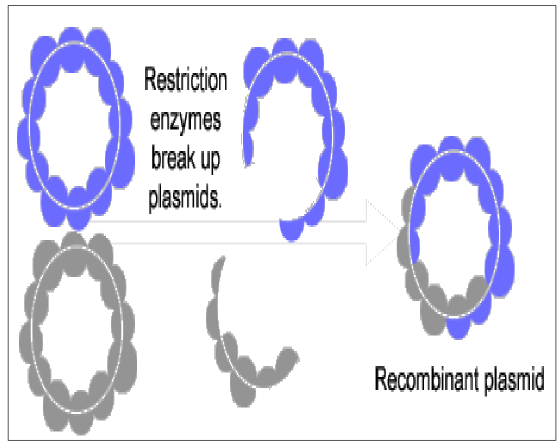
Production of Insulin by Gene Splicing

Background

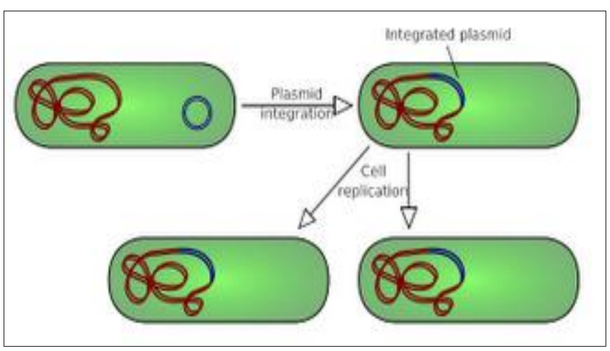
Gene-splicing is a process in which scientists can take the genes from one organism and attach them to the genes in another organism.

How **do** they get the gene out of the DNA?

Special "molecular scissors" called **restriction enzymes** are used to cut the desired gene out of the DNA in which it is found. The restriction enzyme is also used to cut open the bacterial DNA. Then, another enzyme is used to "glue" the desired gene into the bacterial DNA. This useful enzyme is called **DNA ligase**.



Plasmid is inserted into another bacterium. By replicating, the plasmids also copy the insulin genes. The bacteria then manufacture the human insulin protein molecules that can then be gathered and purified for use by millions of people suffering from diabetes.

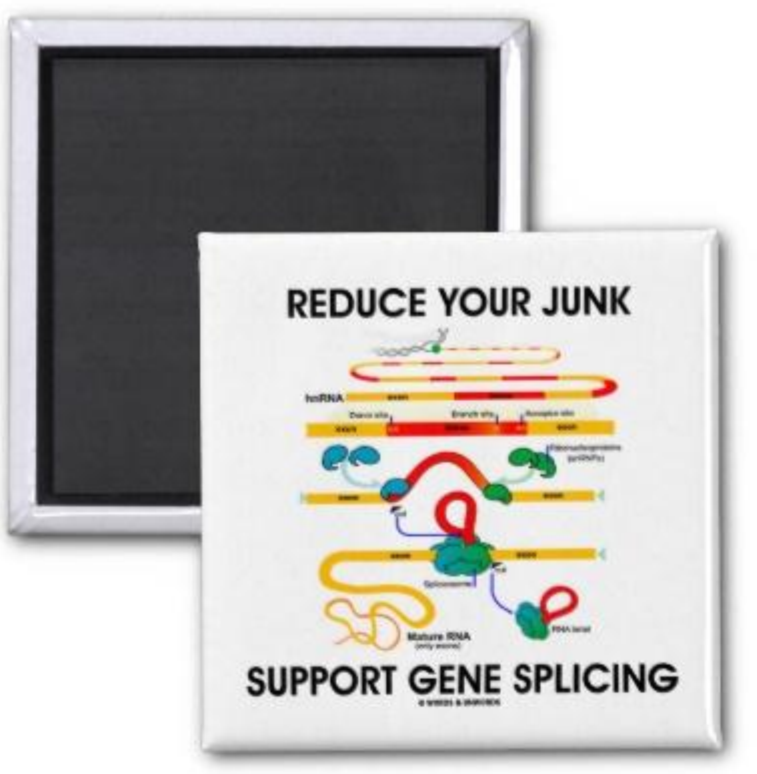


Activity 2
An Inventory of producing Insulin by Gene Splicing

Purpose:
This lab activity is to help students learn the process of gene splicing.

Directions:

1. Visit the website:
   http://www.mhhe.com/biosci/genbio/virtual_labs_2K8/labs/BL_08/index.html
2. Choose a genetic trait to splice into the DNA of the host organism.
3. Choose a host organism.
4. Follow the instructions listed on the virtual lab.
5. Answer the questions in worksheet #2.



Worksheet #2

Answer the following questions:

- What does the term "sticky ends" refer to in gene splicing?

____

____

____

- What is a plasmid? How is a plasmid used in gene splicing?

____

____

____

- What types of vectors are used to carry DNA from one species into the DNA of another species? Give examples.

____

____

____

- What is a "transgenic organism"? Give examples.

____

____

____

- Why is it essential that the same restriction enzyme be used to cleave (cut) the DNA of both organisms used to create a transgenic organism?

____

____

____

Activity 3
An Inventory of producing Insulin by Gene Splicing
Writing with Thinking Maps

Purpose:
Students take an inventory of producing insulin by gene splicing. Working in groups of five, students organize the information into one of the chosen thinking maps to show the procedure of gene splicing.

Learning Objectives:

- Identify the steps of production of insulin by gene splicing technique.

Materials:

- Power point
- Cardboard (A4)
- Scissors
- Markers
- Long ruler
- Glue
- worksheet #3

Instructions:
- Divide students into groups of five, and have them successively read the power point presentation about gene splicing.
- Students chose one of the thinking maps to organize the information.
- Students pick the information according to the chosen concept map.

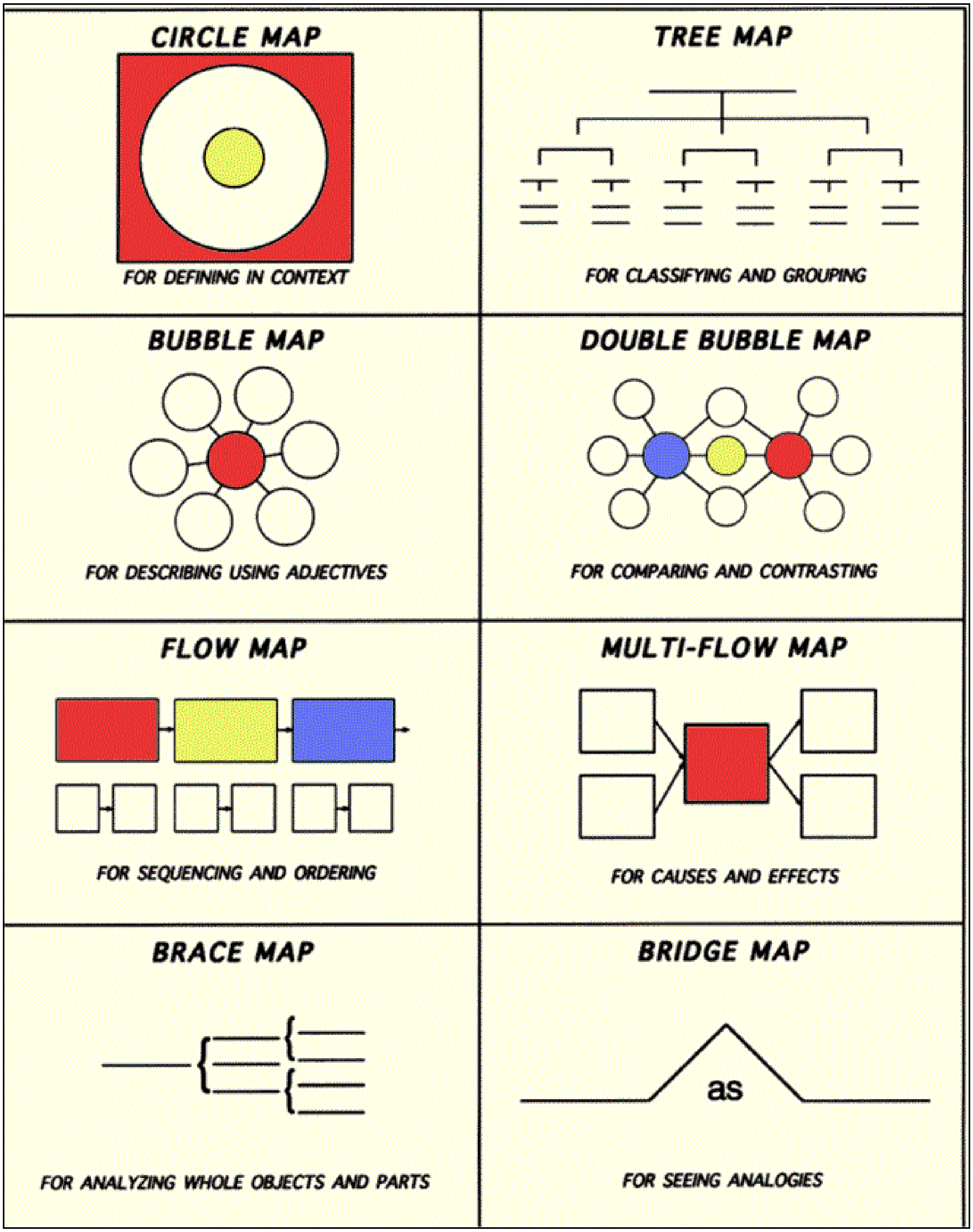
Worksheet #3
An Inventory of producing Insulin by Gene Splicing
Writing with Thinking Maps

Purpose
Construct a concept map

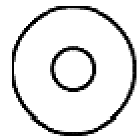
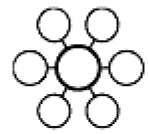
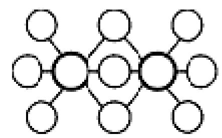
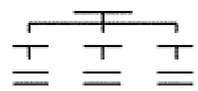
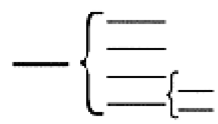
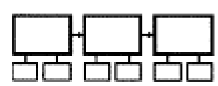
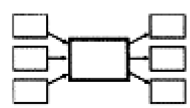
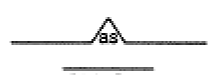
Directions
- Cut the terms below.
- Use the terms to construct a concept map which describes the process of producing insulin by gene splicing.
- Link the words with arrows. Use linking words/action verbs on the arrows

Ligase	Bacteria	Genetic Engineering
Glue	DNA	Splice
Foreign gene	Cut	Multiply
Restriction Enzyme	Sticky ends	Plasmid
Enzyme	Clones	

Writing with Thinking Maps



Writing with Thinking Maps

Questions from Texts, Teachers and Tests →	Thinking Processes →	Thinking Maps as Tools	
How are you defining this thing or idea? What is the context? What is your frame of reference?	**DEFINING IN CONTEXT**	Circle Map	
How are you describing this thing? Which adjectives would best describe this thing?	**DESCRIBING QUALITIES**	Bubble Map	
What are the similar and different qualities of these things? Which qualities do you value most? Why?	**COMPARING AND CONTRASTING**	Double Bubble Map	
What are the main ideas, supporting ideas and details in this information?	**CLASSIFYING**	Tree Map	
What are the component parts and subparts of this whole physical object?	**PART-WHOLE**	Brace Map	
What happened? What is the sequence of events? What are the substages?	**SEQUENCING**	Flow Map	
What are the causes and effects of this event? What might happen next?	**CAUSE AND EFFECT**	Multi-Flow Map	
What is the analogy being used? What is the guiding metaphor?	**SEEING ANALOGIES**	Bridge Map	

Activity 4
An Inventory of producing Insulin by Gene Splicing
Writing a story

Purpose:
Students take an inventory of producing insulin by gene splicing. Working in groups of five, students organize the information into the form of writing a story.

Learning Objectives:

- Identify the steps of production of insulin by gene splicing technique.

Materials:

- Power point
- Cardboard (A4)
- worksheet #4

Instructions:
- Divide students into groups of five, and have them successively read the power point presentation about gene splicing.
- Students use the given terms to create their own story about gene splicing.

Worksheet #4
An Inventory of producing Insulin by Gene Splicing
Writing a Story

Purpose
Create a story.

Directions
Use the given terms to create your own story which describes the process of producing insulin by gene splicing.

Ligase	**Bacteria**	**Genetic Engineering**
Glue	**DNA**	**Splice**
Foreign gene	**Cut**	**Multiply**
Restriction Enzyme	**Sticky ends**	**Plasmid**
Enzyme	**Clones**	

Activity 5
Restriction Enzyme Paper Lab

Purpose:
DNA splicing, the cutting and linking of DNA molecules, is one of the basic tools of modern biotechnology. The basic concept behind DNA splicing is to remove a functional DNA fragment from one organism and to combine it with the DNA of another organism in order to study how the gene works. The desired result of gene splicing is for the recipient organism to carry out the genetic instructions provided by its newly acquired gene.
The first part of this type of experiment involves the cutting of a DNA strand using enzymes called restriction enzymes. These enzymes each cut at a specific sequence present in the DNA strand. Working in groups of five, students will work out a restriction enzyme paper lab to understand how do restriction enzymes work..

Learning Objectives:
- Define restriction enzymes.
- Identify the meaning of sticky ends.
- Indicate the role of restriction enzymes.
- Explain how restriction enzymes perform gene splicing.

Materials:
- Pencil
- Scissors
- Glue
- Worksheet #5

Worksheet #5
Restriction Enzyme Paper Lab

The following restriction enzyme, EcoR1, has a recognition sequence in bacterial DNA of **GAATTC, both forward and backward, depending on the strand**.
The enzyme cuts this sequence between the **G** and **A** : **G AATTC**
↑

The other strand will have the same sequence, going in the **opposite** direction, and is called a pallindromic sequence, **CTTAA   G**
↑

Other examples of palindromes in the English language could include:
Direction of one sequence ⟶ EYE, MADAM, MOM, DAD
EYE, MADAM, MOM, DAD ⟶

1. Given the following sequence of DNA, identify with an arrow the places where the EcoR1restriction enzyme will cut.

5' T T G C C G A A C C G A A T T C T T G G T A G G A T C G A A T T C C C A A G A 3'
3' A AC G G C T T G G C T T A A G A A C C A T C C T A G C T T A A G G G T T C T 5'

2. Locate the first arrow in the 5'–3' direction. Extend the point of the arrow in the horizontal direction moving between the complementary bases until you reach the point of the arrow found in the complementary 3'–5' strand. Using scissors cut the zigzag line. Repeat this procedure for the next cut site found in the 5'–3' strand. You should now have three pieces of DNA. All pieces will have what is known as **"sticky ends."**

3. The fragment in the middle with ***two*** sticky ends would most probably be chopped up by other restriction enzymes. The other two fragments each have one sticky end, and this would allow the sticky end from the 5'–3' direction to complementarily base pair with the sticky end from the 3'–5' direction. Bacteria have hundreds of enzymes recognizing different sequences, which in turn would continue to cut the viral DNA fragments into smaller and smaller pieces.

4. Using tape, ***glue*** the sticky end from each of the other two fragments. The ***glue*** that seals the sticky ends together are another enzyme called ligase. Do you see that the same restriction enzyme, EcoR1, can re-enter and make further cuts?

Using Macro, Sub-Micro, and Symbolic Approach to Design Figures and Activities for Chemistry Teaching

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Abstract

Chemical representations can be categorized in three equivalent types: (1) macro representations that describe the bulk observable properties of matter; (2) sub-micro representations that provide explanations at the particulate level; (3) symbolic representations that involve the use of chemical symbols that represents matter. The simple presence of such representations in figures does not ensure that they sufficiently support students' understanding. Moreover, when they do not fulfill certain requirements, they may cause misconceptions. This workshop focuses on the requirements that chemical representations should fulfill in textbooks in order to enhance conceptual understanding. Moreover, this workshop will engage chemistry teachers in designing figures and activities that may help students understand the macro, sub-micro, and symbolic level of chemistry.

Chemical representations can be categorized in three equivalent types: (1) macro representations that describe the bulk observable properties of matter, for example, heat energy, pH and color changes, and the formation of gases and precipitates; (2) sub-micro representations that provide explanations at the particulate level in which matter is described as being composed of atoms, molecules and ions; (3) symbolic representations that involve the use of chemical symbols, formulas and equations, as well as molecular structure drawings and models that symbolize matter. Consequently, a full understanding of a chemical phenomenon involves the ability to move efficiently between its three types of representations. Nevertheless, the simple presence of such representations in figures does not ensure that they sufficiently support students' understanding. Moreover, when they do not fulfill certain requirements, they may cause misconceptions. Therefore, this workshop focuses on the requirements that chemical representations should fulfill in textbooks in order to enhance conceptual understanding. Moreover, this workshop will engage chemistry teachers in designing figures and activities that may help students understand the macro, sub-micro, and symbolic level of chemistry.

The session is planned as follows:

- Participants will be asked to plan a 60 minutes period. The objectives of the period are to explain types of chemical reactions and balancing chemical equations (20 minutes).
- Participants will present their work; any suggestions for the use of figures while targeting the above objectives will be highlighted and discussed. Teachers' ideas about the role and importance of figures in teaching chemistry (the use of figures in explanations, exams, projects, etc.) will be resembled through sharing experiences and discussions (25 minutes).

- The results of the study conducted by the presenter will be shared and the importance and requirements for designing diagrams that can help in teaching chemistry will be discussed in light of the Macro, Sub-Micro, and Symbolic Approach (20 minutes).

- The presenter will share with the participants a set of demonstrations, projects, exams, and presentations that enhance the learning of chemistry from the three levels approach (30 minutes).

- Participants will review their written plans, design new plans that may include similar activities and demonstrations, and share their work with other participants (25 minutes).

--- Only abstracts included for the following sessions ---

"Best Practices" of Science Teaching

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Best practices are commonly promoted on the basis of ideology. Even though there may be anecdotal evidences to support the use of best practices, they are often closely associated to student's success. The empirical evidence is also substantial for the following "authentic" best practices as selected among a list of plenty: identifying student perception, organizing knowledge around core concepts, supporting metacognition, allowing cooperative learning, employing Socratic Dialogue, using constructivist approach, applying the learning cycle, involving high order of thinking skills, implementing active learning strategies, making use of multiple intelligence, engaging in interdisciplinary tasks, and incorporating technology. As a start, participants will contribute with their experiences to make up a list of what they think is their "Best Practice" of effective science teaching. After the workshop material is presented, participants will engage in groups and choose any new teaching practice that they have never used before. They apply their choice to a science objective and discuss it with the group members.

Designing and Evaluating Science Investigations

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Science Experimentation and investigation aim at creating opportunities for students to engage in a problem solving situation, to test a hypothesis or to answer a question. Yet, Science investigations no longer serve the purpose they are designed for, since students are usually provided with a detailed description of the experimental protocol needed to run an investigation; a fact that turns this inquiry-based learning experience into a standard lesson. This workshop presents the guidelines that should be followed to design and evaluate an inquiry-based investigation . We should focus on learning rather than teaching and therefore, we should not tell our students what to do; but we should give them simple rules that will guide them to design their investigation(formulate a focused problem, design the experimental protocol, identify the variables and develop a method that allows for the collection of sufficient relevant data). Session participants will be given a research question that they need to investigate. They shall design a detailed investigation, collect and process raw data, and finally conclude and evaluate. Participants will then be asked to evaluate each other's investigations based on the following criteria: the experimental design, data collection and processing, conclusion and evaluation, as well as the manipulative and personal skills of the different groups.

Uncovering and Correcting students' Science Misconceptions.

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Science misconceptions are a common misbelieve, where a semi-truth or falsehood is perpetuated as scientific fact. Misconceptions can be referred to as a preconceived notion or a conceptual misunderstanding. Students who hold misconceptions do not even know that their ideas are false or incorrect. When they are told they are wrong, they often have a hard time giving up their misconceptions, especially if they have had a misconception for a long time. During this session, participants will learn how to uncover these misconceptions and how to correct them destroying the barriers that challenge them. The science topics that will be involved are neurology, heredity, and immunology in life science, and electrochemistry and conversion of energy in physical science for middle and high school. Participants will have the opportunity to share their experiences regarding students misconceptions exhibited in their classrooms and ways of addressing them.

Implementing "STEM" in the Science Class

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STEM is an acronym that stands for Science, Technology, Engineering, and Math. It is a new trend in science education where the four disciplines are integrated together to take learning to a higher level and make it more authentic by relating it to real life situations. Through STEM, students have to design, build, collect data, calculate, measure, set budgets, and present projects that are directly linked to reality. Through this approach, students will learn how to use various types of technology, soft

ware and hardware, for data collection, analysis, and presentation. STEM has been integrated as a part of the science curriculum across the many divisions in many schools worldwide.

Using "Think Bags" to Develop Inquiry Models in Science

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Inquiry- oriented instruction in science engages students in the method of investigation in science. "Inquiry is the [set] of behaviors involved in the struggle of human beings for reasonable explanations of phenomena about which they are curious." Novak (1964). Although inquiry involves skills and activities, the purpose of using it is to search for knowledge, to question and to satisfy curiosity. Science is sometimes perceived as a class in which students memorize facts, perform a few experiments and pass required assessments. Many students dread science classes. Science should stimulate students to think critically by observing, questioning, reasoning, and challenging, inquiring and innovating. Science should be the most dynamic class in a student's education. Today's student is technology savvy which leads to the misperception that all information from the internet is accurate and there is little new to discover. All countries face the challenge of how to motivate students to seek knowledge and to seek careers in science and math to solve world problems. This presentation seeks to inspire teachers to use student's curiosity to generate interest in science learning.

An article from the Journal of Science Teacher Education February, 2002: Reforming Science Teaching: What Research Says about Inquiry points out that: "Inquiry has a decades-long and persistent history as the central word used to characterize good science teaching and learning." Inquiry- related teaching is effective in fostering scientific literacy and understanding of science processes (Lindberg.1990); vocabulary knowledge and conceptual understanding (Lloyd & Contreras, 1987); critical thinking (Narode et al, 1997); positive attitudes toward science (Kyle et. Al 1995); and higher achievement on tests of procedural knowledge (Glasson 1999). Inquiry- oriented teaching is especially valuable for students speaking multiple languages. Rosebery et al. 2002, found that inquiry- oriented science teaching was shown to promote development of classification skills and oral communication skills. among bilingual third graders. Inquiry based activities allow students to explore and use their "language of thought" to interpret what they see and then communicate it in another language. Inquiry facilitates dual coding (Miller, 2003). Inquiry based teaching does not preclude the use of textbooks and other reference materials. However, it seeks to stimulate students to discover, think, question, wonder and understand and perceive science as more than a reading activity.

In order for teachers to effectively use inquiry in teaching science, they need effective, easy to use methods to demystify its inclusion in the classroom. Through having teachers assume the role of "learner" by participating in hands-on activities and by creating their own models, they can move from listeners at a conference to innovators in their classroom. By having teachers participate in creating a model of inquiry and then developing their own model, they will be able to have an activity which they understand, remember and can take back to the classroom and immediately use to enhance student engagement. Too often teachers attend meetings and are unable to fully utilize the information gained because they are unsure about how to recreate it once they return to their classroom. By having teachers participate, discuss and create their own models for introducing inquiry, they can have the confidence to return to the classroom and try new methods of stimulating students to gain curiosity and knowledge about science and perhaps see science as a new career path.

Choice Boards: A Versatile Method for Differentiated Teaching

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Abstract:

The purpose of the workshop was to present some hands on experience of using ideas and strategies of differentiation that can be incorporated in the science lesson. Workshop addressed an holistic approach to differentiation for the participants (Based on Brian –Based Learning). Participants were given the theoretical aspect of the need for differentiation as well as a practice session where they would plan the strategies for their lessons. Main aspects that were dealt were as follows

- What is differentiation?
- Misconception about Differentiated Instructions
- Prerequisite of Differentiated Instructions
- Differentiated assessments
- Strategies of differentiation

As the participant walked in they had a survey to fill about their knowledge of the differentiated strategies. When all the participants had arrived we started the workshop with a gallery walk for the cartoon posters that were pasted around the room. Teachers had to move around the room write a comment on the cartoons. This was accompanied by a video song on differentiation. Debriefing was done for the activity. Later there was introduction to the Brain Based learning through the video and linking it to the differentiation. Then the participants were grouped using the Jigsaw strategy and each group were planned a strategy which was shared with the audience. The workshop ended with a question/answer session and written feedback from the participants.

Introduction:

Differentiated instruction is an approach that enables teachers to plan strategically to meet the needs of every student. It is rooted in the belief that there is variability among any group of learners and that teachers should adjust instruction accordingly (Tomlinson, 1999, 2001, 2003). It is the teacher's response to the diverse learning needs of his or her students.

Differentiated instruction has been a buzzword in k-12 education for the past two decades but has only recently gained ground in adult basic education. The cornerstone of differentiation is active planning: the teacher plans instruction strategically to meet learners where they are and to offer multiple avenues through which they can access, understand, and apply learning. In differentiating lessons to be responsive to the needs of each learner, teachers must take into account not only what they are teaching (content), but also whom they are teaching (individual students). They need to know the varying readiness levels, interests, and learning profiles of each of their students and then design learning options to tap into these three factors.

- *Readiness*

  Readiness refers to a student's knowledge, understanding, and skill related to a particular sequence of learning. Readiness can vary widely over time, and according to topic and circumstance. As Tomlinson (2003) points out, if readiness levels in a class vary, so must the complexity of work provided. Tiered activities are one way to address readiness effectively. Readiness also can be addressed through small group sessions or the provision of one-to-one teacher and peer support or coaching

- *Interest*

  Interest arises from topics that evoke curiosity and passion in students and in which they want to invest time and energy to learn about. When a student's interests are tapped, that student is more likely to be engaged and to persist in learning (Csikszentmihalyi, 1990; Maslow, 1962; Sousa, 2001; Wolfe, 2001).

- *Learning Profile*

  Learning profile refers to how a student learns best. Preferences for learning are shaped by learning style, intelligence preference, culture, and gender.

Evidence indicates that students are more successful in school and are more engaged if they are taught in ways that are responsive to their readiness levels (Vygotsky, 1986), their interests (Csikszentmihalyi, 1990), and their learning profiles (Sternberg et al., 1998). According to Tomlinson (2001, 2003), in adopting differentiated instruction, teachers try to address these three characteristics for each student.

Strategy: The strategies to which the participants were introduced were as follows

Gallery walk:

In a Gallery Walk, students explore multiple texts or images that are placed around the room. Teachers often use this strategy as a way to have students share their work with peers, examine multiple historical documents, or respond to a collection of quotations. Because this strategy requires students to physically move around the room, it can be especially engaging to kinesthetic learners.

Choice Activities

Choice can be a great motivator for students to participate. Students can be given options based on learning style or interest. They may also be given *content* choices as to what will be learned (ideas, concepts, facts, rules, principles) or how what they will learn will be enriched (depth, complexity, novelty, or acceleration).

The **processes** for how content will be learned may include the learning activities, questions, thinking skills, and methods such as problem-based learning, Socratic Method, simulations, independent study, centers, videos, texts, expert mentors, or small groups.

The outcome of learning can provide opportunities for *products* that show the content or skill that has been learned. Options for showing learning in a preferred learning style or talent area or with a partner/group may improve motivation for many students. Following were the strategies that were used to show the participants how they can introduce choices in content, process and products.

Cubing:

Cubing is an engaging teaching strategy that encourages critical thinking and in-depth exploration of a topic. It can be used either as a writing strategy for brainstorming and generating ideas, or as a way to promote deeper understanding of the main ideas of a story or a topic in the content areas. Students use a six-sided cube as a visual aid to provide writing prompts and create a three-dimensional interpretation that addresses many different aspects of a topic. Cubing can be done as a group or individual project.

Think tac toe:

Think-Tac-Toe plays off the familiar childhood game. It is a simple way to give students alternative ways of exploring and expressing key ideas and using key skills. Typically, the Think-Tac-Toe grid has nine cells in it like a Tic-Tac-Toe game. The number of rows and cells can, of course, be adjusted. As with related strategies, it is important that no matter which choices students make, they must grapple with the key ideas and use the keys skills central to the topic or area of study. In other words, whichever choices the student makes, he/she should be addressing the same KUDs as the others

Dinner menu:

A type of learning that provides a “menu” of activities-some that all students must do, and some that allow students choices. A learning menu ensures that each learner focuses on knowledge, understanding and skills designated as essential. Choice Board Menus are

- List of assignments, activities, or projects students will work on during a set amount of time (i.e, one class period ,one week)which they can complete the work.
- Used to differentiate for learning styles, interest and readiness. A choice that students use to meet goals
  The teacher directs the menu process, but the student is given control over his/her choice of options, order of completion, etc.

Learning Contract:

A contract is an agreement made between the teacher and the student in which the student agrees to accomplish certain assignments. This is a way to match student readiness with the skills and content being taught. It also means that students must be able to plan and organize themselves in order to complete work that may be interdisciplinary, problem-based, or require research. This strategy is often used to extend learning at a higher level or to integrate thinking skills into assignments for those students whose work may be being compacted (see compacting). An Extension Menu can also be used as a contract. You may ask various students to complete a set number of extension boxes in a day or in a week, depending on their pace and/or ability. Most importantly, vary the length of the contract so that it matches a student’s readiness to handle such responsibility.

Flexible Grouping:

The key to grouping in a differentiated classroom is flexibility. Groups will vary with topic (based on reassessment), interest, learning style, readiness, ability, etc. In order for small groups to function there must be adequate preparation for students in role responsibilities and opportunities for reflecting on the success of a group’s efforts through established criteria. Groups can vary from pairs, triads, groups of four, or even larger groups for instructional purposes. By assigning different roles within groups students will also learn how to work independently and with responsibility towards a group of their peers

Description of session:
Activities performed during the session were as mentioned below in the order in which it was performed. *KWL Survey* was the starter activity, as the participants were still joining the session. This was followed by *gallery walk* of the cartoons based on the needs of differentiation where the participants commented on it; later it was shared within the groups. Participants actively commented and participated in the discussion which added valuable information on the topic of differentiation.

Later *video on brain based learning* was shared with them to know the scientific reasons why as teachers we should differentiate our instructions. Shared the information on the misconception on what is thought about differentiation and what is it actual. This was done by discussion within the group.
Jigsaw: With the use of Jigsaw strategy the groups were divided into five groups and each where they took a strategy each and planned and discussed the same. They returned to their home group and shared the strategies within the group. After that each group choose a strategy and shared with the whole group. Here interesting discussion took place where teachers were removing their doubts of how to use the strategies. The objectives that were covered were reviewed to ensure that everything was addressed during the session. Feedback was then collected from the participants who were asked to connect with the presenter through email if any questions were still unanswered. Participants were also provided with the CD of the workshop PowerPoint and handouts with all resources.

Conclusion:
The session that was conducted was a fruitful as the participants were all teachers in different subjects. Differentiation is a vast subject and not possible to learn all at once. There should be a week-long training for the same and teachers should begin with a small step. In order to successfully differentiate classrooms teachers must first:

- recognize the need to differentiate
- build a community of learners that respects individual differences and needs
- become proficient at identifying and understanding the needs of varied learners
- identify key concepts, skills, and principles to be learned
- become proficient at implementing differentiation strategies
- learn how to manage a differentiated classroom

Teachers will know that they are differentiating when they are providing more small group activities and these groups are flexible from activity to activity based on a variety of pre-assessment strategies. There will also be an increase in individual alternatives such as centers, contracts, independent study, and even homework assignments.

Teachers will know that they have been successful at differentiating when: they begin to see themself as an organizer of learning opportunities rather than the “sage on the stage”; their assessment and instruction become inseparable; they have created a community of learners who respect the individual differences within their classroom and can work independently according to the working conditions developed for their r classroom; and finally, all their students, whether they are below, at, or above grade level, are feeling challenged and motivated to reach their maximum potential by learning new, meaningful, and essential concepts, principles, and skills.

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Web Resources on Differentiating Instruction:

Differentiating Instruction for Advanced Learners in the Mixed-Ability Middle School Classroom
http://ericec.org/digests/e536.html

Leadership for Differentiated Classrooms: The Challenge with Mixed-Ability Groups is to Satisfy both Equity and Excellence
http://www.aasa.org/publications/sa/1999_10/tomlinson.htm

Using Technology to Differentiate Instruction

http://www.lakelandschools.org/EDTECH/Differentiation/home.htm

Differentiated Instruction
http://www.cast.org/ncac/index.cfm?i=2876

Strategies for Differentiating

http://members.shaw.ca/priscillatheroux/differentiatingstrategies.html

How to Plan for Differentiated Instruction
http://www.teach-nology.com/tutorials/teaching/differentiate/planning/

What is Differentiated Instruction
http://www.smcm.edu/academics/EdStudy/d7-Proj/Projects/ResearchSites/acbrowning/index.htm

Differentiating Instruction For Advanced Learners In the Mixed-Ability Middle School Classroom
http://www.kidsource.com/kidsource/content/diff_instruction.html

The Definition of Differentiating Instruction
http://www.ascd.org/portal/site/ascd/menuitem.3adeebc6736780dddeb3ffdb62108a0c/

Differentiating Instruction: Finding Man ageable Ways to Meet Individual Needs
http://www.ascd.org/cms/objectlib/ascdframeset/index.cfm?publication=http://www.ascd.org/ed_topics/cu2000win_willis.html

Reconcilable Differences? Standards-Based Teaching and Differentiation
http://www.ascd.org/cms/objectlib/ascdframeset/index.cfm?publication=http://www.ascd.org/ed_topics/el200009_tomlinson.html

An ASCD Study Guide for Leadership for Differentiating Schools and Classrooms
http://www.ascd.org/portal/site/ascd/menuitem.8f136d86e0aa2b9cdeb3ffdb62108a0c/template.article?articleMgmtId=72c40f05c1520010VgnVCM1000003d01a8c0RCRD

Differentiated Instruction Resources
http://www.sde.com/Conferences/Differentiated-Instruction/DIResources.htm

Enhancing Teachers' Competencies in Education for Sustainable Development through Professional Networks

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Abstract

UNESCO Regional Bureau-Beirut and Queen Rania Teacher Academy (QRTA)-Jordan have been working on the development of teachers' competencies in Education for Sustainable Development (ESD) in the Arab region. Seven universities in Jordan, Lebanon, Oman, Palestine, Syria, Tunisia, and UAE were involved in the ESD-Teaching and Learning Modules to promote the integration of ESD in the Faculties of Education curricula, as capacity building for teachers and institutions.
The first presentation was on ESD Competencies and Professional Networks in three countries (Jordan, Egypt, and UAE). The shared experiences covered the Public Action for Water, Energy, and Environment Project (PAP) implemented by QRTA- Jordan and supported by USAID; Shaheen's World implemented by Environment Agency-Abu Dhabi (EAD) and the Ministry of Education in UAE; and Bezra (Seed) World implemented by the Ministry of Education in Egypt, with technical support from the Danish Agency for International Development (DANIDA). The second presentation was on the United Nations University (UNU)-Regional Center of Expertise (RCE) on ESD Network. The Network consists of 101 institutions in Africa (15), Asia and Pacific (41) Europe (27), North and South America (16), and the Arab Region (2). The functions of UNU-RCEs include: capacity development, communications, research, influencing policy, and engagement with international organizations on ESD. A CD with UNESCO ESD Resource Materials in several languages was provided to the participants in the work.

Several Universities across the Arab Region (Jordan, Lebanon, Oman, Palestine, Syria, Tunisia, and United Arab Emirates) have been involved in Re-orienting their Teacher Education curricula to address sustainability during 2010-2011. Several recommendations resulted from the ESD-Teacher Education Capacity Building Workshop on the UNESCO ESD-Japan Fund in Trust (JFIT) Project (Beirut, 18-20 January 2011), with focus on enhancing teachers' competencies in ESD –teaching and learning in the Arab region, especially in science, languages, and mathematics fields.

In line with Beirut ESD Workshop recommendations and the developed ESD-Teaching and Learning Modules, Queen Rania Teacher Academy (QRTA) in Jordan has established a new training Network for in-service teachers to provide them with specialized training on reorienting their teaching and learning practices to address Education for Sustainable Development (ESD), and Sustainability in general.

Through support and fund from USAID-Jordan, QRTA, launched "The Public Action for Water, Energy and Environment Project" (PAP), which is a public education and behavioral change communication program was developed to support the Jordanian water and energy sectors as well as supporting specific initiatives related to the environment, with particular regard to solid waste. The objectives of the project are to develop student's knowledge about the scarcity and limitations of resources; instil positive environmental values and attitudes within schools for both children and educators; encourage individual action that can contribute to conservation of these resources; and educate young people on how science and technology can provide alternatives to improve consumption patterns.

Similar projects were also lunched in the Arab region to help in addressing the regional environmental concerns through ESD. One of these projects is the Environment Agency – Abu Dhabi's (EAD) online environmental learning website: "*Shaheen's World"* that aims to significantly enhance students' knowledge, skills, attitudes and ability to adapt to a changing physical environment, while providing a mechanism to promote and support the use of web-based environmental solutions. The pedagogy of Shaheen's activities tap into participatory child-centered learning and teaching methods including; rights-based and skills-based approaches to learning associated with inquiry, critical thinking, role play and action learning as set forth in the child-friendly environmental website.

Another regional project is the Egyptian environmental project: *"Bezra World"* (The Seed in Arabic), which is an online multiplayer game for students and adults introduced through attractive online activities such as storybooks and cartoons in order to reach learners from different ages and experiences. Bezra's activities support learners' innate interest and curiosity in nature and sustainability issues.

UNESCO Regional Bureau for Education in the Arab States-Beirut has been active in promoting professional development of teachers in ESD, Science, and Mathematics, as part of cooperation with Member States and Universities in the Arab region. Two examples will be shared during the Workshop on the UN University ESD Regional Centres of Excellence (RCE) Network, and the UN *Decade of Education for Sustainable Development (DESD, 2005-2014).*

The aim of presenting this workshop (during SMEC 15 Programme) is to demonstrate leading national and regional experiences related to the professional development of teachers and supervisors in Education for Sustainable Development (ESD), Sciences, and Mathematics. The teaching and learning experiences were developed and initiated through cooperation between schools and universities in the Arab region (Jordan, UAE, and Egypt), in line with the UN Decade of Education for Sustainable Development (DESD, 2005-2014) programme. Networking and sharing of experiences on innovative teaching and learning Resource Materials have been key factor in enhancing teachers' competencies in these fields.

The Department of Education at the American University of Beirut (AUB) has been one of seven institutions in the region, which joined effort on development of ESD-Teaching and Learning Modules, with focus on Social, Economic, and Ecological/Environmental dimensions of ESD.

--- Only abstracts included for the following sessions ---

ألواح ذكية ....لعقول ذكية

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ثورة التكنولوجيا التفاعلية الذكية أصبحت لغة الأولاد المستخدمة في حياتهم لذا لابد لمعلمي العلوم والرياضيات أن يكتسبوا هذه اللغة من أجل زيادة دافعية الأولاد نحو التعلم وإكسابهم المفاهيم العلمية بلغتهم الخاصة. في هذا السياق يأتي SMART BOARD من أجل تبسيط وتقريب الأهداف التعليمية وتقديمها بشكل تفاعلي يحاكي أساليب التكنولوجيا الذكية والعقول الذكية للأولاد. تهدف هذه الورشة لعرض تجربة اللوح الذكي في تدريس العلوم والرياضيات وكيفية تمكنه من تقديم الأهداف المجردة والنظرية إلى التلاميذ بأنشطة تكنولوجية تساعد المعلم في تحسين سير حصته عبر إداراة الوقت والعمل على الذكاءات المتعددة و الفروقات الفردية وأنماط التعلم المختلفة في الصف وجعل الحصص العلمية حصص مشوقة ومرحة وذو فائدة في آن واحد بل أكثر من ذلك حيث يزداد التفاعل والتقارب بين المعلم والتلاميذ كل هذا من خلال التعرف على اللوح وأدواته و التدرب على تنفيذ أنشطة تفاعلية في الصف. يعتبر إستخدام الألواح الذكية والتفاعلية في الصفوف من أهم الوسائل الحديثة في التعليم والتي بدأت تنتشر في مدارسنا بنسب مختلفة ومن أجل زيادة الوعي حول هذا الموضوع للمعلمين وحسهم على إستخدام التكنولوجيا الحديثة في تعليم العلوم والرياضيات للإضاءة على المفاهيم العلمية بلغة الآولاد الذين اصبحوا يستخدمون SMART PHONE بشكل يومي و سهل،لذ لابد من المعلم ان يتوجه لتلامذته بأسلوبهم الحديث لا الأسلوب التقليدي . سيتم خلال هذه الورشة الإضاءة على اللوح التفاعلي وتعريف المعلمين به وكيفية استخدامه ونتائجه وعرض تجربة مؤسسة الهادي وكيفية الإستفادة من هذا اللوح عند التلاميذ ومراعاته للصعوبات التعلمية والفروقات الفردية داخل الصفوف والأثار الذي يتركه عند التلاميذ. كما سيتم الإضاءة على بعض المفاهيم العلمية في العلوم والرياضيات والتي تعتبر مجردة وكيف تم شرحها عبر انشطة على اللوح التفاعلي ومدى إلإستفادة التي حققها اللتلاميذ. وسيقوم المعلمين بالعمل على اللوح وتجربته وتعلم تنفيذ انشطة وإن لم يكن في صفوفهم الواح تفاعلية وسيتم العمل على بعض التقنيات البسيطة التي تمكنهم من تحويل المفاهيم المجردة في الرياضيات والعلوم لمفاهيم تحاكي عقل التلاميذ وقدراتهم في مختلف المراحل الأكاديمية بإستخدامهم بعض البرامج البسيطة.

A Lesson Plan on the Mathematics of Social Networking

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Abstract:

This workshop will demonstrate the BLOSSOMS module "Who do you know? The theory behind social networking." In the workshop, the participants had the opportunity to experience the module first-hand, from the students' perspective, while also gaining an understanding of how they, as educators, can use the module to enhance learning in their own classrooms. The module itself is targeted at high school level mathematics classes as a means to introduce both network modeling and algorithmic thinking.

Introduction:

In 2012, the American University of Beirut partnered with the Blended Learning Open Sources Science or Mathematics Studies (BLOSSOMS) program of MIT in order to develop a series of video modules for use in high school mathematics and science classrooms. This interactive workshop session focused on one of the modules ("Who do you know? The theory behind social networking") with the goal of explaining the theory and use of the "teaching duet" model used in the video module.

The teaching duet concept was developed by the MIT BLOSSOMS team as a way to ensure that both teachers and students engage with an educational video rather than just watch the video. The concept centers on the idea that a university professor forms a duet with the classroom teacher. The professor serves, in the video, to explain the concepts and introduce an activity, while the teacher actively manages and runs the activity in the classroom. More information on this technique can be found at: http://blossoms.mit.edu/about_us/teaching_duet_pedagogy.

As coordinating both the video segments and the classroom activities may seem overwhelming, this interactive session was designed to illustrate the use of a BLOSSOMS module in a high school mathematics class. The module itself focusses on introducing students to both graph theory and algorithmic thinking.

Strategy:

This video lesson itself serves to introduce students to algorithmic thinking through the use of a popular field in graph theory—social networking. Specifically, by acting as nodes in a graph (i.e. people in a social network), the students will experientially gain an understanding of graph theory terminology and distance in a graph (i.e. number of introductions required to meet a target person). Once the idea of distance in a graph has been built, the students will discover Dijkstra's Algorithm. The lesson should take approximately 90 minutes and can be comfortably partitioned across two class sessions if necessary (see the note in the accompanying Teacher Guide). There are no special supplies needed for this class and all necessary hand-outs can be downloaded from this website.

Description of Session:

The session followed closely to the structure of the BLOSSOMS module, "Who do you know? The theory behind social networking" (http://blossoms.mit.edu/videos/lessons/who_do_you_know_theory_behind_social_networking).

- The first activity in the module poses the question: "On average, in Lebanon with a population of 4million people, how many people does each person need to know in order to ensure that every two randomly selected people share a mutual friend." The participants then gave their answer to this question, one-by-one, and their answers were written on the board. There was quite a diversity in answers, but there was one correct answer: 2000. In terms of administering this activity in the classroom, the voting can be done in several ways: secret ballot, post-it notes on the board, one guess by a single student and then voting on whether it is higher or lower, for example.

- Following the first introductory segment and activity, the video is used to explain the second activity. The second activity of this module is the most complicated. It involves simulating a party with the students. However, this is not a normal party: the students are given a set of people that they "know" and a single person whom they would like to "know" (their target person). The only way they can meet their target person is by following a series of introductions made by starting with those they know. In this way the students become the nodes in a graph while the introductions they need are the arcs.

  In the session, the participants were given nametags with letters (A – J) and lists of those they know and their target person. The participants then enjoyed chatting with each other as they tried to figure out who their connections were. Participants that met their "target" early on in the game served to help others understand the rules and meet their targets.
  Following the activity, we discussed how the "party" can be structured in the context of the classroom. Specifically, the participants were shown the "For Teachers" portion of the module website which contains a set of excel files that allows for the preparation of all the required handouts for different class sizes. The participants were relieved to see that the use of the Excel sheet was quite simple – it only requires pasting the class roster into the appropriate column.

- Following the second activity the video serves to define several graph theoretic terms -- specifically node and arc. The participants were then encouraged, in the third activity, to try to draw the graph of their group using the people as nodes and the arcs as the relationships connecting them. This was done iteratively at the board, by having each participant add their view of the network. As each participant added their node and arcs, the others shouted out corrections and asked questions about the graph, leading to a correct depiction of all of the participants and their presumed relationships.

- After the correct graph was on the board, handouts with a printed depiction of the graph were given to all participants and the question was posed (in the video): "Now that you have full knowledge of the connections in your class, can you see if you were able to find your target person in the least number of introductions possible?" Working through this question led to some discussion about the relationship between graph size/complexity and the capability to trace a "shortest path". Following the discussion of shortest paths in a graph, the video module was used again to present Dijkstra's algorithm – a guaranteed method for finding the shortest path in any graph.

- In the fifth activity, the students worked through Dijkstra's algorithm on the handouts of the graph. All participants successfully implemented the algorithm as presented in the video. It was also noted that in a classroom setting, the teacher can give a prize to the first student to successfully implement the algorithm. Additionally, while the students are working, the teacher can draw the correct graph on the board and subsequently have a student come up to demonstrate the algorithm in front of the class. It was also noted, that students may form into groups to complete this activity working together. This activity concludes the module.

- Finally, there was a brief discussion of alternative methods by which one could run some of the module's activities, as follows:
    - Depending on the level and aims of the class, the teacher could skip the last activity focusing on the presentation and implementation of the algorithm; and instead focus on building graphs to represent information. For example, the class could continue with the challenge of building a graph representation of their family members (i.e. a family tree) or their neighborhood (i.e. a stylized map) or the connections between steps in a process (i.e. a project flow chart), etc.
    - The party in Activity 2 can be run as a "silent" party in a computer lab by having students "chat" on line to discover their connections. Alternatively, the party theme could be changed into a "spy game" theme in which the participants must use "informants" to find a "target".
    - Finally suggestions for homework associated with this module include having the students draw graphs of their friends/family on Facebook or running Dijkstra's algorithm on a map of their neighborhood.

Conclusion:

The feedback from participants on the actual value of this module in their classrooms was mixed. Not all participants felt that the module would tie well to their curriculum. Indeed, this module does sit slightly outside the Lebanese mathematics curriculum. Nevertheless, the module could be used on days just prior to holidays or at times when the students' focus on curricular material is lacking. The value of the module is that it serves to introduce graphs as a method for information representation while also teaching algorithmic thinking in the finding of a shortest path in a given graph.

Aside from the specific module presented, the participants agreed that the BLOSSOMS modules form a valuable resource. The "teaching duet" model was well received and the intention of participants to browse for and use the modules was clear.

The BLOSSOMS website:
http://blossoms.mit.edu/

The module presented in this session can be found at:
http://blossoms.mit.edu/videos/lessons/who_do_you_know_theory_behind_social_networking

This site provides a Java applet detailing the steps of Dijkstra's Algorithm.
http://www.dgp.toronto.edu/~jstewart/270/9798s/Laffra/DijkstraApplet.html

This site sponsored by Commoncraft, presents a brief video summarizing the concept of Social Networking.
http://www.commoncraft.com/video/social-networking

This is the site of the Vizster project at Stanford University, which is dedicated to Social Network Visualization.
http://hci.stanford.edu/jheer/projects/vizster/

This website, Visual Complexity, presents a rich library of graphically compelling networks.
http://www.visualcomplexity.com/vc/

Hosted by Oakland University, this is the website for the Erdös Number Project, which studies research collaboration among mathematicians.
http://www.oakland.edu/enp/

This site, The Oracle of Bacon, finds the shortest path between actors and actresses according to the films they've worked on together.
http://oracleofbacon.org/

Believe in "Motivation": Chase Your Dreams

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Abstract:

Motivation is a necessity so that *learning* becomes a continuing, improving, interesting and hopefully enjoyable *process*. All through the presentation, attendees will try to make learning fun. They have to realize that students should understand that learning is the *goal*. In addition, session participants will be able to view multiple videos regarding motivational ideas and the means of using them in their math classes. Thus, attendees will be looking towards math with new perspective. During the workshop, participants will be experiencing effective mathematical concepts.

This workshop primarily aims at increasing the participants' understanding of how to motivate students in math classroom. This was planned to be implemented through real-life Math activities. This session will include authentic and easy-applicable strategies for Math teachers to use and consequently achieve profound students' development in elementary mathematics classrooms.

The session is planned as follows:

- Participants will be reading the first slide of the PowerPoint that shows the central idea, the objectives of the workshop and setting the essential agreements. **(3 minutes)**;
- To break the ice, participants will be human graphs according to their teaching experience so teachers may take advantage of the engagement to warm their students up with an interesting environment; **(3 minutes);**
- Participants will use their math journal to answer the question "If you have a problem whom would you ask for help?" **(5 minutes);**
- "Math call 911" video will be watched to answer their questions **(3 minutes);**
- To display their prior knowledge, group activity will be done to match all the key words concerning the concept " motivation" **(5 minutes);**
- Participants will take time to ask questions and post them on the burning (tension) wall **(3 minutes);**
- (g) Video: "The best motivation video" and a discussion will be followed to connect real-life situations with teachers. **(10 minutes).**

--- Only abstracts included for the following sessions ---

معمل الرياضيات البيئة المناسبة لتطوير عملية التعلم والتعليم

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يعتبر التنوع في اساليب التدريس مدخلا مهما لتحسين التعلم والتعليم لذلك وجب علينا التفكير في ما يسمى بمعمل الرياضيات الذي يعتبر المكان و البيئة المناسبة المخصصة للتدريس المجهز بالعديد من اداوات التعلم يذهب إليه الطلاب ليدرسوا المهارات و المفاهيم المجردة بيدوية وأنشطة عملية تبسط الرياضيات وتجسد مفاهيمها بصورة واضحة تساعدة الطالب على استيعابها ,لذلك سوف يتم في هذه الجلسة عرض فيلم لنموذج معمل رياضيات في مؤسسة الهادي (ع) و كيفية تدريس المعلمين بالمعمل لزيادة وعي المشاركين للضرورة أنشاء المعمل بالمدرسة و بعد ذلك سوف يطلب من المشاركين وضع تعريف للمعمل و أهم مكوناته و فوائد إستخدامه وسوف يقوم المشاركين بالتدرب على تفعيل المعمل من خلال تنفيذ العديد من الأنشطة بإستخدام اليدويات

تعليم الارقام

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ان الهدف الاساسي من هذه الجلسة هو زيادة ادراك المشاركين للتركيز على تعليم متعدد الحواس لمفهوم الارقام لتلاميذ رياض الاطفال في مادة الرياضيات.وسيمثل المشاركون دور المتعلم خلال الجلسة باستخدام لوحة المئة حيث يمكننا من خلالها تعليم الارقام بالاضافة الى عمليتي الجمع والطرح. كذلك سيتم تعليم الارقام من خلال انشطة والعاب تربوية وابتكار هذه الانشطة مستخدمين مواد بسيطة وغير مكلفة وهي مفيدة لهذه المرحلة العمرية.

Formative Assessment in Math Classes

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Formative assessment can be an exciting and productive approach to learning. Once you learn the basics, you can apply the strategies in a variety of ways that make instruction fun for teachers and students alike. We realize that teachers (especially those who have been in the field for a while) have seen one teaching technique after another come down the pike. The goal of this workshop is to provide teachers with the basic tools of formative assessment and then let them decide how to implement these tools in there instruction. It is a chance to differentiate between summative and formative assessment.

A Blossom's Interactive video lesson on Rational numbers versus Irrational Numbers

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This session presents the main features of a recently completed video lesson, as part of the MIT BLOSSOM's project. The lesson features the main properties of the sets of Rational and Irrational numbers. It starts with basic definitions and a main question for which the lesson aims at finding a proper answer. Moving gradually, using basic Discrete Mathematics principles, the student is brought to reach such answer by clearly distinguishing between the countable and uncountable properties of respectively the sets of Rational and Irrational numbers.

M & M (Math and Mnemonics) In the Elementary Classroom

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The primary purpose of this session is to increase participants' understanding of how to use mnemonics to develop elementary students' understanding of various basic mathematical concepts. Participants will take on the role of the learner during the session by actually applying several types of mnemonics to solve problems. Mnemonics apply systematical evidence based strategies in order to enhance the students' memory skills. They are most commonly used to help students find a way to relate new information to information they have already locked in their long-term memory. Moreover, mnemonics are very useful for introducing and developing the comprehension and application of multi-step concepts. The session is planned as follows: (a) Brief introduction and initial exploration of the steps of memorizing, and the techniques to improve memory (15 minutes); (b) Participants will be equipped with a number of mnemonic strategies and they will apply them immediately by solving various mathematical problems. These activities include chaining, rhyming, association, chunking, pegging, acrostics, substitution, linking, and mapping (40 minutes); (c) Participants will try to create their own math mnemonic to a concept that they feel their students are challenged by (10 minutes); and (d) Participants will present their mnemonic and reflect on the application of the mnemonic strategies presented in the session (10 minutes).

Flipping the Classroom: Using an Intelligent Algebra Solver and Automating Instruction

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The teaching and learning of algebra has two main components:

- procedural and skill mastery
- conceptual mastery and applications.

Because of time constraints and the tedious nature of the conventional teaching and learning process, the former component typically takes a large part of a class session while the latter (which is at the core of a good mathematics education) is sacrificed. We discuss how to use a new and innovative algebra solver to “flip the classroom” to automate the mastery of procedural and skill mastery of algebra topics outside the classroom. We will explain how to use such a system and talk about how to dedicate the precious class time with students to focus on conceptual mastery and applications. In addition, to minimize the in-class time for presenting procedural and skill mastery components of algebra, we will discuss the use of the algebra solver using interactive whiteboard in the classroom. Participants will use the “intelligent algebra solver” system and share their ideas of how they think this technology can be used to help their students gain mastery of algebra more efficiently and more effectively.

استخدام القصة في تعليم الرياضيات في الحلقة الثانية

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يشكل الاسلوب القصصي في تعلم الرياضيات من الاستراتيجيات التعليمية الحديثة التي تعتمد على ربط الرياضيات بالحياة اليومية وإكساب المتعلمين المعلومات المفيدة والمهمة بطريقة تفاعلية سلسة وتزويدهم بالعديد من القيم الاجتماعية والوجدانية, وسوف يجري إطلاع المشاركين على المبادئ العامة للأسلوب القصصي وكيفية زيادة التفاعل بين المعلم والمتعلم وبين المتعلمين أنفسهم من خلال إعادة المتعلم للقصة بلغته الخاصة وزيادة قدرته على المناقشة ومحاولة تغيير النص لخلق واقع جديد, فضلاً عن إشراكهم في تنفيذ دروس محضرة مسبقاً للصف الرابع والخامس الأساسي وستتاح الفرصة أيضاً لوضع أفكار جديدة وتحويلها لقصة درس وعرضها أمام المشاركين. ان الهدف الاساسي من هذه الجلسة هو زيادة إدراك المشاركين لأهمية استخدام استراتيجية تعلّم الرياضيات عبر القصة في غرفة الصفوف الابتدائية لما لها من أهمية في ربط التعليم بالحياة اليومية وإكساب المتعلم المعلومات المهمة والمفيدة وتزويدهم بالعديد من القيم الوجدانية والاجتماعية وغيرها وكيفية الوصول بالمتعلم إلى مرحلة المبادرة إلى طرح الأسئلة التي تعتمد عليها الإجابة. وسيمثّل المشاركون دور المتعلمين من خلال استماعهم النشط للقصة ومن ثم صياغتها بأسلوبهم الخاص, ومن بعدها تنفيذ الأنشطة المرفقة مع القصة (جدول قابلية القسمة ...) ومن بعدها الأسئلة التي تتمحور حول معلومات وردت في سياق القصة والجدول الذي من خلاله سيتم التعرف على مفهوم الأعداد الأولية, وفي نهاية الجلسة سيقوم المتعلمون بتلخيص معارفهم الجديدة ضمن خارطة مفاهيم.

To What Extent Does the Use of the Inquiry and Reflection method of Teaching Lead grades 8 Chemistry Students to Become Thinkers and Researchers?

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Abstract

Lebanese Chemistry teachers detected lack in intermediate and secondary students' critical thinking skills, such as arguing, analyzing data and interpreting experiments' results. Consequently, we elaborated the Inquiry and Reflection teaching method (I&R), and implemented it for three months, in order to foster grade 8 chemistry students' thinking skills, in one Lebanese private school. So that to measure the impact of this instructional method implementation on the students' critical thinking skills improvement, we compared the control and experimental groups' students' grades in the critical thinking test, the analysis questions, the interpretation problems and the argumentative test. Findings showed that the experimental group students improved their critical thinking skills significantly, while the control group ones did not.

Introduction

In recent years there has been growing interest across the world in ways of developing children's thinking and learning skills (Fisher, 2005). In contrast to traditional science instruction, which emphasizes lectures to efficiently present scientific information and encourages students to memorize facts from textbooks, today's scientific instruction emphasizes on problem-solving, inquiry-based laboratory activities and rejection of science as a body of facts that must be memorized (Padilla, 1990, & Zohar, 2005, & Fennimore, 1990, & Burke, 2008). Since Lebanese Chemistry teachers detected lack in intermediate and secondary students' critical thinking skills, we elaborated the Inquiry and Reflection teaching method (I&R), and implemented it for three months, in order to foster grade 8 chemistry students' thinking skills, in one Lebanese private school.

The I&R method is an instructional approach based on a conjunction between Inquiry and metacognition. Inquiry is a teaching method where students: identify the problem, make conjectures, plan and conduct experiments, observe analyze and interpret data and finally draw conclusions. Metacognition is the "thinking about thinking", it is the awareness and the control of the processes by which we learn.

Strategy

The I&R method is an instructional approach based on a conjunction between Inquiry and metacognition. They both enhance critical thinking skills.

This approach included four phases:

- *Scaffolded inquiry*: Students learned about inquiry as they engaged in authentic scientific research: they were involved in "open-ended questions and experiences by hypothesizing, investigating, planning experiment, conducting experiment, observing, analyzing the findings and concluding.
- *Reflective assessment:* where students evaluated their own and each other's research. Therefore, this process enabled them to understand the Inquiry Process, to be systematic, and to reason carefully. So, the habits of thought would be involved in their skills.
- *Argumentation:* students gather the "proofs" to support the claims they seek to defend and then resolve their dispute by agreeing that one conclusion is better supported than another
- *Generalized Inquiry and Reflection:* the inquiry cycle in conjunction with reflection, had been repeated, which helped students to refine their inquiry and reflection processes so they could apply them to new learning situations, and real world situations.

Description of Session

The instructional method had been implemented for three months in one Lebanese private school. In fact, there were 2 grade 8 sections. The section A students constituted the control group and were taught via the traditional method. While the section B students constituted the experimental group and were taught via the I & R method.

At the beginning of each lab session, the experimental group students, who were working by groups, had to watch videos or to conduct a library research in order to define and understand the key words and the outline of the topic. Then, they have to find answers on the teacher questions by making predictions about the results they might obtain at the end of the experiments. Then each group should perform these experiments, in order to verify hypotheses. After that, each group should expose the hypotheses they stated, the results they obtained, the analysis made and the conclusion they found; in fact in this step each group had to prove that they make the best and right analysis and come up with the adequate conclusion while the other groups are wrong, and this by giving proofs and arguments supporting their claims and generating counterarguments and rebuttals to others' arguments. At the end, each group must present some perspectives or examples from everyday life or limitations of the study and laws we discovered.
These experiments were designed by the teacher in the first session (chemical reactions), who prepared all the materials; in the second session (Types of Chemical Reactions) the students gathered and prepared all the necessary materials for performing the experiments designed by their teacher; however, in the third session (Rates of Chemical Reactions), students participated in the designing of the experiments, while in the fourth one (Acidic and Basic solutions), they designed all the experiments and gathered all the materials.

In order to measure the critical thinking skills' improvement, a critical thinking test, an argumentative test, two analysis questions and two interpretation problems were developed and administrated to all students.

- The critical thinking test had been inspired from the sample of "James Madison Critical Thinking Test" and was adapted to the Lebanese curricula, and translated from English to Arabic in order to familiarize it with Lebanese students. It had been given for both groups (control and experimental groups), as a pre-test before the I&R implementation, and as a post test at the end of the experimental study, thirteen weeks later.

- An analysis question and an interpretation problem had been given for students on the second exam which took place after the first lab session. Similarly, another analysis question and interpretation problem had been given for students in the final exam at the end of the experimental study.
- An argumentation test had been given for both groups at the end of the experimental study in order to measure students' capacity to generate adequate arguments, counterarguments and rebuttals.

Conclusion

Overall, the findings support our hypothesis that the I&R method initiates students to become critical thinkers.

In the pre-test, according to the statistical tests, both groups had similar critical thinking skills' levels, since there wasn't a significant difference between the experimental group's grades and the control group's ones; therefore, the difference between both groups at the end of the experimental study is only because of the I&R method's positive impact. In fact, at the end of the experimental study, the control group made a slight improvement in the critical thinking test, while the experimental group progressed largely, similarly to the analysis, interpretation and argumentation skills.

The present work supports earlier findings that inquiry teaching and learning showed a lot of positive impact in stimulating students' thinking skills and that it could train students to think divergently in a higher thinking level and have positive attitudes; as well as, it showed the co-development of reasoning strategies and domain knowledge (Zimmerman, 2007). Furthermore, the findings of this study support the findings of previous studies showing the positive effects of metacognitive guidance on learning outcomes (Zion, 2005).

However, literature suggests that many studies on inquiry teaching implemented in the teaching and learning process have been conducted, but none had related inquiry teaching with increasing students' critical thinking level. The contribution of the present work is to show that the I&R method implementation enhances all students' critical thinking skills.

Curriculum developers could benefit from the study to develop instructional strategies and curricula that help students improve their critical thinking skills. In fact, the students' critical thinking skills' progress is warranted: Weak, average and competent students will improve their analysis, interpretation, and argumentation skills. Strategies used might be helpful to be used by researchers working on disabilities and weaknesses in order to plan workshops and seminars for future teachers. The I&R method improves all students' cognitive skills without being exclusive for the high-achieving students. Second, the lab sessions in the I&R method, aren't expensive, since we use materials and chemical products from everyday life; therefore, even in public schools and the private ones which aren't well equipped, students can perform the experiments. Third, students are more motivated when learning via the I&R method than via the traditional one; in fact, they found it funnier and interesting because they were involved in a situation of competition, challenge and responsibility. Fourth, the I&R method allows students to develop their strong personality and their self-esteem, since it put them in real life contexts, instead of the virtual scientific context of the classroom. Fifth, this instructional method provides students with relevant life skills, since it allows them to acquire: the knowledge “ le savoir”, the know-how “le savoir-faire” and the self-knowledge “le savoir-vivre”. Finally, educators do not have to hesitate about the I&R method because it doesn’t need time more than the traditional one, since covering the chapter using both methods required the same amount of time.

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Using Middle School Science Club Activities in Elementary Classrooms

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Abstract

"Science Ventures" is a science club targeting middle school students and offering them the chance to explore basic scientific concepts through practical investigations, research and guest speakers. It is a way to motivate them further to participate actively in science activities, to explore with them new ideas, and to promote their involvement in science. Activities chosen focus on the six PYP themes that IC – Elementary students work on during their elementary years. At least two to three experiments are prepared wrapping the central idea covered in each PYP theme. Members of the club perform those activities, explore ideas behind them and connect them to the PYP theme concerned so to share them later on with the young learners of the Elementary School. Depending on the complexity of the concept tested in the experiment, the activity is communicated to the younger students mentored by their older middle scholars. Different experiments will be shared with participants who will be involved in a discussion of how to connect these investigations to the six PYP themes and the importance of letting young students mentor younger learners. Participants will also share their own ideas on how to improve this extracurricular activity and maximize its productivity and beneficial effects.

Goal:
To extend an experience in a school extracurricular activity.

Objective:
To share International College-Middle School experience in the organization of a science club whose objective is to promote understanding of science by allowing trained members/students from the Middle School to mentor younger Elementary students and explain to them experiments they have been performing themselves as part of a club activity.

Materials to be used:
Simple lab tools for conducting the experiments with the participants will be used during the session. The presenter will bring all the lab tools with her. Participants will be grouped into three or paired depending on their recorded number in the session so to maximize engagement in the hands-on activities.

Outline and flow of the session:

- Brief introduction and initial overview of the science club hands-on as interrelated with the PYP themes – 5 minutes
- Hands-on activities as interrelated with the PYP themes:
  - Sharing the planet – 15 minutes
    - What are those oil spills? For lower elementary
    - Is this potable water? For upper elementary

- How the world works – 15 minutes
  - What is the color of light? For lower elementary
  - Let us construct an electric circuit. For upper elementary
- How we organize ourselves – 10 minutes
  - Building food chains & biodiversity. For upper & lower elementary
- How we express ourselves & Who we are – 10 minutes
  - Discovery of the microscope. For upper & lower elementary
- Where we are in place & time – 10 minutes
  - The amazing human skeleton. For upper & lower elementary
- Participants sharing ideas for improvements – 10 minutes

Nature of audience involvement:
Interactive session targeting upper and lower elementary school teachers who will be engaged in hands-on activities.

Supervision in the Science Class

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Abstract

Science classroom supervision is an educational activity usually conducted in schools by the instructional supervisor or the principal at least once a year. Routinely, this activity may seem a burden and everyone involved would want to get it over and done with. However, if conducted in a clinical approach by trained science coordinators, this activity may induce a great deal of learning, development and change of habits at the level of the teacher, the supervisor and the school's culture as a whole. This will certainly impact student's achievement at the end. Based on the model of Glockman, Gordon, and Goldhammer a model of the clinical supervision model, applied in science, will be shared with the participants emphasizing the role of a healthy relationship between the supervisor and the supervisee as an important component for the success of the supervision process.

As opposed to summative classroom supervision usually conducted by Headmasters or Principals in the science classroom, formative supervision is expected to be conducted by the subject coordinator and is expected to be developmental to both the instructor and the supervisor.

Based on the model of Glickman, Gordon and Goldhammer the session will introduce the science classroom supervision process in details informing about the pre-conference sessions and its design, the conference session in its application and the post conference session and its conclusion. The session will also coach the participants in the development of observational tools needed for the science class session such as inquiry teaching approach tool, tool for observing laboratory sessions, and tools for discerning how the nature of science is being induced in the teaching process.

Finally, the session will highlight the importance of a collegial relationship that must be built between the instructional supervisor and the supervisee in order to secure a successful supervision process since it must induce a constructive learning process and hopefully a change of habits & mind.

The session is planned as follows: The instructor will introduce the three phases of the supervision process (20 minutes). Participants will work in groups on developing an observational tool (20 minutes). This will be followed by role playing scenarios on the relation between the instructional supervisor and the teacher (30 minutes). Finally, a reflection session on the effectiveness of this approach of classroom supervision as opposed to other forms of supervision will be held. (5 min).

Write to Learn Science Right: Debate and Relate

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Abstract:
Open-ended questions are like the magic sticks that can turn an ordinary lesson, like the environment, the planets, living and non-living things etc. into an inspiring personal experience and eventually into an enduring understanding. Transforming your classroom into a courtroom, a round table, or other similar interactive situations can easily engage your students and provoke their curiosity thus creating perfect moments of learning How can we use all the other disciplines to enhance our students' scientific performance? How can we invest our students' writing skills, visual abilities and debate tendency to construct the foundations of their scientific analysis? Upon your participation in this workshop, you will see how science and English language can walk hand in hand, how writing activities can be scientific, and how the scientific principles can easily turn out to be debatable.

The 21st century students are exposed to a lot of issues that raise so many questions in their minds. This curiosity provokes us, teachers, to engage students in interdisciplinary projects that tackle these contemporary topics creating personal points of view that they can carry on forever.

How do I intend to open my session?

-<u>Opening Activity : Ice Breaker</u> - Show a video extracted from « Who Moved my Cheese ? » a story by Spencer Johnson. - Each participant is asked to talk about what cheese reminds him/her of. - Think of ways to relate cheese to scientific topics.	10 min

What are the next steps that I intend to follow?

1- <u>Science and Debate</u> - Science as an interdisciplinary subject - How scientific topics can become debatable ? - The use of cartoons to create a debate related to a scientific principle (living things) - Paricipants are given a role and are asked to discuss the consequences of their opinions such as the consumption of energy drinks (the same idea shown in the cartoon above). - Conlude that debate can be easily considered as both a scientific and an oral linguistic exercise.	20 min

2- <u>Science and Writing</u> - Ask participants how to use science in writing other than just to answer a question - Tell participants that there are many ways to use writing skills in science : - (Activity for all) : Transform a scientific topic like development into an cartoon episode, make students create dialogues and fill in balloons to express their understanding, and this can serve as a formative or a diagonstic assessment. - Differnetiation : Other groups in the same class can do the same activity, but transforming the same situation into an essay, depending on their linguistic level. - Students are asked to write down a journal that follows their scientific understanding, session by session	30 min

How do I intend to close my session?

3-Group Work : I- Diivide the participants into groups ; each group will be asked to finish a certain assignment and then share their outcomes II- Show specimens of how our plans are applicable in science classrooms (mainly pictures ..) III- Find the characters of « Who Moved My Cheese ? » in our students IV- Formulate an appropriate conclusion based on « Who Moved My Cheese ? » and the used examples and handouts.	20 min 10min

--- Only abstracts included for the following sessions ---

Mise en oeuvre des apprentissages scientifiques méthodologiques aux niveaux des cycles complémentaire et primaire

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Les apprentissages scientifiques à l'école ne doivent pas relever uniquement d'un simple conditionnement pouvant correspondre à la mémorisation de quelques notions même bien expliquées,mais ils doivent envisager des activités variées : dont les activités d'observation,de questionnement,de formulation d'hypothèses, d'analyses de textes…Ces activités sont centrées sur l'élève, sa réfléxion et ses reproductions. Pour concevoir de telles activités méthodologiques, on présente un m*odèle de démarche d'enseignement qui met l'accent sur trois formes d'activités essentielles dans le travail scientifique:*

- *-Poser un problème et le résoudre*
- *-Rassembler les réponses des élèves*
- *-Caractériser une nouvelle connaissance.*

Dans la première activité l'élève s'intérroge sur le ou les fait(s) observés.C'est un moment délicat pour lui comme pour l'enseignant.Le problème apparait lorsque les élèves sont déjà impliqués dans l'activité d'observation, on parle alors de situation déclenchante; cette situation provoque l'intérét des élèves et les conduit à découvrir, à agir d'une façon ou d'une autre et finalement, à s'exprimer et à s'interroger.Après avoir posé le problème on passe à la deuxième activité qui consiste dans la résolution du problème. Dans cette deuxième phase les élèves expriment leurs conceptions et prennent conscience entre leurs propres conceptions et celles qui sont présentées par l'enseignant.Après cette prise de conscience, ils pourront arriver à transformer leurs idées. Cette analyse leur permet d'acquérir la compétence de l'initiation scientifique.Dans la troisième activité méthodologique on rassemble les résultats des élèves et on sélectionne ceux qui apportent une solution aux problèmes retenus. Ainsi les élèves peuvent mémoriser la réponse et connaitre les nouvelles connaissances .

À la fin de cet enseignement l'enseignant peut demander aux élèves de réfléchir et d'analyser les différentes activités suivies dans la démarche adoptée . Alors les élèves participent à l'évaluation du travail présenté et arrivent à apprécier les activités méthodologiques qui ont été mises en jeu.

La session dure une heure et demie.Elle englobe un exposé audio-visuel présenté aux enseignants et une discussion autour de l'exposé. cette session exige un LCD.

كيفية تعليم مادة الفيزياء بوسائل أقل كلفة في المرحلتين المتوسطة والثانوية

سميحة وهبي، مدارس المبرات : ثانوية الإمام الحسن(ع) ،بيروت- لبنان،

الهدف الإساسي من هذه الورشة هو تقديم أفكار مبتكرة في إيصال بعض الأهداف في مادة الفيزياء باستخدام وسائل غير مكلفة ماديا وتنفذ بطرق إبداعية ، بدل تلك التي تتطلب كلفة عالية قد لا تتوافر في بعض المدارس التي تفتقر للمختبرات والوسائل التي تساعد في أيصال المفاهيم الفيزيائية وخصوصا في عصر التطور التكنولوجي وفي ظل تقريب المادة من الحياة اليومية للطالب .وسوف يتم إطلاع المشاركين على بعض الوسائل التي سنقوم بإنجازها معهم وإجراء بعض التجارب وشرح لكيفية الإستفادة منها في شرح المفاهيم في المرحلتين المتوسطة والثانوية.

New Types of Assessments Used to Engage Students in Chemistry Learning

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Practice is the best method to allow students grasp academic concepts. Students are more motivated to engage in hands-on activities when they are the leaders of their work and when they are credited for it. The limited Chemistry sessions assigned by the Ministry of Education drive chemistry teachers to follow traditional strategies in learning and evaluating students.

The *primary purpose* of this session is to increase participants' understanding of how to get use of Chemistry sessions to apply a variety of new assessments in their Chemistry classrooms in all intermediate and secondary levels. These assessments reinforce students' motivation and engagement in chemistry applications and allow teachers to grade different students' skills. These assessments help in turning your classroom into a student centered classroom, instead of teacher centered. This allows students to be the creators of their knowledge and apply what they learned in their real life outside school.

In-class interactive video-based learning: Tissue Specific Gene Expression

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A basic notion in biology that most high school students fail to conceptualize is the fact that all cells in the animal or human body contain the same DNA yet different cells in different tissues express a common set of genes. In addition, they express other genes that vary depending on the type of tissue and the stage of development. How do cells, at the level of the nucleus, which houses the complex chromatin, regulate this mode of tissue specific gene expression? The workshop will demonstrate how to guide the students through a video-based 50 minute interactive thought process to allow them to conclude this complex set up of the chromatin in the nucleus and its interaction with the Nuclear Matrix.

Whole Brain Thinking as a Tool For Better Understanding

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Abstract
One of the problems that teachers face when explaining a lesson is to get all students to understand the concept at hand. Using whole brain thinking techniques is an effective method to reach out to more students. Whole brain thinking is not limited to education, it can be applied whenever decision-making is necessary. In fact many famous people have used it to produce great work. Participants will initially learn to identify their type of thinking and practice becoming whole brain thinkers. During the session, participants will also be provided with, as well as create activities that they can use in the classroom as well as in their daily lives. By becoming a whole brain thinker, the teacher not only helps students become better learners, but he/she gains insight to arrive at better solutions to complex problems.

The primary purpose of this session is to highlight the concept of whole brain thinking and its importance in learning. This can be applied in more than one domain in education; whole brain teachers can teach students to be whole brain thinkers by introducing a chapter using different methods. This way of thinking can be applied in almost all subjects. Beyond education, whole brain thinking can be useful in decision-making, and to those in leadership positions. This workshop will not only introduce the theory, but will also include hands-on activities that will help participants differentiate between left and right brain thinking, and thus increase their whole brain thinking.

The workshop is planned as follows: The workshop starts with an explanation of left-right brain thinking. In this part, there is an activity that helps the participants to differentiate between right and left brain thinking **(15 minutes).** The second part shows the importance of whole brain thinking in teaching and learning. It includes an activity that helps the participants train to use both sides of the brain **(20 minutes).** In the third part, there will be an explanation of how our development and education can be affected by the way we think. The participant will be shown applications of whole brain thinking in different subjects. This part includes an activity which allows each participant to determine if he or she is a left or a right brain thinker and another activity where teachers of different subjects try to come up with ideas of how to apply whole brain thinking in their classrooms **(30 minutes).** And finally there is a wrap up and a conclusion **(10 minutes).**

--- Only abstracts included for the following sessions ---

Interactive Stereoscopic 3D and Virtual Reality for Math and Science Education

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Accessibility of complex phenomena, be it natural in the physical sciences or abstract in the mathematical sciences, is greatly undermined by the limits of presentation in today's classroom. Let's assume that there are clear "images" or "models" of these complex phenomena in the mind of the teacher and that she/he will do her/his best to transfer these "images" and "models" to the students' minds and then, and only then, try to explain the ideas and connections between these ideas. Knowledge representation is a mature field, yet it is difficult to observe its relevance in the current presentation formats as it translates into the classroom. Every form of knowledge representation is an approximation of the knowledge. Some approximations are better than others (depending of course on the circumstances). When it comes to certain concepts of science and math, an accurate and realistic interactive and immersive representation can save plenty of time and increase retention in knowledge acquisition. In this session, we will demonstrate and discuss how innovative visualization technologies can create a "bridge" between the mind of the teacher and that of the students. This "bridge" is to be the pathway on which the "images" and "models" (that help explain the underlying concepts that define the complex phenomena in science and math) can travel from the teacher's mind to the students' minds.